CASE NO.

7608

APPLICATION,

TRANSCRIPTS,

SMALL EXHIBITS,

ETC.

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
SOUTH CENTRAL REGION
505 MARQUETTE AVENUE, N.W., SUITE 815
ALBUQUERQUE, NEW MEXICO 87102

IN REPLY
REFER TO: MS 460

AUG [illegible] 1982

Mr. W. Perry Pearce
Oil Conservation Division
State of New Mexico
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Mr. Pearce:

This jurisdictional agency concurs in the recommendation of the State of New Mexico, Case No. 7608, Order No. R-7047, dated August 9, 1982, that the Basin Dakota formation underlying the described lands in subject order in San Juan County, New Mexico, be designated as a Section 107 tight formation.

It is requested that this concurrence be included with the recommendation submitted to the Federal Energy Regulatory Commission.

Sincerely yours,

Gene F. Daniel
Deputy Minerals Manager
Oil and Gas

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

August 24, 1982

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

Mr. Howard Kilchrist
Federal Energy Regulatory Commission
Department of Energy
825 North Capitol Street, N.E.
Washington, D. C. 20426

Re: Tight Formation Designation
on the Application of
Tenneco Oil Company,
Case 7608, OCD Order No. R-7047

Dear Mr. Kilchrist:

Enclosed please find two copies of the Recommendation and exhibits of the New Mexico Oil Conservation Division for designation of certain portions of the Basin-Dakota formation in San Juan County, New Mexico, as a tight formation.

Sincerely,

W. PERRY PEARCE
General Counsel

WPP/dr

enc.

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

NGPA SECTION 107 TIGHT FORMATION RECOMMENDATION	)	Docket No._____
STATE OF NEW MEXICO OIL CONSERVATION DIVISION OF THE ENERGY AND MINERALS DEPARTMENT	)	

RECOMMENDATION FOR TIGHT FORMATION DESIGNATION UNDER SECTION 107 OF THE NGPA.

Tenneco Oil Company, pursuant to Section 107 of the Natural Gas Policy Act, 18 CFR §271.703 of the FERC regulations, and the Special Rules and Procedures for Tight Formation Designations under Section 107 of the Natural Gas Policy Act of 1978 of the Oil Conservation Division, petitioned the Oil Conservation Division for tight formation designation of a portion of the Basin-Dakota formation in San Juan County, New Mexico.

After notice and hearing on the application of Tenneco Oil Company, the Oil Conservation Division hereby recommends that that portion of the Basin-Dakota formation which is described in Exhibit A (being Oil Conservation Division Order No. R-7047) attached hereto and incorporated by reference, be designated a tight formation. Additionally, the Oil Conservation Division, submits herewith Exhibits B, a copy of the exhibits presented to the Division, and C, a copy of a letter evidencing the concurrence of the Minerals Management Service, attached hereto and incorporated herein by reference, which are supporting data required under 18 CFR §271.703(c)(3) of the FERC regulations and Minerals Management Service ratification of this recommendation, respectively.

Respectfully submitted,

W. PERRY PEARCE
Attorney for the
Oil Conservation Division

VERIFICATION

STATE OF NEW MEXICO)
)ss.
COUNTY OF SANTA FE)

W. PERRY PEARCE, being first duly sworn, on oath, states that he is an attorney for the Oil Conservation Division of the Energy and Minerals Department of the State of New Mexico; that he has executed the foregoing document with full power and authority to do so; and that the matters and facts set forth therein are true to the best of his information, knowledge and belief.

W. PERRY PEARCE

Subscribed and sworn to before me, this 24th day of August, 1982.

NOTARY PUBLIC

My Commission Expires:

Oct 28, 1985

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of the foregoing Recommendation on Tenneco Oil Company in accordance with the requirements of Section 1.17 of the Rules of Practice and Procedure.

Dated this 24th day of August, 1982.

W. PERRY PEARCE

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
7 July 1982

EXAMINER HEARING

IN THE MATTER OF:

Application of Tenneco Oil Company for designation of a tight formation, San Juan County, New Mexico. CASE 7608

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: W. Perry Pearce, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: W. Thomas Kellahin, Esq.
KELLAHIN & KELLAHIN
Santa Fe, New Mexico 87501

I N D E X

E X H I B I T S

MR. STAMETS: The hearing will come to order, please.

We'll call first this morning Case 7608.

MR. PEARCE: That is the application of Tenneco Oil Company for designation of a tight formation, San Juan County, New Mexico.

MR. KELLAHIN: If the Examiner please, I'm Tom Kellahin of Santa Fe, New Mexico, appearing on behalf of the applicant, and I have one witness to be sworn, Mr. Robert J. Gibb, G-I-B-B.

(Witness sworn.)

MR. KELLAHIN: Mr. Stamets, Mr. Gibb is here to testify today on some questions that arose from the prior hearing.

To answer those questions Mr. Gibb and Tenneco have prepared certain supplemental exhibits, which we have marked as Exhibits K, L, and M, which need to be inserted into the exhibit books from the prior hearing.

In addition there is a supplemental table of contents and a supplemental summary of engineering data, also to be inserted into the exhibit books.

ROBERT J. GIBB

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KELLAHIN:

Q. Mr. Gibb, have you previously testified before the Division as a petroleum engineer?

A. No, I have not.

Q. Would you identify for Mr. Stamets when and where you obtained your degree?

A. I graduated in 1973 from the Pennsylvania State University with a Bachelor of Science in petroleum and natural gas engineering.

Q. Subsequent to your graduation where have you been employed as a petroleum engineer?

A. In 1973 I went to work for Marathon Oil Company in Denver and was responsible for their tertiary recovery projects drilling and well completion in the Illinois Basin.

In 1975 I went to work for Tenneco Oil Company as a petroleum engineer, responsible for petroleum engineering aspects of the San Juan Basin. I have since been made

Petroleum Engineering Supervisor. The San Juan Basin is still under my authority.

Q. Were you present at the previous hearing of this case before the Oil Conservation Division?

A. Yes, I was.

Q. Have you prepared certain additional exhibits, or caused to be prepared certain additional exhibits, for this tight sands case?

A. Yes, we have. There are three in there, marked K, L, and M.

Q. All right, sir, would you turn to the packet of original exhibits and remove the plat showing the outline of the area to be designated as a tight sands area?

A. That is Exhibit B in the original exhibits.

Q. Why don't we use just the one, Mr. Gibb.

To refresh the Examiner's memory, Mr. Gibb, would you identify for us what you've described as three windows in the area to be designated?

A. On the map there is a general highlighted outline showing the entire application area. Included in the application area are three areas, one consists of approximately four sections; one of two sections; and one of, I believe, one section, that we have identified to contain wells that exhibit anomalous production characteristics related to

the wells outside the windows.

Q. Was that work done by you or under your direction and supervision?

A. Yes, it was.

Q. And you're familiar with the exhibits that you propose to discuss today?

A. Yes, I am.

MR. KELLAHIN: We tender Mr. Gibb as an expert petroleum engineer.

MR. STAMETS: He is considered qualified.

Q. Mr. Gibb, would you refresh the Examiner's memory with regards to Tenneco's position concerning the three window areas in the tight sands designated area?

A. In preparing the data for the tight gas sands area we, as a normal course of action, went through certain production analyses of all wells within the area. The production characteristics and the estimated ultimate recoveries of the wells within the windows seem to be anomalously high when related to the wells outside of those windowed areas. We can't explain it using geological data or basic engineering data. We can't explain the cause for it, that is. All that we can say is that those wells seem to exhibit different characteristics, different production characteristics than the wells outside of those windows.

Q. Does Tenneco have any position with regards to either the inclusion or the exclusion of the windowed areas?

A. It is Tenneco's position, as I stated, that these areas are anomalous. We -- in that we can't identify them, we feel that will leave it up to the OCD to determine whether these areas should be included in the application or excluded.

Tenneco would have no objection to the inclusion of those wells in the area.

Q. All right, sir, let me direct your attention now to what we have submitted as Tenneco's Exhibit K, have you generally identify what that material is about, and then explain any specifics that you care to.

A. Supplementary Exhibit K was prepared in response to some questions reaised in the earlier hearing. Basically it shows some general production data for all wells within the application area. It shows the well, the location, the operator name, the date of first production for the well, the cumulative production as of 1-1-1982, the 1981 total production, and the average daily rates during 1981, simply the total annual rate divided by 365.

Q. All right, sir, let's turn now to Exhibit L and have you identify that exhibit.

A. Exhibit L consists of three parts, Exhibit

L-1, L-2, and L-3.

In this exhibit we have gone in and tried to estimate, using decline curve analysis where possible, and general engineering applications where decline curve analysis is not applicable, to determine and ultimate recovery for wells within the windows.

If I can direct you to the second page in Exhibit L as an example, for the four-section window in Townships 30 North, 8 West, and 31 North, 8 West, the wells within the window have been identified; there are twelve of them; we have run what we consider to be an estimated economic ultimate recovery for those wells. The average for the wells within the window is a little bit over a BCF, 1083 MMCF total.

We have then gone to the wells immediately surrounding the window, and by immediately surrounding I'm talking about the area of approximately a half mile. We've identified seven wells. We've applied the same type analysis to those wells. We've come up with an average ultimate recovery for those wells of 476 MMCF, or approximately half that of the wells within the window.

This is the type anomaly that we've been referring to; the fact that we feel the wells inside the windows and the wells immediately outside the windows are not

the same but again, we cannot identify the cause for the difference.

Q. How have you identified the areal extent of these anomalies?

A. We have just used our best estimate. We've tried to keep it to section sizes.

Q. All right, sir, let's turn to Exhibit M.

A. On Exhibit L, I might add that we have included the decline curves used and the extrapolation on the decline curve that was used to arrive at the ultimate recovery.

Q. All right, sir, Exhibit M.

A. Exhibit M, I may have to ask your indulgence, was in response to a question regarding how many sections have been developed within the application area.

We've gone in and identified approximately 952 possible drill sites, which is based on 160-acre spacing, or following the infill Order R-1670-B. We've made estimates where nonstandard sections were included.

Of these 952 possible drill sites, 111 have been developed within the area. That would account for about 11.7 percent of the possible developable locations to have already been developed.

We've then gone in and tried to identify those sections with no wells, represented by the zero percent

line; those sections with one well, represented by the 25 percent line; two wells, by the 50 percent line; three wells by the 75 percent line; and four wells by the 100 percent line.

As you can see, 146 of the sections have never been tested, or 62 percent. 68 of the sections, or 30 percent, have had only one well. 20 of the sections, or 8-1/2 percent have had two wells; and only one section has had 3 wells drilled on it. That one section by wells drilled includes a replacement well.

Q. Mr. Gibb, were you able to locate any pre-stimulation data with regards to the wells included in the window areas?

A. As we mentioned in the testimony last month, taking pre-stimulation data in the San Juan Basin is rather rare. We located no pre-stimulation tests of any of the wells within the windows; however, I think that we can say, based on my experience in the San Juan Basin, that had we had pre-stimulation tests on those wells, the chances of those tests being within the FERC guidelines would have been very, very good.

Q. In your opinion, Mr. Gibb, is the 107 price incentive necessary to provide an incentive to Tenneco and other operators in the proposed area for the additional drilling of Dakota wells that would not otherwise be drilled?

A. I would say that would be a good statement, yes, sir.

Q. And were Exhibits K, L, and M prepared by you or compiled under your direction and supervision?

A. Yes, they were.

Q. Do you have anything else to add to your testimony, Mr. Gibb?

A. No, I do not.

MR. KELLAHIN: That concludes our examination of Mr. Gibb. We move the introduction of Tenneco Exhibits K, L, and M.

MR. STAMETS: These exhibits will be admitted.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Gibb, it would appear as though new Section K does not include any of the wells in the three window areas.

A. That is correct. The only exhibit that includes data on the windowed areas would be Exhibit L.

Q. Do you have any figures which would represent the estimated ultimate recovery of wells in this area and outside the windows other than what you've shown as wells

adjacent to the windowed areas?

A. No, I don't believe we have that specifically. Let me check one exhibit.

No, we do not. I might say that I would anticipate that the wells further outside the windows would exhibit the same characteristics as those wells immediately outside the windows, or poorer, and by poorer I mean poorer quality wells.

Q. Have you made any determination as to what effect including the windowed areas within your application would be?

A. The only effect that it could have, sir, would be on the pre-stimulation average rate, and in that there were no pre-stimulation tests included, nor core tests taken within the windowed areas, I -- it would suffice to say it would have no effect on our summary of data.

Q. So that there is no evidence which would demonstrate that they should be left out. The only thing that you've got is that they're relatively good producers.

A. Post-stimulation good producers.

Q. Now, you talked about an average of -- in this one window, the best one of the three -- an average cum per well of just over a Bcf. How good a well is that in average terms?

A. Well, certainly not the best of wells that we would have drilled, but it certainly is a good, solid economic well.

Q. What does it take to make an economic well for Tenneco in this area?

A. My guess would be on the order of 450-to-500 million cubic feet to meet minimum requirements.

Q. So on that basis then, the wells in the largest window and the second largest window that produce 853-million and a billion, would be economic wells?

A. Yes, sir.

Q. And then the one in the third window, the smallest one, I guess that's just one section, you show a cum of 465, that would be a marginal economic well.

A. That is correct.

Q. And it would appear in that small window that you have one infill well in the process of being completed.

A. I believe that well is completed but it is not yet on production.

Q. So at this stage it looks like if we got into economics, which we really haven't, it would only be about one location that -- well, let me see, we're not into economics. Not considering economics, there's only one loca-

tion which we would really be concerned with in discussing whether these windows ought to be included or not included.

A. I'm not sure I follow you.

Q. I'm not sure I do, either.

In trying to determine whether or not we should include these windows in this application we would be considering what effect they might have on the application. By your own admission, the wells in two of the windows are economic wells and in the third window it's perhaps marginal, but in the third window there's only one location, so perhaps this is not worth messing with at this point.

A. I understand.

Q. Okay, and would you say that's a fair analysis of the situation?

A. Yes, sir.

Q. Now, in talking to the Federal Energy Regulatory Commission the other day, and in discussing these windows, they said that it was a legitimate reason to leave windows in a tight formation area if including the windowed areas caused the area not to qualify.

Now in this case we can't say that would be correct because we don't know what the situation is. There were no cores, no tests, or anything in there, is that right?

A. That is correct.

Q. They also wish to know what made those areas anomalous, and I'm at a loss. If you know the answer then it's not anomalous and if you don't know the answer it's anomalous, so I'm not certain how to -- how to approach this question.

Perhaps we could discuss, or you could discuss, the sorts of things that might happen in this area which would produce higher production from wells that appear the same as far as logs and other evidence that you might have available.

A. Well, you can -- there's any number of possibilities. Some of the possibilities that we have seen in the San Juan Basin are limited natural fractures, again which would not show up on a log. You can always, in that we're dealing with post-stimulation evaluation of these wells, you can always question as to whether the fracture technique or the fracture methodology or size on these wells was different than that used in many of the wells in the surrounding area. I think we've already stated, and I'm afraid that the only way I can state it is that we have evaluated these wells. We have determined that their post-stimulation performance is anomalous of the post-stimulation performance of the surrounding wells, and we cannot come up with a concrete evidence for a cause.

Q. So basically you have no evidence available to you which would allow you to demonstrate that even though the production was high, the wells clearly qualify for tight formation designation?

A. Correct.

Q. And lacking that evidence, you've left these areas out.

A. That is correct.

MR. STAMETS: Are there any questions of the witness?

MR. CHAVEZ: Yes, I have a question.

QUESTIONS BY MR. CHAVEZ:

Q. In supplementary Exhibit L-1, your average cumulative per well in these windowed areas is a little over a thousand MM -- over a billion cubic feet.

In your supplementary Exhibit K there is one well, Northwest Pipeline Well located in Section 8, Township 32 North, 7 West, the San Juan 32-7 No. 36, which already has a cumulative of over a billion.

Was there any particular criteria that eliminated that well from being within a windowed area?

A. Yes. I think that if you'd look at that supplementary Exhibit K, we list approximately two-and-a-half

pages of wells that fall within the 32-7 township and range.

I think if you'll look at the cumulative production and the age of those wells, many of them being quite old, you'll see that it in itself is an anomaly, and it is a single well anomaly. The wells in Section 7 and in Section 9, Section 9 in particular, are almost twenty years old and have yet to produce a quarter of what the well in Section 8 is, so that it is a single well anomaly. We didn't feel that it constituted any kind of trend.

The windows, we feel, constitute some sort of a trend. We have more than one well of high quality within the windows.

Q. By high quality, what -- what do you mean?

A. Economic quality.

MR. CHAVEZ: I don't have any more questions.

MR. STAMETS: Any other questions of the witness?

MR. STOGNER: I have one question, Mr. Examiner.

QUESTIONS BY MR. STOGNER:

Q. In your supplemental L-1, the Howell "B" No. 5 is your well immediately surrounding the large window that constitutes four sections, why do you think Section 31

should not be included in this window since estimated ultimate recovery is 1.56-billion cubic feet, which is well over your cumulative production over here in your windows of 1.08?

A. That 1.08 is an ultimate recovery.

I can't say that well should or should not have been, all I can say is that we made an engineering judgment to draw the line somewhere, and that is where we drew the line.

MR. STOGNER: That's all the questions I have.

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

MR. DAVIES: I'd like to make a statement.

MR. STAMETS: Certainly. If you'd identify your self for the record, please.

MR. DAVIES: I'm Mike Davies for Southern Union Exploration Company.

Southern Union Exploration Company agrees with and supports Tenneco's application for a tight gas status in the proposed area.

Thank you.

MR. STAMETS: Anything else?

If there is nothing further, this case will be taken under advisement.

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7606 heard by me on 7-7, 1982.

Richard L. Stamets, Examiner
Oil Conservation Division

SALLY W. BOYD, C.S.R.
Rt. 1 Box 193-B
Santa Fe, New Mexico 87501
Phone (505) 455-7409

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
9 June 1982

EXAMINER HEARING

IN THE MATTER OF:

Application of Tenneco Oil Company for designation of a tight formation, San Juan County, New Mexico. CASE 7608

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: W. Perry Pearce, Esq.
Legal Counsel to the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: Michael P. Kovich, Esq.
Tenneco Oil Company
P. O. Box 2511
Houston, Texas 77001

A P P E A R A N C E S

For Turner and Little: Ernest L. Padilla, Esq.
P. O. Box 2523
Santa Fe, New Mexico 87501

For Speer and Oxoco: Richard Tully, Esq.
P. O. Box 234
Farmington, New Mexico 87401

I N D E X

E X H I B I T S

MR. STAMETS: We'll call next Case 7608.

MR. PEARCE: Case 7608 is the application of Tenneco Oil Company for designation of a tight formation, San Juan County, New Mexico.

MR. KOVICH: If it please the Commissioner, I am Michael Kovich, representing Tenneco Oil Company.

Our purpose here today is to request that the Oil Conservation Division recommend to the FERC to designate the Basin Dakota underlying our application area as a tight formation under Section 107-C-5 of the Natural Gas Policy Act of 1978.

Tenneco Oil Company will have two witnesses today, a geological engineer and a petroleum engineer, and all of the evidence presented to meet Federal Energy Regulatory Commission guidelines, contained in 18 Code of Federal Regulations 271.703.

In preparation for this hearing Tenneco Oil met with and presented the datum we will present today to the Minerals Management Service Office in Albuquerque, and they have tentatively approved this datum.

The exhibits are before you in a looseleaf notebook. A summary of testimony, which serves as a narrative table of contents and Exhibits A through J are contained.

I would request that the Examiner allow the

witnesses to identify these exhibits during the testimony and I'll introduce them into evidence at the close of the hearing.

I have two witnesses to be sworn.

MR. STAMETS: Are there any other witnesses in this case?

MR. PADILLA: Mr. Examiner, Ernest L. Padilla on behalf of Turner Production Company and Curtis Little.

MR. STAMETS: Do you have any witnesses?

MR. PADILLA: No, Mr. Examiner, we don't believe that we'll have any witnesses. We may, depending on what the testimony reveals, have some additional information, but we don't think at this time it will be necessary.

MR. STAMETS: Any other appearances?

(Witnesses sworn.)

MR. KOVICH: We'll first present our geological data.

T. ROBERT KELLEY

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KOVICH:

Q. Would you please state your name and spell it for the record?

A. My name is T. Robert Kelley. That's K-E-L-L-E-Y.

Q. Mr. Kelley, by whom are you employed and in what capacity?

A. I'm employed with Tenneco Oil Company as a geological engineer.

Q. And is the proposed area for tight formation designation within your area of responsiblity of Tenneco as a geological engineer?

A. Yes, it is.

Q. And you are familiar with this application and its contents?

A. I am.

Q. Now would you please briefly describe your educational and vocational background, please?

A. Yes, sir. I received a Bachelor of Science

in geological engineering from the University of Arizona in 1979.

Then I went on to work with Amoco Production Company for approximately one and a half years as a production engineer and then moved to Tenneco Oil Company and have worked for the past one and a half years as a geological engineer.

Q. And that's in the San Juan Basin?

A. Yes, that is correct.

MR. KOVICH: I submit Mr. Kelley's qualifications and request that he be permitted to testify as an expert geological engineer.

MR. STAMETS: The witness is considered qualified.

Q. Now, Mr. Kelley, have you conducted a geological study of the Basin Dakota formation underlying our proposed application area?

A. Yes, I have.

Q. And would you please describe for the Examiner the geographic limits of our application area?

A. I will. Mr. Examiner, Exhibit A shows -- is a one inch to 16,000 foot regional map of all Dakota and Gallup completions. This map outlines the Tenneco tight gas study area with respect to its San Juan Basin geographical location. As you can see, it's located in the northern portion

of the San Juan Basin.

Also shown is its near proximity to three previously state-approved Basin Dakota tight gas Case Numbers 7116, 7317, and 7252.

This area includes approximately 148,000 acres in San Juan County, New Mexico, and is located -- the center of the area is located approximately 15 miles east of the town of Aztec, New Mexico.

What you have before you is Exhibit B, which is a one inch to 3000 foot Dakota completion base map of the Tenneco application area. This map shows the Tenneco area bounded to the north by the New Mexico state line; to the west by the previously approved tight gas Case Number 7116; to the east by the previously approved state -- previously state-approved tight gas Case Number 7116; and to the south by an interpreted geologic and productive characteristics.

Three windows exist in this area and have been excluded due to production anomalies that will be explained later.

This map also shows the the status of all Dakota completions with respect to single Dakota completions, dually completed wells, temporarily abandoned wells, and plugged and abandoned wells.

There are also data points that are indi-

cated by three geometric figures that are included on this particular exhibit, and three cross sections are also -- have also been generated across the area to facilitate the geologic discussion of the area.

Q. Now, Mr. Kelley, could you please describe for the Examiner the Basin Dakota producing formation as it is defined by the State of New Mexico?

A. Exhibit C will allow me to do that. Exhibit C is a type log of the Basin Dakota producing formation underlying the Tenneco Oil tight gas study area. The referenced well is the El Paso Natural Gas Garner No. 9. This is a -- this type log, the Gartner No. 9, is located in the northeast quarter of Section 33 of Township 30 North, Range 8 West, in San Juan County, New Mexico.

What is shown is an induction electrical log and gamma ray that shows the Basin Dakota producing formation and a portion of the Mancos formation.

Also of interest is that this particular well, the Gartner No. 9, also -- we also have some pore permeability data that will be included in Exhibit H and Exhibit E-3, the south to north trending cross section, also includes the Gartner No. 9.

Now, the State of New Mexico has defined the Basin Dakota producing interval to begin at the base of

the Greenhorn limestone and extend to a point 400 feet below, which will include the Graneros, Dakota, and some portion of the Morrison formation. The average depth to the top of the producing -- the Basin Dakota producting formation in the area is approximately 7,575 feet. This was -- this was determined by taking the individual townships and generating an average depth to the top of the producing formation.

The gross thickness of the pay sand in this area is approximately 250 to 350 feet thick.

Now, I'm going to a discussion of depositional environment. The Dakota sandstone was deposited in late Cretaceous time in a transgressional sequence of events. As the Cretaceous sea moved in a south/southwesterly direction, three distinct units were formed. The basal unit was formed under predominately fluvial conditions, lending to the channeling nature of the sandstones in the area.

Now the deposition of the middle unit is indicative of a transition between this fluvial condition and marine environments. These sands exhibit variable lateral distribution and thickness throughout the area.

And the upper unit is characterized -- has a character, if you wish, that of a marine bar-type deposit, a marine bar depositional environment and exhibits increasing grain size upward with an abrupt upper contact, as you can see.

Now these three units are the primary -- primary producing objectives of the Tenneco Dakota Tight Gas Study Area.

The Dakota sandstone in this area has an average pay porosity of approximately 5 to 6 percent. In general, these transgressive sands exhibit poorer grain sorting and higher silt and clay content due to the various processes of their respective depositional environments, which in conjunction with the depth burial lends credence to the tight nature of the Dakota sand in this area.

MR. STAMETS: May I ask a question at this point, please?

On this type log will you be telling us the top and bottom of the formation which you propose for tight sands designation or does it correspond with the OCD top and bottom?

MR. KOVICH: I may be able to answer that. We will go with the OCD Greenhorn and 400 feet below. All of these -- all of these will fall within that definition.

MR. STAMETS: Now that's 400 feet below a particular datum point, right?

MR. KOVICH: Yes, it is.

A. Below the top of the Basin Dakota formation as defined by the State of New Mexico.

MR. KOVICH: I believe that's the base of the Greenhorn limestone, that is the marker.

MR. STAMETS: Let's go off the record.

(There followed a discussion off the record.)

MR. STAMETS: All right.

A. If you'll now turn to Exhibit D, we see a one inch equal 3000 foot structure map to the top of the Basin Dakota producing formation. The structure is mapped on 100 foot contours subsea and shows increasing depth of burial as we move in a northeasterly direction.

Now I mentioned the southern boundary earlier. The southern boundary coincides with this particular structure. Now geologically this boundary is not a hard line, but in conjunction with production data it is interpreted that depth of burial does influence permeability, and that's what we are -- that's what this particular exhibit is showing.

Q. Now, Mr. Kelley, getting one -- go back just a second for me, when you said you calculated a depth to the top of the Dakota formation, you averaged each depth in a particular township and then you averaged those townships

together, is that correct?

A. That is correct.

Q. To give you an average as the -- as you move down dip --

A. Yes.

Q. -- or down into the basin.

A. That is correct.

Q. All right, thank you. All right, now could you explain --

MR. STAMETS: I'm not sure I understood that explanation.

MR. KOVICH: All right.

Q. Well, I'll rephrase that one time again. You averaged -- you got an average depth of each township within our application area, did you not?

A. That is correct.

Q. And then you took those numbers, which would be approximately eight, I believe, eight average depths per township --

A. Approximately.

Q. -- and averaged those together to reflect that the formation was increasing in depth as you move northeasterly.

A. That is correct.

MR. STAMETS: That's what this map is based on, township averages?

MR. KOVICH: No, that's what the average depth number is based on that he gave you.

A. Well --

MR. KOVICH: When we get to the FERC allowable chart we needed a number and that's where we're getting that.

MR. STAMETS: Fine. Thank you.

A. Now, if we move to the stratigraphic cross section of the area, you take a look at Exhibit E-1, which is the A-A' cross section which begins from one previously state-approved tight gas application and turn -- and is also in the previously state-approved tight gas application Number 7116, we take a look at this cross section of the Dakota. It is hung on the -- or the datum is the top of the Basin Dakota producing formation. It is a stratigraphic cross section with horizontal and vertical scales of -- one of two inches -- of two and a half -- horizontal and vertical scales of two inches equal a mile and two and a half inches equal 100 feet, respectively.

Now as you take a look at the Dakota producing interval in this area you can see that, from this cross

section you can see that this particular Dakota sand can be correlated by the three -- the three primary units that I have described earlier, you can see that they are developed. They are developed throughout the area and you can follow their -- follow their development as you move from a west to easterly direction.

Of interest of the Dakota producing interval, the upper unit is pinching out as we move from west to east. It is also evident that that upper sand body pinches out as we move from the south to the north direction. So that, that is basically a -- that basically shows that there is lateral continuity of the sands in this Tight Gas Study Area.

Q. All right, now, Mr. Kelley, referring back to the layer cake that we have here with the Dakota being below the Mancos, could you move up hole for me and tell us where the lowest fresh water aquifer in this area is?

A. Yes, I will. The lowestmost fresh water zone is the Ojo Alamo formation. Now, it's, in relationship to the Dakota producing interval, it is approximately 5-6,000 feet above the Dakota producing interval.

Q. Thank you. Now, was the geologic portion of the summary of testimony, and exhibits that you've presented, A through E, prepared by you or at your direction?

A. They were.

MR. KOVICH: That's all I have of Mr. Kelley.

MR. STAMETS: Any questions of Mr. Kelley at this point?

We may have some for Mr. Kelley later.

MR. KOVICH: I next will present our petroleum engineer, Mr. Liley.

DEAN G. LILEY

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. KOVICH:

Q. Would you please state your name and spell it for the record?

A. My name is Dean Liley, L-I-L-E-Y.

Q. Mr. Liley, by whom are you employed and in what capacity?

A. I'm employed by Tenneco Oil Company as a Senior Petroleum Engineer.

Q. Is the proposed application area within your area of responsibility as a Senior Petroleum Engineer with Tenneco Oil?

A. Yes, it is.

Q. And are you familiar with this application and its contents?

A. Yes, sir, I am.

Q. And would you briefly describe your educational and vocational background for the Examiner?

A. I attended the Colorado School of Mines and received a Bachelor of Science degree in petroleum engineering in 1977. At that time I went to work for Tenneco Oil Company in their Bakersfield office as a Production Engineer for two and a half years.

From there I came to the Denver office and worked as a Reservoir Engineer and have been for the past year and a half in the San Juan Basin.

Q. All right.

MR. KOVICH: I would submit Mr. Liley's qualifications and request that he be permitted to testify as an expert petroleum engineer.

MR. STAMETS: He is considered qualified.

Q. Now, Mr. Liley, have you conducted an engineering study of this area?

A. Yes, I have.

Q. And would you describe the data base that you used in this study?

A. Yes. Exhibit F is a well list or a table of the wells, Dakota penetration, within the application area. It shows the operator; it shows the well location; the well spud date; completion date; the Dakota status of the well. It also shows whether a well is a dual well and also indicates the data points used and whether it be rate or permeability in this study.

Q. Now, Mr. Liley, there are -- I notice there are one, two, three window areas that are being excluded from this application that lie within the outer boundary. Why are these window areas excluded from this data base?

A. These areas are excluded because they had anomolous production characteristics although the area is limited.

And the reason why it is limited is -- or some reinforcement as to why we draw -- drew the windows there, we do have some wells outside the windows that do not exhibit this anomolous production characteristics, therefor the area we have drawn is limited.

Q. Now you said anomolous production characteristics. I will restate this by saying that these areas are not representative of the tight Basin Dakota formation we're here today to talk about.

A. That is correct. They do not represent the

overall application area.

Q. Okay. Now, according to the Federal guidelines, you will have to determine an expected prestimulated gas flow rate against atmospheric pressure. Would you tell the Examiner how you did that?

A. Okay. Exhibit G is a table showing the prestimulated flow rates we used in our application.

The first three wells flow rates, the Turner Com B No. 2, the Riddle Com No. 8, and the Florance No. 111, were all natural flow tests conducted prior to the pressure buildups run on the wells. The final two wells, the San Juan Unit 32-7 No. 43 and the San Juan Unit 32-7 No. 68, were natural flow tests taken during drilling operations.

As you can see, the first well and the last two wells do not have enough gas to record a rate.

The two wells that we could achieve a rate are the Riddle Com No. 8 and the Florance 111. These two rates are 109 and 37 Mcf per day respectively. These rates are AOF calculations and the calculations were based on state-approved correlations that currently are being -- or currently required for well testing in the State of New Mexico.

As you can see, the 109 and 37 fall well below the 336 Mcf per day limit as set forth by the FERC at

our average depth of the Dakota at 7575 feet.

Q. Now, Mr. Lilcy, I notice that there's only five data points. Isn't that a small number of data points?

A. It would be for any other area but for the Basin Dakota in the San Juan Basin it is a well known and well accepted fact that it is a tight formation. It does need some type of stimulation to produce; therefor there is no gain or no incentive to go in and test the well prior to stimulation.

Q. So you could conclude then that the stabilized production rate against atmospheric pressure of a well completed in this formation without stimulation is not expected to exceed that 336 Mcf per day limit?

A. That is correct.

Q. Now, there's also a limit on the oil production. How did you determine expected oil production without stimulation for wells completed in this formation?

A. Okay. Basin Dakota formation, there is no crude oil in our application area; there is no crude oil production.

Q. And therefor no well would be expected to produce the five barrels or more a day of crude oil.

A. That is correct.

Q. All right. Now, how did you determine the average in situ permeability of a well in this area?

A. Okay. The permeability determination was found from two methods. First of all, we have core permeability, and we also had pressure build-up permeability.

The exhibit, the first page of Exhibit H is a table showing our core permeability data. We had three wells that were cored in the area, the San Juan 32-7 No. 37, the San Juan Unit 32-7 No. 22, and the Gartner No. 9.

In analyzing these cores we have,a 20 ohm resistivity was used -- resistivity cutoff was used to come up with a single permeability value for these wells. This value is, although it is an average and a single value for the well, it is a true or in situ permeability.

The permeability must be adjusted to overburden pressure and water saturation and this was done using a paper, which is in Exhibit I, an SPE paper entitled Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores.

Taking this paper and adjusting it due to overburden and water saturation, we've come up with three in situ permeability figures. They are .0009 millidarcy for the San Juan 37 No. 37; .009 millidarcy for the No. 22; and .0007 for the Gartner No. 9.

Going to the permeability values that we came up with using pressure buildup, there was two of them,

the Riddle Com No. 8 and the Florance 111.

Q. Excuse me for a second. I think the Examiner will find that in the back of the Exhibit H, in the plastic folders in the back of Exhibit H.

A. Two pressure buildups were run, again, on the Riddle Com No. 8 and the Florance 111. These pressure buildups were analyzed using the Horner type plot and utilizing a real gas potential.

The permeability values that are calculated are in situ values. They are, for the Riddle Com No. 8, .013 millidarcy, and for the Florance 111, .0025 millidarcy.

Taking the core permeabilities and combining them with the pressure buildup permeability, we had an average permeability for the application area of .005 millidarcy.

Q. So then it would be your conclusion that the average in situ permeability is in fact less than .1 millidarcy?

A. That's correct.

Q. Mr. Liley, has this area been subject to a great degree of development?

A. No, it hasn't, and calculating 925 available well sites within the application area, only 110 wells have been drilled. This equates to approximately 12 percent

development.

Q. Now the 925 well sites that you say are available, those were calculated according to the statewide infill drilling order, Order R-1670-B, is that correct?

A. That is correct.

Q. So that would give you 320-acre units with optional 160's?

A. That is correct.

Q. All right. Now, how was fresh water protected from fracturing operations within the application area?

A. Exhibit J is a typical Dakota wellbore schematic of the well profile. As you can see, the casing design in the exhibit shows complete coverage of the Ojo Alamo, which is the deepest fresh water formation in the application area.

It also should be noted that there is cement to the surface on all casing strings. This profile has been accepted by the Mineral Management Division. Not only are we covered with cement on the Ojo Alamo, but we do have, as Tim stated in his presentation, 5-6000 feet of difference between there, the Ojo Alamo and the top of the Basin Dakota, which will insure protection.

Q. Mr. Liley, were the engineering portions of the summary of testimony and Exhibits F through J that are

contained in the looseleaf notebook prepared by you or at your direction?

A. Yes, they were.

Q. Thank you.

MR. KOVICH: That's all I have for Mr. Liley.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Liley, you talked about 12 percent of the total proration units being developed.

A. Yes, sir.

Q. And that's counting infill locations.

A. Yes.

Q. What percentage of the 320-acre proration units have been developed?

A. Well, it would just be about twice that, about 24 percent, I think.

I don't know. I don't have that figure with me.

Q. I'd like to see something which shows me the total number of sections involved, perhaps specifically identifying those partial sections across the top of this area, segregating those out, showing me how many of those

sections have one well, how many of them two wells, how many have three wells, and how many have four.

MR. KOVICH: We can tabulate that as a late filed exhibit, if you like.

MR. STAMETS: That would be fine.

MR. KOVICH: And I would imagine we can label that as Exhibit K.

MR. STAMETS: That will be fine.

Q. Now I'd like a little more information on these anomalous areas, what makes them anomalous geologically, engineeringwise, how did you determine they were anomalous, and why were they left out.

A. The anomalous areas are -- can't really be explained geologically. We base the anomalous on production information within the windowed areas.

Q. What types of production do you have inside these -- or in the area that you want designated versus what you have in these windows?

A. Well, in the windowed areas we have as high as -- well, more than a Bcf of ultimate production in some of the wells, whereas, outside we did not extend it outside because the wells outside, some of them are P&A'd and some produce very limited -- or will ultimately produce very small amounts of gas.

Q. What's the average well in the area that you're interested in, what does it produce?

A. I couldn't say definitely.

Q. What does the average well inside the anomalous area produce?

A. I couldn't say that either.

MR. STAMETS: We're going to take a ten minute recess while we talk about this.

(Thereupon a recess was taken.)

MR. STAMETS: The hearing will please come to order.

Mr. Stogner, I believe you have a question or two.

MR. STOGNER: Yes, sir, I've got one question on Exhibit G.

QUESTIONS BY MR. STOGNER:

Q. On Exhibit G, the type -- the flow rate test, you show no oil production, which you stated earlier that there is no crude production in there; however, does it make any condensate?

A. No, sir, it did not.

Q. No condensate at all?

A. No condensate at all.

Q. How about some of the other wells in this area, would they be expected to make some condensate?

A. A very small majority of them make condensate within the area.

Q. Regarding the windows, in other tight formation designations in other states are these other windows relatively small to a large acreage area or are they a small area with -- with relatively large windows, like this?

MR. KOVICH: If I may answer that, please, I don't believe Mr. Liley's experience extends past this particular application. In other states where we've been involved with windows, which would be Utah and Colorado for personal experience, they are relatively small compared to the area, and when I say small, I mean in this magnitude, I think eight sections, four sections, one section, whatever it might be. Generally not large doughnuts; you won't see a large area with a large hole in the middle of it.

If I might add, the reason, and our policy behind every one of these windows was that we do not window to improve averages. We window on the basis of geological and engineering data, and that's why these are here, because they were identified by our expert petroleum engineer as

anomalous and of limited areal extent.

I'd like to go on the record as saying they are not here because they are, you know, high producing wells. There is an engineering basis for this and he can state that they only go so far and in his opinion go no farther.

MR. STAMETS: Any other questions?

MR. KOVICH: All right, if I might ask a couple of follow-up questions of Mr. Liley.

REDIRECT EXAMINATION

BY MR. KOVICH:

Q. I realize, Mr. Liley, that you could not give his an exact average, say, recovery outside the windowed areas and exact average recovery inside the windowed areas, but can you give us an approximation or an order of magnitude of what happens, what is the difference between them?

A. Okay. Within the windowed areas a close approximation would be somewhere in the neighborhood of a Bcf for ultimate production. On the outside, or within the boundaries of the application area, the ultimate recovery would be in the neighborhood of 350 to 400-million cubic feet of gas, which is three to four times under the windowed out areas.

Q. Now, Mr. Liley, could you give us, again,

not an exact percentage of how many 320-acre units have been developed, but maybe an approximation or order of magnitude?

A. Okay, and order of magnitude would be somewhere in the neighborhood of 24 percent.

MR. KOVICH: That's all I have for Mr. Liley.

MR. STAMETS: Any other questions of either of the witnesses? They may be excused.

Mr. Kovich, since this is the first case we've had with windows, I'm going to ask you to submit some additional information subsequent to this hearing, and I'm going to continue this hearing until the first Examiner Hearing in July, and on the basis of the additional material which you submit I will be able to let you know before that hearing date, and before the end of this month, whether or not we would expect anybody from Tenneco to appear and present further evidence. I seriously doubt that that will be necessary, but rather than having to reopen the case and readvertise it, I think we'll take this route.

The information I would like to see in addition to the proration unit summary that I asked for earlier, is production data for wells inside and outside the windows, including information on when the well was drilled, current production rates, cum figures, and then any reservoir data

which Tenneco may have, permeabilities, porosities, pressures, geologic information, anything that you have which bears on how the window areas differ significantly from the areas outside the windows.

And as I said, I'm very hopeful that with that information we'll be able to close this case with no further testimony. Also, I would request that you submit a proposed form of order in this case.

That date for July is July the 7th.

Does anyone else have anything that they wish to offer in this case at this time?

MR. TULLY: Mr. Stamets. My apologies to the Division about not making my appearance earlier, but I thought you were going to hear Case 7607 first.

I'm Richard Tully, representing William R. Speer and Oxoco Production Corporation, and we, my clients would like to express support for the application of Tenneco in this Dakota Tight Sands application.

In addition to that, Oxoco Production Corporation as the operator of a lease and a well has some additional information that Tenneco was not privy to prior to this hearing, and I don't know how you would like to handle this. I could either read from the daily drilling summary myself or, if you'd like, the person who prepared

this is here and available to testify, whichever way you would like to handle it.

MR. STAMETS: Let's have you have a witness sworn, qualified, and put this in the record, please.

MR. TULLY: William R. Speer will be my witness, representing himself and Oxoco Production Corporation.

WILLIAM R. SPEER

being called as a witness and being previously sworn and qualified, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. TULLY:

MR. STAMETS: The record should show that Mr. Speer has previously been sworn and qualified today. Mr. Speer was qualified as a geologist.

Q. Would you please state your name and address?

A. William R. Speer, 900 Crestview Drive, Farmington, New Mexico.

Q. Occupation?

A. Geologist.

Q. Mr. Speer, I note that you have an instrument in front of you entitled Daily Drilling Summary. Would

you please identify and explain that instrument?

A. This is a daily drilling summary of Oxoco Production Corporation's Trail Canyon No. 3 Well, located in the southeast quarter of Section 7, 32 -- Township 32 North, Range 8 West, San Juan County.

This well was recently drilled and casing run to a total depth of 8290 feet and is currently waiting on completion.

This well was a Dakota test drilled in a standard manner; that is, the casing program consisted of an intermediate casing string being run through the Pictured Cliffs formation and the hole was drilled with air as the circulating medium to total depth, into the Dakota formation.

We stopped the drilling at four different points and tested the open hole to determine what natural gauges we might have at these four points, the four points being the base of the Menefee formation, the base of the Point Lookout formation, base of the Gallup formation, and then again at total depth.

We did this gauging by virtue of closing off the air that we were using for circulation medium, closing the rams on a drill pipe, and then venting the gas coming from the hole through a two-inch bleedoff line.

The test at the base of the Menefee at a

depth of 5940 feet was too small to measure with a pressure gauge through a one inch line.

At the base of the Point Lookout at a depth of 6176, we again gauged the open hole and had a reading with a pitot tube and monometer of 12 Mcf per day rate. These were 45 minute tests, minimal, in all cases.

At the base of the Gallup formation at 7601 feet, we had a measured rate of 22 Mcf per day.

And at the total depth of 9290 feet we gauged the open hole again for a total gauge of 264 Mcf per day. If we assume that you subtract the 22 we previously had gauged down to the base of the Gallup, we would assume that we had 242 Mcf per day at the base of the Dakota, and we believe that this probably constitutes as good a test of the natural ability of the well from the Dakota formation as you can get, since it's in essence a constant drill stem test.

Q. What was the total depth again?

A. 8290 feet.

Q. Okay, and what was the spud date of the well?

A. The well was spud on May the 19th. The gauging days were May 29th on the Mesaverde, the Menefee, and the Point Lookout, May 30th on the Gallup formation, and our

gauge at total depth was on May 31st of this year.

MR. TULLY: We have nothing further, Mr. Examiner.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Speer, was that well being drilled absolutely dry or did you have liquids in the hole?

A. We did not have any fluids evidenced at all at any time. We were fortunate enough in that case.

Q. What was the length of the last test?

A. Minimal 45 was the way we did it. I think in that particular case we were shutdown longer than 45 minutes, but we gauged it at 5, 15, 30, and 45 minutes to see if we were experiencing any increase, and we did not. The gas normally got up in less than 10 minutes and did not increase during the testing period.

Q. But even at the maximum rate that you experienced, that still is well below the figure permitted by the FERC.

A. That's correct.

MR. STAMETS: Any other questions of this witness?

MR. TULLY: Mr. Examiner, if you would like,

we would be pleased, if you so desire, to provide you with appropriate copies of this Daily Drilling Summary to accompany the other exhibits.

MR. STAMETS: Would you like to designate this as a Speer-Oxoco Exhibit?

MR. TULLY: That would be fine.

MR. STAMETS: How would you prefer it?

MR. TULLY: Either that or if you'd like, we'd be glad to provide it to Tenneco and they can so incorporate it if they desire, as an exhibit.

MR. STAMETS: Mr. Tully, I'd ask you to label this drilling report as Oxoco or Speer Exhibit Number One in this case.

MR. TULLY: Okay, sir.

MR. STAMETS: And we need three copies and I'm sure Tenneco would like to have a copy.

MR. TULLY: Would you like for us to do this today or would you like it subsequently --

MR. STAMETS: If you could do it today, I think it would be much better for the record. We have Xerox machines upstairs and if you'll see Ms. Davison, she will take good care of you.

MR. TULLY: Thank you.

MR. STAMETS: Any other questions of Mr.

Speer? He may be excused.

Anything further in this case?

MR. PEARCE: Mr. Examiner, if I may, we have received in this proceeding correspondence, which I think if I may, I'll simply read into the record.

It's a letter dated June the 10th of 1982, from Curtis J. Little, Petroleum Geologist. It is addressed to the Oil Conservation Commission and references this case.

The letter reads, and I quote, The undersigned supports the applicant for the designation of the Dakota formation as a tight formation pursuant to Section 107 of the Natural Gas Policy Act, and 18 CFR, Sections 271.701 through 705.

Signed, Curtis J. Little.

MR. STAMETS: Is there anything else in today's record?

MR. PADILLA: Mr. Examiner, for the record, I would also like to state that Turner Production Company also urges the approval of the application for tight formation designation.

MR. STAMETS: Anything further?

If not, we will continue this case, then, until the July 7th Examiner Hearing.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

Sally W. Boyd CSR

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 7608 heard by me on 6-9 1982.

Richard L. Stamets, Examiner
Oil Conservation Division

SALLY W. BOYD, C.S.R.
P. O. Box 193
Santa Fe, New Mexico 87501
Phone (505) 455-7409

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

POST OFFICE BOX 2088
STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO 87501
(505) 827-2434

August 11, 1982

Mr. Michael P. Kovich, Attorney
Tenneco Oil Company
Tenneco Building
P. O. Box 2511
Houston, Texas 77001

Re: CASE NO. 7608
ORDER NO. R-7047

Applicant:

Tenneco Oil Company

Dear Sir:

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

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD

Other Ernest L. Padilla, Richard Tully

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7608
Order No. R-7047

APPLICATION OF TENNECO OIL COMPANY FOR DESIGNATION OF A TIGHT FORMATION, SAN JUAN COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on June 9, 1982, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 9th day of August, 1982, the Division Director, 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 Division has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Tenneco Oil Company, requests that the Division in accordance with Section 107 of the Natural Gas Policy Act of 1978 and 18 C.F.R. §271.701-703 recommend to the Federal Energy Regulatory Commission (FERC) that the Basin-Dakota formation underlying certain lands in San Juan County, New Mexico, as described on Exhibit "A" attached to this order, hereinafter referred to as the Basin-Dakota formation, be designated as a tight formation in the Federal Energy Regulatory Commission's regulations.

(3) That the area proposed for tight formation designation lies within the horizontal limits of the Basin-Dakota Pool, which is a very large area previously defined and described by the Oil Conservation Division in San Juan County, New Mexico.

(4) That within the Basin-Dakota Pool are large areas of extensive development and large areas of very limited development.

(5) That the Dakota formation has been approved for infill drilling which permits the subject area to be developed with one Dakota well on each quarter section or 160-acre tract.

(6) That the area for which tight formation designation is herein sought is comprised of standard sections and a large number of irregularly shaped sections.

(7) That the total potential number of wells required to fully develop said area with an original well and an infill well on each proration unit (standard or non-standard size) is approximately 952.

(8) That at the time of the hearing a total of 111 wells had been drilled in the area, 87 of which were producers or 12 percent and 9 percent, respectively, of the potential drillable wells.

(9) That no proration unit within the proposed area contains an infill well.

(10) That the area proposed for tight formation designation is a largely undeveloped area.

(11) That the application excluded from consideration three small areas or windows consisting of the following described sections:

Area No. 1

TOWNSHIP 30 NORTH, RANGE 8 WEST, NMPM
Sections 3, 4, and 5: All

TOWNSHIP 31 NORTH, RANGE 8 WEST, NMPM
Section 32: All

Area No. 2

TOWNSHIP 31 NORTH, RANGE 9 WEST, NMPM
Sections 27 and 28: All

Area No. 3

TOWNSHIP 30 NORTH, RANGE 8 WEST, NMPM
Section 35: All

(12) That there was no evidence available as to the in situ gas permeability or unstimulated gas well production within said areas.

(13) That these areas were excluded from consideration by the applicant solely due to anomolous production considered to be of limited extent and unexplainable by ordinary engineering and geological examination.

(14) That the Basin-Dakota formation underlies all of the lands described in Exhibit "A"; that the formation consists of transgressive sands which exhibit poor grain sorting and high silt and clay content due to the processes of the depositional environments; that the top of the formation is found at an average depth of 7575 feet below the surface; and that the gross thickness of productive sand is approximately 250-300 feet.

(15) That the type section for the Basin-Dakota formation is described as that 400 foot interval found below a depth of 7251 feet as found on the Induction-Electrical and Gamma Ray log from the El Paso Natural Gas Gartner Well No. 9 located in the NE/4 of Section 13, Township 30 North, Range 8 West, San Juan County, New Mexico.

(16) That the technical evidence presented in this case demonstrated that no well formerly or currently completed in the Basin-Dakota formation within the proposed area exhibited permeability, gas productivity, or crude oil productivity in excess of the following parameters:

(a) average in situ gas permeability throughout the pay section of 0.1 millidarcy; and

(b) stabilized gas production rate, without stimulation, against atmospheric pressure, of 336 MCFPD, the FERC maximum allowable gas production rate for an average formation depth of 7575 feet; and

(c) crude oil production rate of 5 barrels per day.

(17) That the technical evidence presented in this case demonstrated that the predominant percentage of wells which may be completed in the Dakota formation within the proposed tight formation area may reasonably be presumed to exhibit permeability, gas productivity, or crude oil productivity not in excess of the above described parameters.

(18) That within the proposed area there is a recognized aquifer being the Ojo Alamo, found at depths of 5000 to 6000 feet above the Dakota formation.

(19) That existing State of New Mexico and Federal Regulations relating to casing and cementing of wells will assure that development of the Dakota formation will not adversely affect any overlying aquifers.

(20) That the area described on Exhibit "A" to this order should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. §271.703 of the regulations that the Dakota formation underlying those lands in San Juan County, New Mexico, described on Exhibit "A" to this order, be designated as a tight formation.

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

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

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

SEAL

fd/

TOWNSHIP 32 NORTH, RANGE 7 WEST, NMPM
Sections 7 through 9: All
Sections 16 through 21: All
Sections 25 through 36: All

TOWNSHIP 32 NORTH, RANGE 8 WEST, NMPM
Sections 7 through 36: All

TOWNSHIP 32 NORTH, RANGE 9 WEST, NMPM
Sections 7 through 36: All

TOWNSHIP 31 NORTH, RANGE 8 WEST, NMPM
Sections 1 through 31: All
Sections 33 through 36: All

TOWNSHIP 31 NORTH, RANGE 9 WEST, NMPM
Sections 1 through 26: All
Sections 29 through 36: All

TOWNSHIP 30 NORTH, RANGE 8 WEST, NMPM
Sections 1 and 2: All
Sections 6 through 34: All
Section 36: All

TOWNSHIP 30 NORTH, RANGE 9 WEST, NMPM
Sections 1 through 30: All
Sections 35 and 36: All

TOWNSHIP 30 NORTH, RANGE 10 WEST, NMPM
Sections 1 through 18: All
Section 24: All

TOWNSHIP 29 NORTH, RANGE 8 WEST, NMPM
Sections 1 through 6: All

TOWNSHIP 29 NORTH, RANGE 9 WEST, NMPM
Sections 1 and 2: All

Containing a total of 149,760 acres, more or less.

EXHIBIT "A"
Case No. 7608
Order No. R-7047

Docket No. 16-82

Dockets Nos.19 -82 and 20 -82 are tentatively set for June 23 and July 7, 1982. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - WEDNESDAY - JUNE 2, 1982
OIL CONSERVATION COMMISSION - 9 A.M.
MORGAN HALL, STATE LAND OFFICE BUILDING
SANTA FE, NEW MEXICO

CASE 7522: (DE NOVO - Continued from May 17, 1982, Commission Hearing)

Application of Santa Fe Exploration Co. for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval of an unorthodox location 660 feet from the North and West lines of Section 14, Township 20 South, Range 25 East, Permo-Penn, Strawn, Atoka and Morrow formations, the N/2 of said Section 14 to be dedicated to the well.

Upon application of Chama Petroleum Company, this case will be heard De Novo pursuant to the provisions of Rule 1220.

CASE 7521: (DE NOVO)

Application of William B. Barnhill for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval of an unorthodox location 660 feet from the South and West lines of Section 35, Township 19 South, Range 25 East, Permo-Penn, Strawn, Atoka and Morrow formations, the S/2 of said Section 35 to be dedicated to the well.

Upon application of Chama Petroleum Company and William B. Barnhill, this case will be heard De Novo pursuant to the provisions of Rule 1220.

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Docket No. 17-82

DOCKET: EXAMINER HEARING - WEDNESDAY - JUNE 9, 1982
9 A.M. MORGAN HALL, 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:

CASE 7599: Application of Barber Oil Inc. for an Exception to Rule 705-A Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an exception to the provisions of Rule 705-A of the Division Rules and Regulations to permit 37 temporarily abandoned injection wells in its Russell Pool waterflood project to remain inactive for a period of up to three years without the required cement or bridge plugs being installed therein to isolate the injection zone.

CASE 7600: Application of Gulf Oil Corporation for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Seven Rivers and Queen formations in the perforated interval from 3338 feet to 3448 feet in its Arnott-Ramsay (NCT-B) Well No. 4 located in Unit D of Section 32, Township 25 South, Range 37 East, Langlie Mattix Pool.

CASE 7548: (Continued from April 14, 1982, Examiner Hearing)

Application of Tahoe Oil & Cattle Co. 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 in the perforated interval from 4932 feet to 4992 feet in its Schwalbe Well No. 1, located in Unit F of Section 21, Township 9 South, Range 37 East, West Sawyer-San Andres Pool.

CASE 7601: Application of Claude Walker for an oil treating plant permit, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority for the construction and operation of an oil treating plant for the purpose of treating and reclaiming sediment oil at its salt water disposal site in the NE/4 NE/4 of Section 11, Township 10 South, Range 35 East.

CASE 7602: Application of Riqueza, Inc. for an oil treating plant permit, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority for the construction and operation of an oil treating plant for the purpose of treating and reclaiming sediment oil in the NE/4 of Section 26, Township 22 South, Range 29 East.

CASE 7603: Application of Riqueza, Inc. for an exception to Order No. R-3221, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an exception to Order No. R-3221 to permit the commercial disposal of produced brine into an unlined surface pit located near its proposed oil treating plant in the NE/4 of Section 26, Township 22 South, Range 29 East.

CASE 7519: (Continued from May 26, 1982, Examiner Hearing)

Application of S & J Oil Company for special pool rules, McKinley County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special pool rules for the Seven Lakes-Menafee Oil Pool to provide for wells to be located not nearer than 25 feet to the quarter-quarter section line nor nearer than 165 feet to lands owned by an offset operator.

CASE 7604: Application of Rio Pecos Corporation for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests from the surface to the base of the Pennsylvanian formation underlying the W/2 of Section 2, Township 19 South, Range 32 East, 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, designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 7605: Application of Yates Petroleum Corporation for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests from the top of the Wolfcamp formation through the uppermost 100 feet of the Mississippian Chester Limestone underlying the W/2 of Section 35, Township 19 South, Range 24 East, 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, designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 7606: Application of MTS Limited Partnership Company for compulsory pooling, Chaves County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests from the surface through the base of the Abo formation underlying the NW/4 of Section 5, Township 7 South, Range 26 East, 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, designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 7592: (Continued from May 26, 1982, Examiner Hearing)

Application of OXOCO for compulsory pooling, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests from the surface to the base of the Mesa Verde formation underlying the E/2 of Section 20, Township 32 North, Range 8 West, 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, designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 7586: (Continued and Readvertised)

Application of Standard Resources Corp. for designation of a tight formation, Chaves and Eddy Counties, New Mexico. Applicant, in the above-styled cause, seeks the designation of the Abo-Wolfcamp formation underlying all or portions of Township 15 South, Ranges 23 through 25 East, Township 19 South, Range 20 East, and Township 20 South, Range 20 East, all in Chaves County; in Eddy County: Township 16 South, Ranges 23 through 26 East, Township 17 South, Ranges 21, 23, 24, and 25 East, and Township 18 South, Ranges 21, 23, 24 and 25 East, Township 19 South, Ranges 21, 23 and 24 East, and Township 20 South, Ranges 21, 23 and 24 East, containing 460,800 acres, more or less, as a tight formation pursuant to Section 107 of the Natural Gas Policy Act and 18 CFR Section 271. 701-705.

CASE 7607: Application of El Paso Natural Gas Company for the abolishment of the Blanco-Pictured Cliffs Pool and the expansion of the South Blanco-Pictured Cliffs Pool in Rio Arriba, Sandoval and San Juan Counties, New Mexico. Applicant, in the above-styled cause, seeks the abolishment of the Blanco-Pictured Cliffs Pool and the expansion of the horizontal limits of the South Blanco-Pictured Cliffs Pool to include the abolished acreage.

Also to be considered will be the appropriate method for institution of gas prorationing for wells effected by the change in pool designation.

CASE 7608: Application of Tenneco Oil Company for designation of a tight formation, San Juan County, New Mexico. Pursuant to Section 107 of the Natural Gas Policy Act of 1978 and 18 CFR Section 271. 701-705, applicant, in the above-styled cause, seeks the designation as a tight formation of the Dakota Producing Interval underlying the following described lands:

All of:

Sections 1 thru 6, Township 29 North, Range 8 West;

Sections 1 and 2, Township 29 North, Range 9 West;

Sections 1 thru 18 and Section 24, Township 30 North, Range 10 West;

Sections 7 thru 9, 16 thru 21 and 25 thru 36, Township 32 North, Range 7 West;

All sections, Township 32 North, Range 8 West; and

All sections, Township 32 North, Range 9 West;

Also:

All of Township 30 North, Range 8 West except Sections 3 thru 5 and Section 35;

All of Township 30 North, Range 9 West except Sections 31 thru 34;

All of Township 31 North, Range 8 West except Section 32; and

All of Township 31 North, Range 9 West except Sections 27 and 28

containing 149,760 acres, more or less.

CASE 7609: In the matter of the hearing called by the Oil Conservation Division on its own motion for an order creating and extending certain pools in Chaves, Eddy, and Lea Counties, New Mexico.

(a) CREATE a new pool in Eddy County, New Mexico, classified as a gas pool for Middle Bell Canyon production and designated as the Brushy Draw-Middle Bell Canyon Gas Pool. The discovery well is the J. C. Williamson EP-USA Well No. 2 located in Unit O of Section 26, Township 26 South, Range 29 East, NMPM. Said Pool would comprise:

TOWNSHIP 26 SOUTH, RANGE 29 EAST, NMPM
Section 26: SE/4

(b) CREATE a new pool in Lea County, New Mexico, classified as an oil pool for Bone Spring production and designated as the Legg-Bone Spring Pool. The discovery well is the Amoco Production Company State LT Well No. 1 located in Unit K of Section 32, Township 21 South, Range 33 East, NMPM. Said Pool would comprise:

TOWNSHIP 21 SOUTH, RANGE 33 EAST, NMPM
Section 32: SW/4

(c) CREATE a new pool in Chaves County, New Mexico, classified as a gas pool for Atoka production and designated as the White Ranch-Atoka Gas Pool. The discovery well is the Depco, Inc. White Ranch Unit Well No. 1 located in Unit F of Section 8, Township 13 South, Range 30 East, NMPM. Said Pool would comprise:

TOWNSHIP 13 SOUTH, RANGE 30 EAST, NMPM
Section 8: W/2

(d) EXTEND the Austin-Mississippian Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 14 SOUTH, RANGE 36 EAST, NMPM
Section 3: N/2 and SW/4

(e) EXTEND the Baum-Upper Pennsylvanian Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 14 SOUTH, RANGE 33 EAST, NMPM
Section 18: NE/4

(f) EXTEND the Burton Flat-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 20 SOUTH, RANGE 28 EAST, NMPM
Section 8: S/2

(g) EXTEND the East Burton Flat-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 20 SOUTH, RANGE 29 EAST, NMPM
Section 6: S/2

(h) EXTEND the Cedar Lake-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 30 EAST, NMPM
Section 34: N/2
Section 35: N/2

(i) EXTEND the Crooked Creek-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 24 SOUTH, RANGE 24 EAST, NMPM
Section 3: S/2
Section 10: N/2

(j) EXTEND the EK Yates-Seven Rivers-Queen Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 34 EAST, NMPM
Section 9: SW/4

(k) EXTEND the Elkins-San Andres Pool in Chaves County, New Mexico, to include therein:

TOWNSHIP 7 SOUTH, RANGE 28 EAST, NMPM
Section 22: S/2 NW/4

(l) EXTEND the Empire-Pennsylvanian Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 17 SOUTH, RANGE 28 EAST, NMPM
Section 20: N/2

(m) EXTEND the East Grama Ridge-Morrow Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 21 SOUTH, RANGE 35 EAST, NMPM
Section 31: S/2

(n) EXTEND the Hoag Tank-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 19 SOUTH, RANGE 24 EAST, NMPM
Section 34: N/2

(o) EXTEND the House-Drinkard Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 19 SOUTH, RANGE 38 EAST, NMPM
Section 35: SE/4

TOWNSHIP 20 SOUTH, RANGE 38 EAST, NMPM
Section 2: NE/4

EXAMINER HEARING-WEDNESDAY-JUNE(

(p) EXTEND the South Kemnitz Atoka-Morrow Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 16 SOUTH, RANGE 34 EAST, NMPM
Section 19: S/2

(q) EXTEND the EastLaRica-Morrow Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 34 EAST, NMPM
Section 35: S/2

(r) EXTEND the North Loving-Atoka Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 23 SOUTH, RANGE 28 EAST, NMPM
Section 5: All

(s) EXTEND the North Loving-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 23 SOUTH, RANGE 28 EAST, NMPM
Section 6: S/2

(t) EXTEND the Maljamar-Atoka Gas Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 16 SOUTH, RANGE 33 EAST, NMPM
Section 28: E/2

(u) EXTEND the South Salt Lake-Morrow Gas Pool in Lea County, New Mexico to include therein:

TOWNSHIP 21 SOUTH, RANGE 32 EAST, NMPM
Section 6: Lots 1, 2, 3, 4, 5, 6, 7, and 8

(v) EXTEND the Sand Hills Grayburg-San Andres Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 20 SOUTH, RANGE 39 EAST, NMPM
Section 31: SE/4

(w) EXTEND the Shugart-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 19 SOUTH, RANGE 31 EAST, NMPM
Section 4: N/2

(x) EXTEND the Tom-Tom San Andres Pool in Chaves County, New Mexico, to include therein:

TOWNSHIP 7 SOUTH, RANGE 31 EAST, NMPM
Section 35: NE/4

(y) EXTEND the Travis-Upper Pennsylvanian Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 13: N/2 NW/4

(z) EXTEND the North Turkey Track-Morrow Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 28 EAST, NMPM
Section 27: E/2

(aa) EXTEND the White City-Pennsylvanian Gas Pool in Eddy County, New Mexico, to include therein:

TOWNSHIP 25 SOUTH, RANGE 26 EAST, NMPM
Section 13: All

(bb) EXTEND the North Young-Bone Spring Pool in Lea County, New Mexico, to include therein:

TOWNSHIP 18 SOUTH, RANGE 32 EAST, NMPM
Section 4: SE/4
Section 11: W/2

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Docket No. 18-82

DOCKET: EXAMINER HEARING - THURSDAY- JUNE 17, 1982

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

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

ALLOWABLE: (1) Consideration of the allowable production of gas for July, 1982, from fifteen prorated pools in Lea, Eddy, and Chaves Counties, New Mexico.

(2) Consideration of the allowable production of gas for July, 1982, from four prorated pools in San Juan, Rio Arriba, and Sandoval Counties, New Mexico.

WILLIAM R. SPEER CONSULTING GEOLOGIST

DAILY DRILLING SUMMARY

7 a.m. Report

Oxoco Production Corp.
Trail Canyon #3
2050 ft. fSl. 430 ft. fEl
Sec. 7, T32N-R8W, NMPM
San Juan Co., New Mexico
Estim. T.D. 8380 ft.

May 20,1982 Thur. Depth 335'. Cementing 10 3/4" surface casing: Moved on location and rigged up Four Corners Drilling Co. Rig No. 6. Spud well at 10:30 p.m., 5/19/82. Drilled 13 3/4" hole to 335'. Ran 7 jts. 10 3/4", 32.75 lb., H-40, ST&C casing (309.10 ft.). Landed at 323 ft. Rigged up National Cementers and began cementing surface casing. Hole deviations: ½° @ 162', 1° @ 335.

Estim.Cumul.Cost: $22,927

May 21, 1982 Fri. Depth 1035'. Cemented 10 3/4" surface casing with 265 sacks (312.7 cu.ft.) Class B cement, 2% CaCl. Plug down to 304' at 8:30 a.m., 5/20/82. Good circulation throughout cementing, circulated 20 sx. cement to surface. Ran two centralizers on 10 3/4" casing on first and third collars. W.O.C. 12 hrs. Nipped up BOP's and tested to 800 psi. Drilled out with 9 7/8" bit No. 2 (Security S-86) at 8:30 p.m., 5/20. Mudded up to wt. 8.9 ob., visc. 33, water loss 9.6 cc. at 800'. Hole deiviation survey: 1° @ 842'.

Estim.Cumul.Cost. $37,018

May 22, 1982 Sat. Depth 2026 ft. Drilling with bit no. 2-9 7/8" S-86F in ss. & sh. Stuck drill pipe at 1400 ft. Spotted 1800 gal. diesel and broke loose. Mud wt. 9.1 lb., visc. 36 sec., water loss 10 cc. Rotary wt. 40,000 lb., RPM-70. Drill collars: 6½ x2¼x620 ft. Mud pump 6x8, 100 strokes/min. @ 2000 psi. Hole deviation surveys: 1° @ 1260', 1¼° @ 1752'. Estim. cumul. cost $49,388.

May 23, 1982 Sun. Depth 2652 ft. Making trip for bit no. 4 in San Jose ss. & sh. Bit no. 2 (9 7/8" S86F) made 1819' in 28½ hrs. Bit no. 3 (9 7/8" HS-65) made 498' in 17 3/4 hr. Mud wt. 9.2 lb., visc. 38 sec., W.L. 10 cc. Hole deviation 2° @ 2154'. Estim cumul. cost $58,228.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EX IBIT NO. 1
CASE NO 7608
Submitted by Speer-Oxoco
Hearing Date 6-9-82

May 24, 1982 Mon. Depth 3234'. Drilling with bit no 4 (9 7/8" HTC J22) in Fruitland fm. ss's. & sh's. Mud wt. 9.3#, visc. 40 sec., w. l. 10cc. Rotary wt. 45,000 lbs., rpm 70. Hole deviation surveys: 1 3/4° @ 2653', 2° @ 3150'. Estimated cumul. cost $66,650.

May 25, 1982 Tues. Depth 3900'. Circulating, prep to trip for intermediate logs. in Lewis shale. Mud wt. 9.4 lb., visc. 70, water loss 7.5 cc. Rotary wt. 45,000 lb., rpm 70. Bit no. 4 (HTC J-22) made 870' in 26 hr., bit no. 5 (HTC J-22) made 378' in 10½ hr. Hole deviation survey 2° @ 3882'. Estim. cumul. cost $76,445.

May 26, 1982 Wed. Depth 3900'. Laying down drill pipe, prep to run 7 5/8" casing. Ran Dresser-Atlas induction-electrical, densilog and compensated nuetron logs to T.D. of 3894'. Hole deviation 1°@3900'. Formation tops: Kirtland Fm. 2966', Fruitland Fm. 3136', Pictured Cliffs Ss. 3610', Lewis Sh. Transitional 3756', Lewis Sh. 3864'. Ran Drill stem test no. 1: 3508-3900: open tool for initial flow period of 15 min., good blow air immediately and thru-out test period. Shut in tool for 25 min. initial period. Opened tool for 2nd flow period of 30 min. Good blow air immediately which decreased and died in 26 min. Shut in tool for 30 min. final period. Recovered 674 ft. of slightly gas-cut, highly viscous drilling mud. Initial hydrostatic pressure 1742 psi, flow pressures, both initial and final, indeterminate due to plugging by viscous mud. Initial shut-in pressure 1512 psi in 30 min., final shut-in pressure 1499 psi in 30 min. Final hydrostatic 1661 psi. Sample bomb contained small amt. of slightly gas-cut heavy mud. Apparently high viscosity of mud (150 sec.) prevented valid DST as hole attempted to unload with gas as it was being circulated after DST, preparatory to running casing. After partial unloading, hole continued to be highly gas-cut as mud was thinned to 65 viscosity and it was necessary to keep hole loaded thru-out drill pipe lay down. Gas may be coming from either DST zone or coal zones above at 3320 to 3410 ft. Estim. cumul. cost $96,145.

May 27, 1982 Thur. Depth 3900'. Drilling cement with bit no.6 (6 3/4" HH-44). Ran 97 jts. 7 5/8", 26.4 lb., K-55, ST&C, 8-rnd casing (3911.68' with 1.10' Rector guide shoe with automatic fill insert float). Landed casing at 3896' w/float at 3853' and centralizers at 3853', 3774', 3692' 3617' and 3496'. Circ. hole to reduce visc. to 60 sec. Rigged up National Cementers and pumped 20 bbls. chemical wash followed by 150 sk. 65/35

May 27 (cont'd.) Pozmix with 12% gel and 6¼ lb./sk. gilsonite followed by 175 sk. Class B cement with 2% $CaCl_2$ and ¼ lb./sk. cellophane flakes. Pump rate during mixing 6 BPM at 300 psi max. press. Displaced with 180.5 bbls. fresh water at 8 BPM and 1000 psi max. press. Plug down at 1620 hrs., 5/26/82 with 1300 psi. Good circ. thru-out cementing job. Set slips with 69,000 lb. tension and Rector cut off casing. Ran temp. survey at 0030 hrs. 5/27/82. Top cement at 1900'. Poor cement from 1900 to 2200 ft., good 2200'-T.D. W.O.C. Est. cumul. cost $160,114.

May 28, 1982 Fri. Depth 5461'. Drilling with bit no 6 (6 3/4" HH-44) and air in Lewis shale. Displaced mud from 7 5/8" casing with air, dryed hole, drilled out cement. Hole dusting good. Drilling wt. 18,000 lb., 70 rpm. Hole deviation surveys: 1°@ 4400', 1 3/4°@ 4900', 2°@ 5398'. Est. cumul. cost $177,533.

May 29, 1982 Sat. Depth 6927'. Drilling with bit no. 6 in Mancos shale Air pressure 180 lb., wt. 18,000 lb., 70 rpm. Gaged open hole at 5940' (Base of Menefee Fm.) by shutting off air, closing rams on drill pipe and venting through 2" bleed-off line. Had inflammable gas TSTM with pressure gage and pitot tube. Gaged again at 6176' (Base of Pt. Lookout Ss.) through 1" line with pitot tube and water manometer and had 12MCFPD rate of inflammable gas at 5, 15, 30 and 45 min. of test. Hole deviation surveys: 1½°@ 5917, 1 3/4°@ 6418. Est. cumul. cost: $192,748.

May 30, 1982 Sun. Depth 8093'. Drilling w/bit no. 7 (HTC J-55) in Graneros shale. Gaged open hole at 7601' (Base of Gallup fm.) had natural gas at measured rate of 22MCFPD. Trip for bit no. 7 (HTC J-55) at 7789. Bit no. 6 (HH-44) made 3889' in 47 hrs. Hole deviation surveys: 1 3/4°@ 6918', 1°@ 7420, 1 3/4°@ 7920. Est cumul. cost $213,798.

May 31, 1982 Mon. Total Depth 8290'. Running 5½" liner with 3½" drill pipe. Drilled to T.D. of 8290' at 8:30 a.m., 5/30/82 with bit no. 7 (HTC J-55) Bit no. 7 made 501' in 10 3/4 hr. Hole deviation survey 2°@8274'. Gauged open hole at T.D., making 264MCFPD natural gas. Ran Dresser Atlas Dual Induction, Compensated Density, Linear Porosity Neutron and Gamma Ray logs to T.D. of 8300'. Formation tops: Mesaverde-5286', Menefee Fm.-5701', Pt. Lookout Ss.-5960', Mancos Transitional-6075', Upper Mancos Sh.-6315', Gallup-7354', Lower Mancos Sh.-7682', Greenhorn Ls.-8027', Graneros Sh.-8096', Dakota Ss.-8210'. Laid down drill pipe and

May 31, 1982 (cont'd.) collars, less 40 stands to run liner. Ran 109 jts. 5½" casing (4,577.03') consisting of 12 jts. of 17.0 lb., N-80 (493.20'); 55 jts. of 17 lb., K-55 (2,311.95') and 42 jts. of 15.5 lb., K-55 (1,771.88') with B&W guide shoe, float collar and latch-in collar. Picked up B&W liner hanger on 3½" drill pipe and continued in hole. Est. cumul. cost $233,373.

June 1,1982 Tues. T.D. 8290'. Waiting on completion tools. Finished running liner on hanger. Tagged bottom @ 8290'. Pulled up 1 ft. off bottom and circulated hole with 200 psi air for 30 min. Good returns--gas, air and dust, no water. Landed 5½" casing at 8288' with latchcollar and float @ 8243' (shoe 41.55' below float). Liner top @ 3700'. Hooked up National Cementers, pumped 20 bbls. chemical wash, followed by 500 sks. 50/50 Poz-mix, 2% gel, ½% NFL-2 & 1/3% CDR-4 @ rate of 56 BPM. Total slurry volume 112 bbls. Cement wt. 13.4 lb./gal. Dropped liner plug and displaced with 130.5 bbls. @ 650 psi. Landed plug with 1250 psi at 8:45 a.m., 5/31/82. Released pressure and checked flow-back-none. Packed off liner and released liner hanger. Picked up 6 ft. and loaded annulus with 131 bbls. water. Closed BOP's and reversed out 19 bbls. of good cement and 10 bbls. chem. wash. Continued reversing out until all gas & air out and shut down, job complete. Released Four Corners Drilling Co. rig no. 6 @ 11:00a.m.,5/31/82. Est. cumul. cost $299,733.

SUPPLEMENTAL TABLE OF CONTENTS

SUPPLEMENTAL SUMMARY OF TESTIMONY

ENGINEERING DATA

PRODUCTION DATA TABLE

Exhibit K is a well list of all the Dakota penetrations within the proposed area. It identifies the well's data of first production, cumulative production (to 1-1-82), 1981 production and the 1981 average daily rate. The intent of this exhibit is to show the production characteristic of the proposed area.

ESTIMATED ULTIMATE RECOVERIES FOR THE WINDOWED AREAS

Exhibit L-1, 2, 3 identifies the wells within and immediately surrounding the three windows of the proposed area. It gives an estimate of the ultimate recoveries of each well and calculates an average for wells inside and immediately surrounding the three windows. These estimates were based on decline curve (rate vs. cumulative production, attached) analysis where there was sufficient production history to establish a constant trend. This technique is not valid for new wells because they do not exhibit a constant decline in their early life. Thus another method was employed. This involved taking the well's average turn on rate (1-2 months) and artificially declining it using a typical Dakota production scheme. This resulted in an estimate of the ultimate recoveries for the newer wells.

The exhibit shows the anamolous production characteristics within the windows and gives evidence to the location of the window's boundaries.

DEVELOPMENT DATA

Exhibit M is a table showing the level of activity within the proposed area. The exhibit gives a percentage of development for each township and range based on the number of wells within each section and shows a percent developed for the entire area.

Tenneco Oil
Exploration and Production
A Tenneco Company

Tenneco Building
PO Box 2511
Houston, Texas 77001
(713) 757-2131

June 29, 1982

JUN 30 1982

Mr. Richard L. Stamets
Examiner, Oil Conservation Division
State Land Office Building
Santa Fe, New Mexico 87501

Re: Late File Exhibits in Case No. 7608, Application of Tenneco Oil Company for Designation of a Tight Formation, San Juan County, New Mexico

Dear Mr. Staments:

Enclosed are three copies of exhibits marked "K", "L" and "M" which we request be accepted as late file exhibits in this case. These exhibits were prepared by Mr. Dean Liley, the expert petroleum engineer who testified at the hearing. Index tabs are provided so that these exhibits may be placed in the looseleaf binders entered into evidence at the hearing.

Exhibit "K" is a well list of all Dakota penetrations within the application area. It identifies the date of first production, total cumulative production to January 1, 1982, 1981 production and 1981 average daily rate for each well. This exhibit demonstrates the production characteristics of the proposed area.

Exhibit "L" identifies the wells within and immediately surrounding the three "windows" in the proposed area. Average ultimate recoveries are estimated for wells within and surrounding each "window". These estimates are based actual decline curves (rate v. cumulative production) where there is sufficient production history to establish a trend. For new wells which do not exhibit a constant decline in their early life the average turn-on rates (1 to 2 months) were artificially declined using a typical Dakota production scheme. This exhibit illustrates the anamolous production characteristics within the "windows" and the limited areal extent of these anamolies.

Exhibit "M" is a table showing the level of drilling activity within the proposed area. A percentage of development is calculated for the entire area based on the total number of drilling locations available under the O.C.D.'s infill Order No. R-1670V. In addition, a percentage of development is presented for each township by giving the number of sections containing 0, 1, 2, 3 or 4 wells (0, 25, 50, 75 and 100%, respectively). This exhibit clearly establishes that the proposed area has not been subject to a great degree of development.

Tenneco Oil
Exploration and Production

We would also wish at this time to correct a few minor errors in the original application. These corrections are:

(1) On the maps, Exhibits "B" and "D" there are two wells labeled #14 in Section 36 of Township 30 North, Range 8 West. The well spotted in the NW/4 should be deleted and the location of the Lively #14 well on the well list, Exhibit "F", page 9, should be changed to read "NWSW Sec. 36."

(2) A Dakota single well labeled #1 should be added to the maps, Exhibits "B" and "D", in the SESE of Section 28 in Township 30 North, Range 8 West. The well list, Exhibit "F", page 12, should now include the following line entry:

Lindsey B #1 Tenneco SWSW Sec. 28	12/12/79	3/4/80	Active	-

Also enclosed is a proposed form of order for your approval. Please send an executed copy of the order for our files.

We appreciate your cooperation and if we may be of any further assistance, please let us know. We will be available should you wish us to appear when you reopen the record in July.

Very truly yours,

TENNECO OIL COMPANY

Michael P. Kovich
Attorney

MPK:mp

Enclosures

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
Tenneco EXHIBIT NO. 9608
CASE NO. 7608
Submitted by _____
Hearing Date _____

TOEP 100C 11/7

CURTIS J. LITTLE
PETROLEUM GEOLOGIST
TELEPHONE (505) 327-5176
POST OFFICE BOX 2497
PETROLEUM PLAZA SUITE 150
FARMINGTON, NEW MEXICO 87401

June 10, 1982

State of New Mexico
Oil Conservation Commission
Santa Fe, New Mexico

Re: Hearing Case No. 7608
Docket No. 17-82

The undersigned supports the Applicant for the designation of the Dakota Formation as a tight formation pursuant to Section 107 of the Natural Gas Policy Act and 18 CFR Section 271.701-705.

CURTIS J. LITTLE

CJL/sfl

KELLAHIN and KELLAHIN
Attorneys at Law
500 Don Gaspar Avenue
Post Office Box 1769
Santa Fe, New Mexico 87501

Jason Kellahin
W. Thomas Kellahin
Karen Aubrey

Telephone 982-4285
Area Code 505

June 1, 1982

Mr. Richard L. Stamets
New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Re: Tenneco Oil Company
OCD Case 7608

Dear Dick:

Please enter our appearance in Division Case 7608 on behalf of Tenneco Oil Company.

We are appearing in association with Mr. Michael P. Kovich, an attorney for Tenneco Oil Company, who will present Tenneco's case.

Very truly yours,

W. Thomas Kellahin

WTK:rb

cc: Millard Carr, Esq.,
Tenneco-Denver
Michael P. Kovich, Esq.,
Tenneco-Houston

June 9, 1982

Tenneco Oil
Exploration and Production
A Tenneco Company

Rocky Mountain Division

P.O. Box 3249
Englewood, Colorado 80155
(303) 740-4800

Delivery Address:
6061 South Willow Drive
Englewood, Colorado

April 26, 1982

New Mexico Oil Conservation Div.
310 Old Santa Fe Trail
Santa Fe, NM 87501

Attn: Joe D. Ramey - Director

Minerals Management Service
505 Marquette N.W. Rm. 815
Albuquerque, NM 87102

Attn: Allen Buckingham

Re: New Mexico Tight Gas Hearing
Tenneco Oil Company Applicant
Basin Dakota Formation
San Juan County, New Mexico

Gentlemen:

Pursuant to our application for a tight gas sand hearing to be heard May 12, 1982 we have attached copies of exhibits we expect to use in our presentation. Please note that these materials are preliminary and that we reserve the right to add to, revise, delete or otherwise alter this information. Final copies will be presented during the hearing on May 12.

The attached exhibits include:

A. Regional map showing all Dakota and Gallup completions and all Basin Dakota tight gas applications in the Basin and their relation to this application.

B. Base map showing outline of our application area and locations of wells used for our geological cross-sections and engineering test data.

C. Type log of the Basin Dakota formation in the area.

D. Base map showing structural contours on top of the Basin Dakota formation.

E. Three (3) geological cross-sections defining Basin Dakota geology of the application area.

F. Table showing data on all Basin Dakota completions within the application area.

G. Table showing pre-stimulation rate data for the application area.

H. Permeability data for the application area:

1) Core data (3)
2) Build-up tests (2)

I. SPE technical paper showing methodology used in core permeability calculations.

J. Profile of typical completion procedure within the application area ensuring protection of fresh water aquifers.

If you have any questions regarding this information, please call.

Very truly yours,

TENNECO OIL COMPANY

Robert J. Gibb

R. J. Gibb
Petroleum Engineering Supervisor

RJG:pe

CC: Mike Kovich, Atty. (Houston)

B

D

EXHIBIT _____
APPLICATION AREA WELL LIST
DAKOTA FORMATION
SAN JUAN COUNTY, NEW MEXICO

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
32N-7W				
SJU 32-7 #55 Northwest Pipeline NESW Sec. 7	12/27/79	7/25/80	Active	
SJU 32-7 #36 El Paso Natural Gas NENW Sec. 8	6/28/62	12/5/62	Active	Dual Comp.: MVRD/DKOT
Allison Unit #26 El Paso Natural Gas NESE Sec. 9	7/20/64	9/24/64	S I	Dual Comp.: MVRD/DKOT Last produced 1/78
SJU 32-7 #37 El Paso Natural Gas NWNW Sec. 9	7/25/62	9/20/62	T A	Dual Comp.: MVRD/DKOT DKOT Core: 7746-7968' Permeability - Core
Allison Unit 5-A El Paso Natural Gas NESE Sec. 16	11/4/80	6/25/81	Active	Dual Comp.: MVRD/DKOT
SJU 32-7 #56 Northwest Pipeline SWNW Sec. 17	1/30/80	6/4/80	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
SJU 32-7 #57 Northwest Pipeline NESE Sec. 17	1/17/80	6/20/80	Active	
SJU 32-7 #58 Northwest Pipeline SWNE Sec. 18	12/14/79	5/23/80	Active	
SJU 32-7 #60 Northwest Pipeline NENE Sec. 20	1/7/80	6/20/80	Active	
SJU 32-7 #43 El Paso Natural Gas NWNE Sec. 21	9/20/73	10/17/73	S I	Last produced 11/81 Rate data
Allison Unit #18 El Paso Natural Gas NWNE Sec. 25	10/25/73	11/23/73	Active	
SJU 32-7 #34 El Paso Natural Gas NENE Sec. 27	10/6/73	11/8/73	S I	Last produced 11/81
SJU 32-7 #62 Northwest Pipeline SWSW Sec. 27	12/27/80	5/19/81	Active	
SJU 32-7 #63 Northwest Pipeline SWNE Sec. 28	1/4/80	5/15/81	Active	
SJU 32--7 #22 El Paso Natural Gas SESW Sec. 29	7/27/59	6/23/60	P & A	Dual Comp.: MVRD/DKOT DKOT Core: 7745-7913' Permeability - Core

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
SJU 32-7 #68 Northwest Pipeline SESE Sec. 34	1/14/81	5/27/81	Active	Rate data
SJU 32-7 #69 Northwest Pipeline NWNE Sec. 35	2/2/81	5/27/81	Active	
SJU 32-7 #67 Northwest Pipeline NWSW Sec. 36	1/23/81	5/26/81	Active	
32N-8W				
Reese Mesa #6 Southland Royalty NWSE Sec. 10	11/19/79	11/17/80	Active	Dual Comp.: MVRD/DKOT
Reese Mesa #4 Southland Royalty NESW Sec. 11	7/9/73	8/25/73	Active	Dual Comp.: MVRD/DKOT
Reese Mesa #1 Southland Royalty NENE Sec. 12	7/22/69	9/13/69	Active	Dual Comp.: MVRD/DKOT
Reese Mesa #2 Southland Royalty NWSW Sec. 12	5/13/73	7/2/73	Active	Dual Comp.: MVRD/DKOT
Reese Mesa #3 Southland Royalty SENE Sec. 13	6/17/73	8/1/73	Active	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Reese Mesa #5 Southland Royalty NENW Sec. 13	6/5/79	8/4/79	Active	Dual Comp.: MVRD/DKOT
Trail Canyon #1 Southland Royalty SWSW Sec. 21	5/16/69	7/7/69	P & A	Dual Comp.: MVRD/DKOT
Wilmer Canyon #1 Southland Royalty SWSW Sec. 24	7/3/69	9/12/69	P & A	Dual Comp.: MVRD/DKOT
Schalk #94 John E. Schalk NENE Sec. 26	8/2/73	1/24/74	Active	Commingled: GLLP/DKOT
Rattlesnake Canyon #1 Southland Royalty SESW Sec. 32	6/18/69	8/25/69	P & A	Dual Comp.: MVRD/DKOT
Albino Canyon #1 Southland Royalty SWSW Sec. 36	5/30/69	7/10/69	T A	Dual Comp.: MVRD/DKOT
32N-9W				
SJU 32-9 #70X El Paso Natural Gas SENE Sec. 21	7/18/59	10/14/59	P & A	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
31N-8W				
Oxnard #1-A Supron Energy NENW Sec. 8	8/29/80	12/10/80	Active	Dual Comp.: MVRD/DKOT
Oxnard 3-A Supron Energy SESE Sec. 8	8/13/80	3/28/81	Active	Dual Comp.: MVRD/DKOT
SJU 32-8 #35 El Paso Natural Gas SWSW Sec. 13	8/22/60	9/26/60	P & A	
Quinn 7-A Supron Energy SESE Sec. 17	6/13/80	11/14/80	Active	Dual Comp.: PCCF/DKOT
Quinn 4-A Supron Energy NESE Sec. 19	7/1/80	12/12/80	Active	Dual Comp.: MVRD/DKOT
Quinn 6-A Supron Energy SESE Sec. 20	1/30/79	3/9/79	Active	Dual Comp.: MVRD/DKOT
SJU 32-8 #12A Northwest Pipeline SWNW Sec. 21	2/11/81	6/21/81	Active	Dual Comp.: MVRD/DKOT
Fletcher #2 Tenneco Oil SWSE Sec. 29	8/20/79	9/15/79	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Howell D-5 El Paso Natural Gas NESE Sec. 31	5/22/80	9/8/80	Active	
Fletcher #1 Tenneco Oil SWSW Sec. 33	7/1/67	8/4/67	Active	
Hale #4 Southland Royalty SENE Sec. 34	9/24/68	11/8/68	P & A	Dual Comp.: MVRD/DKOT
Hale #5 Southland Royalty SWSW Sec. 34	12/17/78	7/5/79	Active	
31N-9W				
Nordhaus 6-A Supron Energy NWNW Sec. 1	1/15/81	4/21/81	Active	Dual Comp. MVRD/DKOT
Nordhaus 2-A Supron Energy NENW Sec. 11	5/11/80	9/18/80	Active	Dual Comp. MVRD/DKOT
Nordhaus 5-A Supron Energy SENW Sec. 12	1/31/81	5/13/81	Active	Dual Comp. MVRD/DKOT
Barrett #1 Tenneco NWSW Sec. 20	2/28/63	5/17/63	P & A	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Barrett A-1 Tenneco Oil SESE Sec. 20	5/29/80	7/14/80	Active	
Riddle B-1 Tenneco Oil SWSW Sec. 22	9/3/80	12/12/80	Active	
Hunsaker #2-R Supron Energy NWNE Sec. 26	5/18/78	12/5/78	Active	Dual Comp.: MVRD/DKOT
Sheets Com #1 Tenneco Oil NWNE Sec. 29	8/31/79	10/25/79	Active	
Pritchard #5 Tenneco Oil NWNE Sec. 34	3/26/71	7/14/71	Active	
Pritchard #6 Tenneco Oil NWSW Sec. 34	8/1/79	9/14/79	Active	
30N-8W				
State Com AM #37 Mesa Petroleum SWNW Sec. 2	8/17/68	10/3/68	Active	
Florance #37 Tenneco Oil SENE Sec. 6	5/18/65	6/5/65	P & A	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Moore #1 Jerome McHugh NENE Sec. 7	5/12/68	6/25/68	Active	
Moore #1 Tenneco Oil SESW Sec. 8	4/25/65	10/14/65	Active	Dual Comp.: MVRD/DKOT
Florance #50 Tenneco SENW Sec. 14	3/4/63	7/29/63	P & A	
Florance #35 Tenneco Oil NENE Sec. 18	10/26/65	12/6/65	Active	Dual Comp.: MVRD/DKOT
Florance 111 Tenneco SWNE Sec. 19	2/25/82	4/9/82	Active	Dual Comp.: DKOT/PCCF Permeability - P.B.U. Rate data
Florance #40 Tenneco Oil SWNE Sec. 21	4/24/65	7/8/65	S I	Dual Comp.: MVRD/DKOT Last produced 10/80
Florance #29 Tenneco Oil NESW Sec. 25	12/10/64	1/5/65	Active	Dual Comp.: MVRD/DKOT
Florance #46 Tenneco SENE Sec. 29	3/18/54	7/13/54	P & A	Fractured: Tested Dakota but never produced
Lively #25 Lively Expl. NWSW Sec. 29	9/28/75	11/19/75	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Gartner #3 Tenneco Oil SENE Sec. 31	3/12/80	4/24/80	Active	Dual Comp.: PCCF/DKOT
Florance #44 Tenneco Oil SENE Sec. 31	5/13/65	7/5/65	P & A	Dual Comp.: MVRD/DKOT
Lively #15 Lively Expl. SENE Sec. 32	4/17/73	5/6/73	Active	
Gartner #9 El Paso Natural Gas NENE Sec. 32	9/29/61	11/13/61	Active	DKOT Core 7362-7602' Permeability - Core
Lively #14 Lively Expl. SWNW Sec. 36	10/7/73	12/8/73	Active	
30N-9W				
Pritchard #1 Tenneco Oil SWSW Sec. 1	9/9/65	10/15/65	T A	Dual Comp.: MVRD/DKOT
Turner-B Com #2 Tenneco Oil NENW Sec. 2	11/24/80	3/16/81	Active	Rate data
Florance #19 Tenneco SENE Sec. 3	8/3/62	1/11/63	Active	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Florance #16 Tenneco Oil NENE Sec. 6	6/19/65	8/17/65	Active	Dual Comp.: MVRD/DKOT
Elliott Gas Com-X #1 Amoco Prod. NESE Sec. 9	1/7/79	4/7/79	Active	
Florance #122 Tenneco Oil SWNW Sec. 10	2/23/80	4/15/80	Active	Dual Comp.: PCCF/DKOT
Florance #114 Tenneco Oil NWSW Sec. 11	3/2/80	4/8/80	Active	Dual Comp.: PCCF/DKOT
Florance 9-A Tenneco Oil NWSE Sec. 13	11/29/75	2/3/76	P & A	Dual Comp.: MVRD/DKOT
Florance #8 Tenneco Oil SESW Sec. 14	6/25/65	8/17/65	Active	Dual Comp.: MVRD/DKOT
Florance #13 Tenneco Oil NWNE Sec. 18	12/12/66	7/16/67	T A	Dual Comp.: MVRD/DKOT
Riddle Com #8 Tenneco Oil NESE Sec. 18	7/26/81	10/20/81	Active	Permeability - P.B.U. Rate data
Mansfield #1 Tenneco Oil SESE Sec. 19	10/1/65	12/6/65	T A	Dual Comp.: MVRD/DKOT

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Florance #2 Tenneco Oil NENE Sec. 20	8/3/65	10/6/65	T A	Dual Comp. MVRD/DKOT Last produced 6/80
Lively #30 Lively Expl. SWSW Sec. 20	12/12/75	1/20/76	Active	
Florance #49 Tenneco SWSE Sec. 22	3/3/63	8/19/63	S I	
Florance #5 Tenneco Oil NENE Sec. 22	8/25/65	10/6/65	Active	Dual Comp. MVRD/DKOT
Florance #6 Tenneco Oil SWSW Sec. 23	6/7/65	7/20/65	Active	Dual Comp.: MVRD/DKOT
Florance #20 Tenneco Oil NWNE Sec. 24	6/2/65	7/8/65	Active	Dual Comp.: MVRD/DKOT
Jacques #3 Tenneco Oil SWNW Sec. 25	12/14/80	3/31/81	Active	Dual Comp.: PCCF/DKOT
Elliott B-9 Amoco NESW Sec. 26	6/11/65	8/24/65	Active	
Elliott B-8 Amoco NESW Sec. 27	4/11/65	5/26/65	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Elliott B-7 Amoco SEME Sec. 27	6/22/64	9/14/64	Active	
Federal 28-1 J. Glenn Turner SESE Sec. 28	9/25/81	11/18/81	Active	
Mansfield #11 El Paso Natural Gas SESW Sec. 29	7/23/72	8/24/72	Active	
Mansfield Com #4 Tenneco Oil NWSE Sec. 30	7/18/81	9/20/81	Active	
Ulibarri Gas Unit #3 Amoco SESW Sec. 35	7/13/65	8/20/65	Active	
Sandoval C-1 Amoco NWNE Sec. 35	12/18/65	2/15/66	Active	
30N-10W				
Schumacher #12 El Paso Natural Gas SWSW Sec. 17	5/20/62	7/19/62	Active	
Schumacher #11 El Paso Natural Gas NESW Sec. 18	3/5/61	4/25/61	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
Schumacher #3 Lynco Oil SWNW Sec. 18	3/19/74	5/25/74	S I	Last produced 8/79
W. H. Riddle #3 Amoco SWSW Sec. 24	8/11/69	10/1/69	Active	
Florance #121 Tenneco Oil SWSW Sec. 24	3/14/80	4/14/80	Active	
29N-8W				
Florance 30 Tenneco SWSW Sec. 1	5/5/62	1/15/63	Active	Dual Comp.: MVRD/DKOT
Gonsales #1 Koch Industries SESE Sec. 1	8/3/80	9/3/80	Active	
Lively #9 Lively Exploration SWSE Sec. 3	4/5/73	5/4/73	Active	
Florance #123 Tenneco SWNW Sec. 3	3/2/80	1/22/81	Active	Dual Comp.: PCCE/DKOT
Pritchard #8 Tenneco Oil SESE Sec. 4	12/5/80	2/19/81	Active	

WELL NAME OPERATOR LOCATION	SPUD DATE	COMP DATE	DAKOTA STATUS	COMMENTS
29N-9W				
Lively #5 Lively Exploration SESE Sec. 1	1/12/73	4/26/73	Active	
Florance 125 Tenneco Oil SWNW Sec. 1	4/28/81	7/27/81	Active	
Lopez Gas Com-1 Amoco Prod. NWNW Sec. 2	12/27/78	3/30/79	Active	

G

TIGHT GAS APPLICATION
NATURAL FLOWRATE TESTS

WELL	LOCATION	PERFORATIONS (GROSS)	RATE(AGAINST ATMOSPHERIC PRESSURE-MCFPD)	DEPTH TO TOP OF DAKOTA	MAXIMUM RATE (FERC GUIDELINES) AT DEPTH(MCFPD)
TURNER COM B #2	NENW 2-30N-9W	7186-7400'	Would not flow	7142	290
RIDDLE COM #8	NESE 18-30N-9W	7257-7492'	109	7208	290
FLORANCE #111	SWNE 19-30N-8W	6776-6992	37	6720	251
S.J.U. 32-7 #43	NWNE 21-32N-7W	Open Hole (T.D. = 7985')	TSTM @ T.D.	7707	336
S.J.U. 32-7 #68	SESE 34-32N-7W	Open Hole (T.D. = 8130')	TSTM @ T.D.	8080	449

Oil ?

TIGHT GAS APPLICATION

EFFECT OF OVERBURDEN PRESSURE AND
WATER SATURATIONS ON CORE PERMEABILITY

WELL	LOCATION	CORE PERMEABILITY (md)	PERMEABILITY ADJUSTMENTS OVERBURDEN	WTR SATURAT	PERMEABILITY INSITU(md)
S.J. 32-7 Unit #37	NWNW 9-32N-7W	.049	.15	.12	.0009
S.J. 32-7 Unit #22	SESW 29-32N-7W	.17	.10	.53	.009
GARTNER #9	NENE 33-30N-8W	.062	.15	.08	.0007

El Paso Natural Gas
San Juan 32-7 Unit #22
SESW-29-32N-7W
San Juan County, New Mexico

DEPTH (ONE FOOT INTERVALS)	PERMEABILITY (AIR) md
7750-51	.01
7751-52	.02
7752-53	.01
7753-54	.01
7784-85	.01
7785-86	.01
7786-87	.01
7787-88	.01
7788-89	3.85
7789-90	.02
7790-91	.02
7791-92	.02
7792-93	.02
7793-94	.61
7794-95	.03
7795-96	.01
7809-10	.01
7810-11	.01
7811-12	.01
7812-13	.01
7813-14	.01
7828-29	.01
7829-30	.54
7830-31	.01
7831-32	.01
7832-33	.01
7860-61	.01
7861-62	.10
7862-63	.02
7863-64	.04
7864-65	.02
7867-68	.08
7868-69	.02
33'	5.59

$$\text{Avg } K = \frac{5.59}{33} = .17$$

CHEMICAL & GEOLOGICAL LABORATORIES

Farmington

CORE ANALYSIS REPORT

Company El Paso Natural Gas Company — Date August 23, 1959 — Lab. No. ____

Well No. San Juan 32-7 No. 22 29 — Location Sec. 29-32N-7W

Field Wildcat — Formation Dakota

County San Juan — Depths 7745' - 7913'

State New Mexico — Drilling Fluid Oil Base

LEGEND

C—Crack, F—Fracture, H—Horizontal, O—Open, NF—No Fracture, IS—Insufficient Sample, S—Slight, St—Stain, V—Vertical, Vu—Vugs

5' deep to log

SAMPLE NO	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY PERCENT	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 15 % ACID
	Core No. 1 7745' - 7767' Recovered 22'									
1	VF	7752-53	8.6	0.01		0	26.0			
2	VF	7753-54	9.6	0.03		0	28.3			
3	VF	7754-55	9.3	0.01		Trace	27.6			
4	VF	7755-56	8.1	0.01		0	26.2			
5	NF	7756-57	8.9	0.02		Trace	30.4			
6	NF	7757-58	7.9	0.01		0	30.4			
7	VF	7758-59	7.6	0.01		0	28.7			
8	VF	7759-60	7.5	0.02		0	27.7	48.0		
9	VF	7760-61	5.6	0.01		Trace	53.8			
10	VF	7761-62	5.1	0.01		0	65.0	50.9		
11	VF	7762-63	2.7	0.01		0	52.5			
12	VF	7763-64	3.3	0.01		0	50.0			
13	VF	7764-65	3.8	0.01		0	62.9			
14	VF	7765-66	1.7	0.01		0	55.3			
	Core No. 2 7767' - 7804' Recovered 37'									
15	NF	7788-89	4.9	0.01		0	33.7	45.3		
16	VF	7789-90	1.8	0.01		0	43.3			
17	VF	7790-91	4.2	0.01		0	24.5			
18	VF	7791-92	2.8	0.01		0	15.3			
19	VF	7792-93	4.9	0.01		0	25.9			
20	VF	7793-94	5.8	3.85		0	15.0			
21	VF	7794-95	5.5	0.02		0	19.5			
22	NF	7795-96	5.2	0.02		0	16.7			
23	NF	7796-97	4.4	0.02		0	17.9			
24	VF	7797-98	3.9	0.02		0	20.0			
25	VF	7798-99	3.8	0.61		0	14.5			
26	VF	7799-7800	6.3	0.03		0	16.8	39.9		
27	VF	7800-01	4.6	0.01		0	15.7			
28	NF	7801-02	4.5	0.02		0	13.8			
29	NF	7802-03	5.3	0.02		0	14.9			
30	VF	7803-04	4.2	0.21		0	14.5			

C—Crack
F—Fracture
H—Horizontal
O—Open

LEGEND

NF—No Fracture

IS—Insufficient Sample

S—Slight
St—Strong
V—Vertical
Vu—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY % PORESPACE	PERMEABILITY M. MILLIDARCIES HORIZONTAL	PERMEABILITY M. MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY M.C.D ACID	SOLUBILITY 15 % ACID
	Core No. 3 7804' - 7819' Recovered 15'									
31	VF	7805-06	5.5	0.03		0	47.3			
32	NF	7806-07	6.0	0.03		0	52.8			
33	NF	7807-08	3.5	0.02		0	49.1			
34	VF	7811-12	6.5	0.02		0	41.1			
35	VF	7812-13	7.5	0.02		0	23.2			
36	VF	7813-14	5.4	0.01		0	19.3			
37	VF	7814-15	8.4	0.01		0	30.5	38.0		
38	VF	7815-16	5.1	0.01		0	41.2			
39	VF	7816-17	3.2	0.01		0	72.5			
40	VF	7817-18	4.9	0.01		0	39.2			
41	VF	7818-19	4.2	0.01		0	46.2			
	Core No. 4 7819' - 7850' Recovered 31'									
42	NF	7828-29	9.8	0.34		0	41.8			
43	NF	7829-30	7.9	0.01		Trace	35.4			
44	VF	7830-31	7.4	0.01		0	43.4			
45	VF	7831-32	3.4	0.62		0	89.6			
46	VF	7832-33	2.8	0.01		Trace	94.7			
47	VF	7833-34	6.0	0.01		Trace	54.0	50.5		
48	VF	7834-35	5.6	0.54		0	61.3			
49	VF	7835-36	5.4	0.01		0	54.1			
50	NF	7836-37	9.9	0.01		Trace	66.9			
51	VF	7837-38	11.8	0.01		0	57.3			
52	NF	7838-39	7.3	0.01		0	67.9			
53	NF	7839-40	1.4	0.04		0	96.0			
54	VF	7840-41	2.9	0.08		0	78.9			
55	NF	7846-47	3.4	0.01		0	72.1			
56	VF	7847-48	9.1	0.34		Trace	45.1			
57	VF	7848-49	11.9	0.06		Trace	50.0			
58	VF	7849-50	8.5	0.03		Trace	41.3			
	Core No. 5 7850' - 7872' Recovered 20'									
59	VC	7850-51	11.0	0.05		Trace	38.3	47.9		
60	NF	7851-52	12.1	0.12		Trace	35.8			
61	NF	7852-53	10.6	0.09		Trace	39.2			
62	NF	7853-54	10.3	0.06		0	40.7			
63	VF,HC	7854-55	9.5	0.13		Trace	34.7	40.9		

C—Crack
F—Fracture
H—Horizontal
O—Open

LEGEND

NF—No Fracture
IS—Insufficient Sample

S—Slight
St—Stain
V—Vertical
Vu—Vugs

SAMPLE NO.	LEGEND	DEPTH, FEET	EFFECTIVE POROSITY % PORE SPACE	PERMEABILITY MILLIDARCIES HORIZONTAL	PERMEABILITY MILLIDARCIES VERTICAL	SATURATIONS % PORE SPACE RESIDUAL OIL	SATURATIONS % PORE SPACE TOTAL WATER	CONNATE WATER	SOLUBILITY MUD ACID	SOLUBILITY 15 % ACID
	Core No. 5 Continued									
64	NF	7855-56	13.6	2.21		Trace	30.3	36.1		
65	NF	7856-57	10.8	0.09		0	39.7			
66	NF	7857-58	9.1	0.04		0	39.9			
67	VHF	7858-59	5.3	0.03		Trace	48.9			
68	HF	7859-60	4.1	0.01		0	53.7			
69	HF	7860-61	4.0	0.01		0	50.0			
70	HF	7861-62	3.0	0.02		Trace	54.3			
71	HF	7862-63	3.2	0.01		0	46.6			
72	NF	7863-64	5.2	0.03		0	35.9			
73	VHF	7864-65	1.5	0.01		0	71.3			
74	VHF	7865-66	1.5	0.01		0	18.0			
75	VHF	7866-67	3.3	0.10		Trace	10.3			
76	HF	7867-68	3.1	0.02		0	15.8			
77	HF	7868-69	3.0	0.04		0	10.0			
78	VF	7869-70	4.5	0.02		0	14.6			
	Core No. 6 7872' - 7878' Recovered 2'									
79	NF	7872-73	3.9	0.08			21.6			
80	HF	7873-74	4.2	0.02			10.8			
	Core No. 7 7880' - 7913' Recovered 31'									
81	HVF	7890-91	3.0	0.01	0	0	55.3			
82	VF	7891-92	3.5	0.03	0	0	41.0			
83	HF	7903-04	1.4	0.02		0	52.1			
84	NF	7906-07	0.5	0.01		0	69.5			
85	HF	7907-08	2.4	0.01		0	36.6			
86	HF	7908-09	1.2	0.03		0	45.0			
87	HF	7909-10	4.7	0.05		0	27.5			

CHEMICAL & GEOLOGICAL LABORATORIES

FARMINGTON NEW MEXICO

CORE SUMMARY AND ESTIMATED RECOVERABLE OIL

CORE SUMMARY

Formation Name		LACTA		
Depth—Feet		7752 - 7762	7786 - 7836	7847 - 7859
Feet of Permeable Productive Formation		10	35	12
Porosity	Minimum	5.1	1.8	5.3
	Maximum	9.6	9.8	13.6
	Weighted Average	7.8	5.2	10.2
Permeability	Minimum	0.01	0.01	0.03
	Maximum	0.03	3.85	2.21
	Weighted Average	0.01	0.02	0.27
Capacity—Average Porosity x Feet Productive Formation		78.0	182.0	122.4
Weighted Average Residual Oil Saturation, % Pore Space		Trace	0	Trace
Weighted Average Total Water Saturation, % Pore Space		34.4	36.0	40.3
Weighted Average Connate Water Saturation, % Pore Space				
Formation Volume Factor				
Probable Type of Production		Gas	Questionalle	Gas & Distillate

Remarks:

ESTIMATED RECOVERABLE OIL

Stock Tank Oil in Place:
- Barrels Space per Acre-Foot
- Barrels Connate Water per Acre-Foot
- Barrels Reservoir Oil per Acre-Foot
- Barrels Stock Tank Oil per Acre-Foot

Solution Gas Drive:
- Barrels per Acre-Foot
- Barrels per Acre

Water Drive:
- Barrels per Acre-Foot
- Barrels per Acre

EL PASO NATURAL GAS
Gartner 9
NENE-33-30N-8W
San Juan County, New Mexico

DEPTH (One foot intervals)	PERMEABILITY(Air)md
7299-7300	.05
7304-05	.03
7309-10	.01
7314-15	.01
7319-20	.01
7392-93	.01
7393-94	.02
7394-95	.01
7395-96	.01
7396-97	.01
7412-13	.08
7413-14	.01
7423-24	.01
7424-25	.01
7425-26	.01
7426-27	.01
7427-28	.01
7428-29	.01
7429-30	.01
7448-49	.05
7449-50	.05
7450-51	.01
7451-52	.01
7458-59	.01
7460-61	.01
7461-62	.01
7463-64	.01
7464-65	.01
7465-66	.01
7466-67	.01

DEPTH (One foot intervals)	PERMEABILITY(Air)md
7472-73	.01
7473-74	.01
7474-75	.52
7477-78	.02
7478-79	.02
7488-89	.01
7489-90	.01
7492-93	.04
7493-94	.12
7494-95	.26
7495-96	.15
7496-97	.16
7497-98	.07
7498-99	.01
7499-7500	.15
7507-08	.01
7508-09	.01
7509-10	.05
7510-11	.01
7511-12	.02
7512-13	.01
7514-15	.01
7515-16	.02
7516-17	.01
7517-18	.01
7518-19	.02
7519-20	.05
7520-21	.03
7521-22	.02
7522-23	.01
7523-24	.01
7524-25	.02
7525-26	.01
7533-34	.01
7534-35	.01
7542-43	.02
7543-44	.01

DEPTH (One foot intervals)	PERMEABILITY(Air)md
7557-58	.01
7558-59	.07
7559-60	.04
7560-61	.01
7561-62	.02
7562-63	.02
7563-64	.01
7564-65	.04
7565-66	.10
7566-67	.07
7567-68	.71
7568-69	.13
7569-70	.02
7570-71	.05
7571-72	.03
7572-73	.19
7573-74	.08
7574-75	.15
7575-76	.01
7576-77	.10
7577-78	.09
7578-79	.31
7579-80	.90
90	5.62

$$\text{AVG K} = \frac{5.62}{90} = .062 \text{ md}$$

Core depths are 10' deep -10 log

CA-20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY — Formation GRANEROS — File RP-3-1527
Well GARTNER 9 — Core Type DIAMOND CONV. — Date Report 10/18/61
Field BASIN DAKOTA — Drilling Fluid WATER BASE MUD — Analysts McCOMAS
County SAN JUAN — State NEW MEXICO — Elev. 6275 DF — Location SEC 33 T30N R8W

Lithological Abbreviations

SAND-SD, DOLOMITE-DOL, ANHYDRITE-ANHY, SANDY-SDY, FINE-FN, CRYSTALLINE-XLN, BROWN-BRN, FRACTURED-FRAC,
SHALE-SH, CHERT-CH, CONGLOMERATE-CONG, SHALY-SHY, MEDIUM-MED, OOLITIC-OOL, GRAY-GY, LAMINATION-LAM,
LIME-LM, GYPSUM-GYP, FOSSILIFEROUS-FOSS, LIMY-LMY, COARSE-CSE, GRANULAR-GRNL, VUGGY-VGY, STYLOLITIC-STY,

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	7309-10	0.05	3.8	0.0	55.2	
2	7314-15	0.03	4.5	0.0	53.4	
3	7319-20	<0.01	4.8	0.0	66.5	
4	7324-25	0.01	4.5	0.0	69.0	VERTICAL FRACTURE
5	7329-30	<0.01	3.0	6.7	73.5	

7290-7330 This interval is non-productive.

26' - Hd SS
Saw For.
Ind Gas - U. Fract
Not optimum

15' - Friable SS
High water

CA-20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY | Formation DAKOTA | File RP-3-1527
Well GARTNER # 9 | Core Type DIAMOND CONV. | Date Report 10/20/61
Field BASIN DAKOTA | Drilling Fluid WATER BASE MUD | Analysts McComas
County SAN JUAN State NEW MEX. Elev 6275 DF Location SEC 33 T30N R8W

Lithological Abbreviations

SAND SD	DOLOMITE DOL	ANHYDRITE ANHY	SANDY SDY	FINE FN	CRYSTALLINE XLN	BROWN BRN	FRACTURED FRAC	SLIGHTLY SLI
SHALE SH	CHERT CH	CONGLOMERATE CONG	SHALY SHY	MEDIUM MED	CHALK CHK	GRAY GY	LAMINATION LAM	VERY V
LIME LM	GYPSUM GYP	FOSSILIFEROUS FOSS	LIMY LMY	COARSE CSE	GRANULAR GRNL	SUGGY SGY	STYLOLITIC STY	WITH W

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
6	7402-03	<0.01	2.0	0.0	95.0	
7	03-04	0.02	2.1	0.0	86.0	
8	04-05	<0.01	1.8	0.0	94.5	
9	05-06	<0.01	2.0	0.0	95.0	
10	06-07	<0.01	3.4	0.0	97.0	
11	7422-23	0.08	1.1	0.0	91.0	
12	23-24	<0.01	2.5	8.0	88.0	

7380-7430 This interval is essentially non-productive.

CA 20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY | Formation DAKOTA | File RP-3-1527
Well GARTNER # 9 | Core Type DIAMOND CONV. | Date Report 10/22/61
Field BASIN DAKOTA | Drilling Fluid WATER BASE MUD | Analysts McCOMAS
County SAN JUAN State NEW MEX | Elev. 6275 DF | Location SEC 33 T30N R8W

Lithological Abbreviations

SAND SD SHALE SH LIME LM | DOLOMITE DOL CHERT CH GYPSUM GYP | ANHYDRITE ANHY CONGLOMERATE CONG FOSSILIFEROUS FOSS | SANDY SDY SHALY SHY LIMY LMY | LIGHT LT MEDIUM MED DARK DK | CALCAREOUS CALC IRON FERR ARGILLACEOUS ARG | BROWN BRN GRAY GY SUGARY SUGY | FRACTURED FRAC LAMINATION LAM OOLITIC OOL | SLIGHT SLTY W FILL W

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
13	7432-33	0.02	2.3	0.0	87.0	
14	33-34	<0.01	3.7	0.0	89.2	
15	34-35	<0.01	4.9	4.1	77.5	
16	35-36	<0.01	4.4	4.5	75.0	
17	36-37	<0.01	4.0	5.0	92.6	
18	37-38	<0.01	4.5	4.4	93.4	
19	38-39	<0.01	3.5	0.0	97.0	
20	39-40	<0.01	1.4	0.0	92.8	
21	40-41	0.02	3.1	0.0	45.0	
22	7458-59	0.05	10.7	0.0	43.0	
23	59-60	0.05	6.5	0.0	43.1	
24	60-61	0.01	7.0	0.0	57.1	
25	61-62	<0.01	2.8	0.0	96.6	
26	7468-69	<0.01	3.9	0.0	94.9	
27	7470-71	<0.01	2.1	0.0	95.2	VERTICAL FRACTURE
28	71-72	<0.01	2.4	0.0	95.8	VERTICAL FRACTURE
29	7473-74	<0.01	2.0	0.0	95.0	VERTICAL FRACTURE
30	74-75	<0.01	0.9	0.0	88.9	VERTICAL FRACTURE
31	75-76	<0.01	0.9	0.0	88.9	VERTICAL FRACTURE
32	76-77	<0.01	1.7	0.0	92.2	VERTICAL FRACTURE
33	7477-78	<0.01	1.8	0.0	94.5	VERTICAL FRACTURE

7430-7480 Although there are three feet in this interval that are capable of producing a small amount of gas, (7458-7461), comercial rates could not be sustained. Therefore; this interval is essentially non-productive.

CA-20

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY Formation DAKOTA File RP-3-1527
Well GARTNER # 9 Core Type DIAMOND CONV. Date Report 10/23/61
Field BASIN DAKOTA Drilling Fluid WATER BASE MUD Analysts McCOMAS
County SAN JUAN State NEW MEXICO Elev. 6275 DF Location SEC 33 T30N R8W

Lithological Abbreviations

SAND-SD SHALE-SH LIME-LM | DOLOMITE-DOL CHERT-CH GYPSUM-GYP | ANHYDRITE-ANHY CONGLOMERATE-CONG FOSSILIFEROUS-FOSS | SANDY-SDY SHALY-SHY LIMY-LMY | FINE-FN MEDIUM-MED COARSE-CSE | CRYSTALLINE-XLN GRAIN-GRN GRANULAR-GRNL | BROWN-BRN GRAY-GY VUGGY-VGY | FRACTURED-FRAC LAMINATION-LAM STYLOLITIC-STY | SLIGHTLY-SLI VERY-V WITH-W

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
34	7482-83	<0.01	2.2	0.0	86.5	
35	83-84	<0.01	2.3	0.0	95.8	
36	84-85	0.52	2.9	0.0	93.0	VERTICAL FRACTURE
37	7487-88	0.02	4.1	0.0	49.0	
38	88-89	0.02	3.0	0.0	67.0	
39	7497-98	<0.01	4.7	0.0	81.0	
40	98-99	<0.01	2.4	0.0	93.4	VERTICAL FRACTURE
41	99-7500	<0.01	1.7	0.0	99.0	VERTICAL FRACTURE

7480-7502 This interval is essentially non-productive.

CA-36

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY | Formation DAKOTA | File RP-3-1527
Well GARTNER # 9 | Core Type DIAMOND CONV. | Date Report 10/24/61
Field BASIN DAKOTA | Drilling Fluid OIL EMULSION MUD | Analysts McCOMAS
County SAN JUAN | State NEW MEXICO | Elev. 6275 DF | Location SEC 33 T30N R8W

Lithological Abbreviations

SAND-SD SHALE-SH LIME-LM | DOLOMITE-DOL CHERT-CH GYPSUM-GYP | ANHYDRITE-ANHY CONGLOMERATE-CONG FOSSILIFEROUS-FOSS | SANDY-SDY SHALY-SHY LIMY-LMY | FINE-FN MEDIUM-MED COARSE-CSE | CRYSTALLINE-XLN CHALKY-CHK GRANULAR-GRNL | BROWN-BRN GRAY-GY VUGGY-VGY | FRACTURED-FRAC LAMINATION-LAM STYLOLITIC-STY | SLIGHTLY-SLY VERY-V WITH-W

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
42	7502-03	0.04	3.3	0.0	66.6	
43	03-04	0.12	6.8	0.0	54.4	
44	04-05	0.26	7.8	0.0	47.5	
45	05-06	0.15	9.0	0.0	38.9	
46	06-07	0.16	10.6	0.0	40.5	
47	07-08	0.07	5.1	0.0	47.1	VERTICAL FRACTURE
48	08-09	<0.01	2.2	9.1	82.0	
49	09-10	0.15	2.2	0.0	95.5	
50	7517-18	0.01	1.4	0.0	92.8	VERTICAL FRACTURE
51	18-19	<0.01	1.4	0.0	71.4	VERTICAL FRACTURE
52	19-20	0.05	1.1	0.0	90.8	VERTICAL FRACTURE
[illegible]	20-21	<0.01	1.7	0.0	94.3	VERTICAL FRACTURE
[illegible]	21-22	0.02	1.1	0.0	90.8	VERTICAL FRACTURE
55	22-23	0.01	0.8	0.0	75.0	VERTICAL FRACTURE
56	7524-25	0.01	1.5	0.0	86.6	VERTICAL FRACTURE
57	25-26	0.02	2.9	21.1	65.5	VERTICAL FRACTURE
58	26-27	<0.01	2.5	0.0	80.0	VERTICAL FRACTURE
59	27-28	<0.01	0.3	0.0	66.6	VERTICAL FRACTURE
60	28-29	0.02	2.8	0.0	78.6	VERTICAL FRACTURE
61	29-30	0.05	7.1	0.0	42.3	VERTICAL FRACTURE
62	30-31	0.03	4.6	0.0	30.4	VERTICAL FRACTURE
63	31-32	0.02	4.0	0.0	35.0	VERTICAL FRACTURE
64	32-33	0.01	1.8	0.0	83.4	VERTICAL FRACTURE
65	33-34	<0.01	2.2	0.0	91.0	VERTICAL FRACTURE
66	34-35	0.02	2.6	0.0	96.2	
67	35-36	<0.01	2.8	7.1	78.5	
68	7543-44	<0.01	1.8	0.0	94.5	VERTICAL FRACTURE
69	44-45	<0.01	2.7	0.0	96.3	VERTICAL FRACTURE
70	7547-48	<0.01	3.6	13.9	83.3	VERTICAL FRACTURE

7502-7548 In this interval there are a total of eight (8) feet that are capable of producing gas. These intervals are 7503-7508 (Permeability 0.15 md/ft average, Porosity 7.9% average, Residual Oil Saturation 0.0% average, and Total Water Saturation 45.7% average), and 7529-7532 (Permeability 0.07 md/ft average, Porosity 5.2% average, Residual Oil Saturation 0.0% average, and Total Water Saturation 35.9% average.). The remainder of the interval 7502-7548 is non-productive.

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

CORE ANALYSIS RESULTS

Company EL PASO NATURAL GAS COMPANY | Formation DAKOTA | File RP-3-1527
Well GARTNER # 9 | Core Type DIAMOND CONV. | Date Report 10/26/61
Field BASIN DAKOTA | Drilling Fluid OIL EMULSION MUD | Analysts McCOMAS
County SAN JUAN | State NEW MEX. | Elev. 6275 DF | Location SEC 33 T30N R8W

Lithological Abbreviations

SAND-SD SHALE-SH LIME-LM | DOLOMITE-DOL CHERT-CH GYPSUM-GYP | ANHYDRITE ANHY CONGLOMERATE CONG FOSSILIFEROUS FOS | SANDY SDY SHALY SHY LIMY-LMY | TIGHT-TI MEDIUM-MED COARSE-CSE | CRYSTALLINE XLN GRAIN GRN GRANULAR GRNL | BROWN BRN GRAY-GY SUGGY-SGY | FRACTURED FRAC LAMINATION-LAM STYLOLITIC-STY | SLIGHTLY-SLI LENS-L WITH-W

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
71	7552-53	0.02	3.2	6.3	50.0	
72	53-54	<0.01	1.5	13.3	66.6	
73	7567-68	0.01	2.6	0.0	6.6	VERTICAL FRACTURE
74	68-69	0.07	3.4	5.9	44.0	" "
75	69-70	0.04	1.6	0.0	25.0	" "
76	70-71	<0.01	1.8	11.1	50.0	" "
77	71-72	0.02	2.0	0.0	20.0	" "
78	72-73	0.02	3.2	0.0	14.5	" "
79	73-74	0.01	1.4	0.0	57.0	" "
80	74-75	0.04	1.3	0.0	61.6	" "
81	75-76	0.10	5.0	0.0	16.0	" "
82	76-77	0.07	7.6	9.2	23.7	" "
83	77-78	0.71	3.9	0.0	20.5	" "
84	78-79	0.13	5.6	0.0	62.5	" "
85	79-80	0.02	3.4	0.0	11.8	" "
86	80-81	0.05	5.3	0.0	15.1	" "
87	81-82	0.03	2.2	0.0	45.4	" "
88	82-83	0.19	3.7	0.0	37.8	" "
89	83-84	0.08	5.2	0.0	15.4	" "
90	84-85	0.15	5.2	0.0	15.4	" "
91	85-86	0.01	3.6	0.0	33.3	" "
92	86-87	0.10	6.1	8.2	23.0	" "
93	87-88	0.09	5.2	0.0	15.4	" "
94	88-89	0.31	9.2	5.4	27.2	" "
95	89-90	0.9	10.9	4.6	30.3	" "
96	90-91	0.21	2.9	0.0	48.3	" "
97	91-92	0.42	9.4	0.0	24.5	" Gas "
98	92-93	0.24	7.5	0.0	62.0	" "
99	93-94	0.52	13.3	0.0	41.4	" H2O "
100	94-95	0.29	11.4	0.0	64.0	" "
101	95-96	0.49	12.2	0.0	68.0	" "
102	96-97	0.11	10.8	0.0	62.0	" "
103	97-98	0.29	10.2	0.0	71.6	" "
104	98-99	1.7	10.5	1.9	72.5	
105	99-7600	3.5	12.4	0.0	63.7	
106	7600-01	0.13	10.5	0.0	53.2	
1	01-02	2.5	15.3	0.0	59.5	

El Paso Natural Gas
San Juan 32-7 No. 37
NWNW Sec. 9, 32N-7W
San Juan County, New Mexico

DEPTH (ONE FOOT INTERVALS)	PERMEABILITY (AIR) md
7768-69	.05
7769-70	.05
7770-71	.17
7771-72	.10
7772-73	.04
7773-74	.02
7774-75	.03
7775-76	.02
7776-77	.03
7777-78	.03
7778-79	.02
7779-80	.02
7780-81	.01
7781-82	.01
7782-83	.01
7783-84	.01
7784-85	.02
7785-86	.01
7818-19	.01
7819-20	.01
7820-21	.01
7821-22	.01
7822-23	.01
7823-24	.03
7824-25	.01
7825-26	.02
7826-27	.01
7827-28	.50
7828-29	.01
7829-30	.01
7830-31	.01
7836-37	.01
7837-38	.01
7888-89	.01

7896-97	.02
7897-98	.01
7898-99	.01
7899-7900	.01
7900-01	.01
7901-02	.01
7902-03	.01
7936-37	.03
7937-38	.01
7940-41	.01
7941-42	.03
7942-43	.01
7943-44	.03
7944-45	.03
7945-46	.02
7946-47	.07
7947048	.03
7948-49	.01
7949-50	.02
7950-51	.01
7951-52	.10
7952-53	.50
7953-54	.03
7954-55	.07
7955-56	.50
59'	2.90

$$\text{Avg } K = \frac{2.90}{59} = .049\text{md}$$

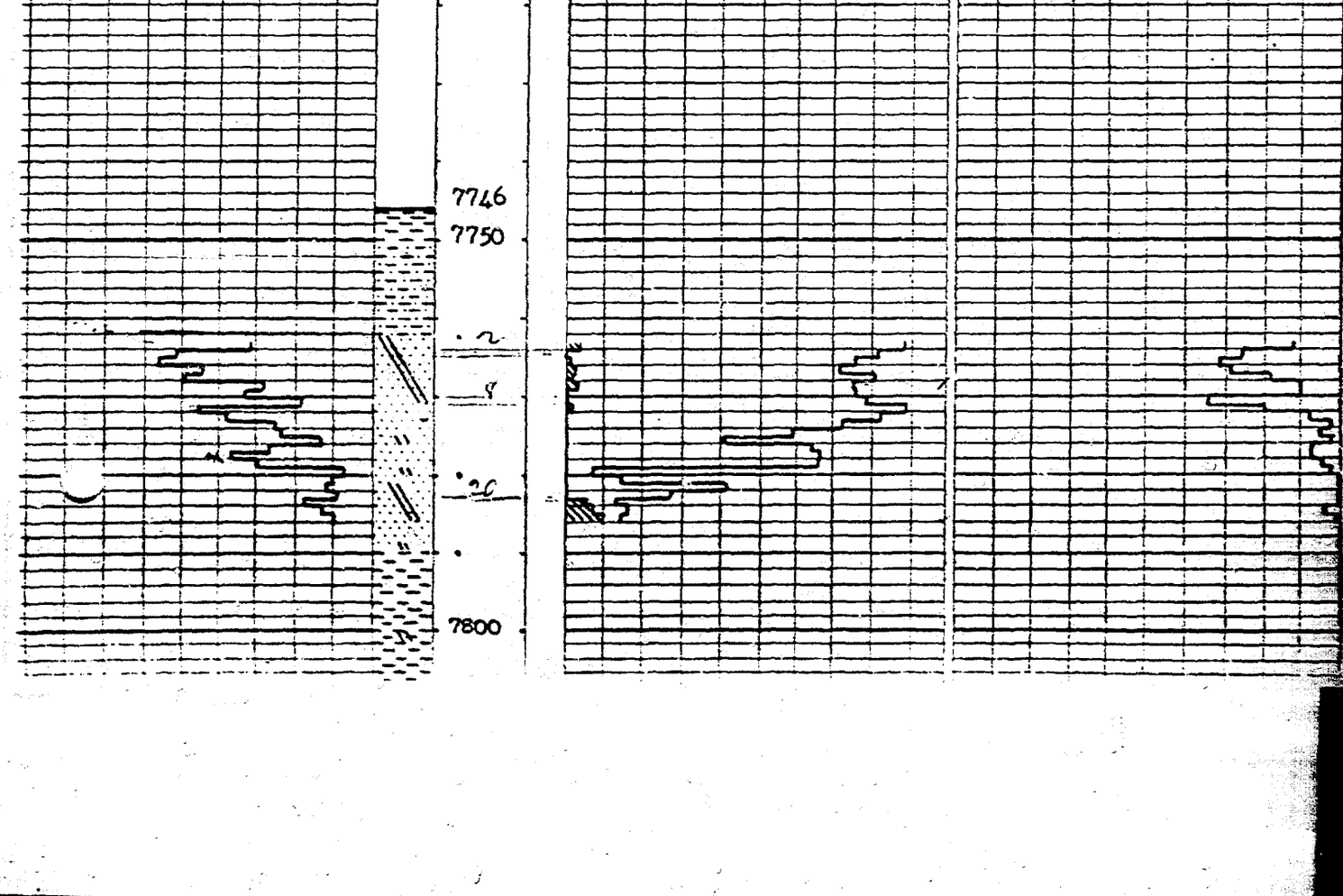
CORE LABORATORIES, INC. CORE LAB *Petroleum Reservoir Engineering*

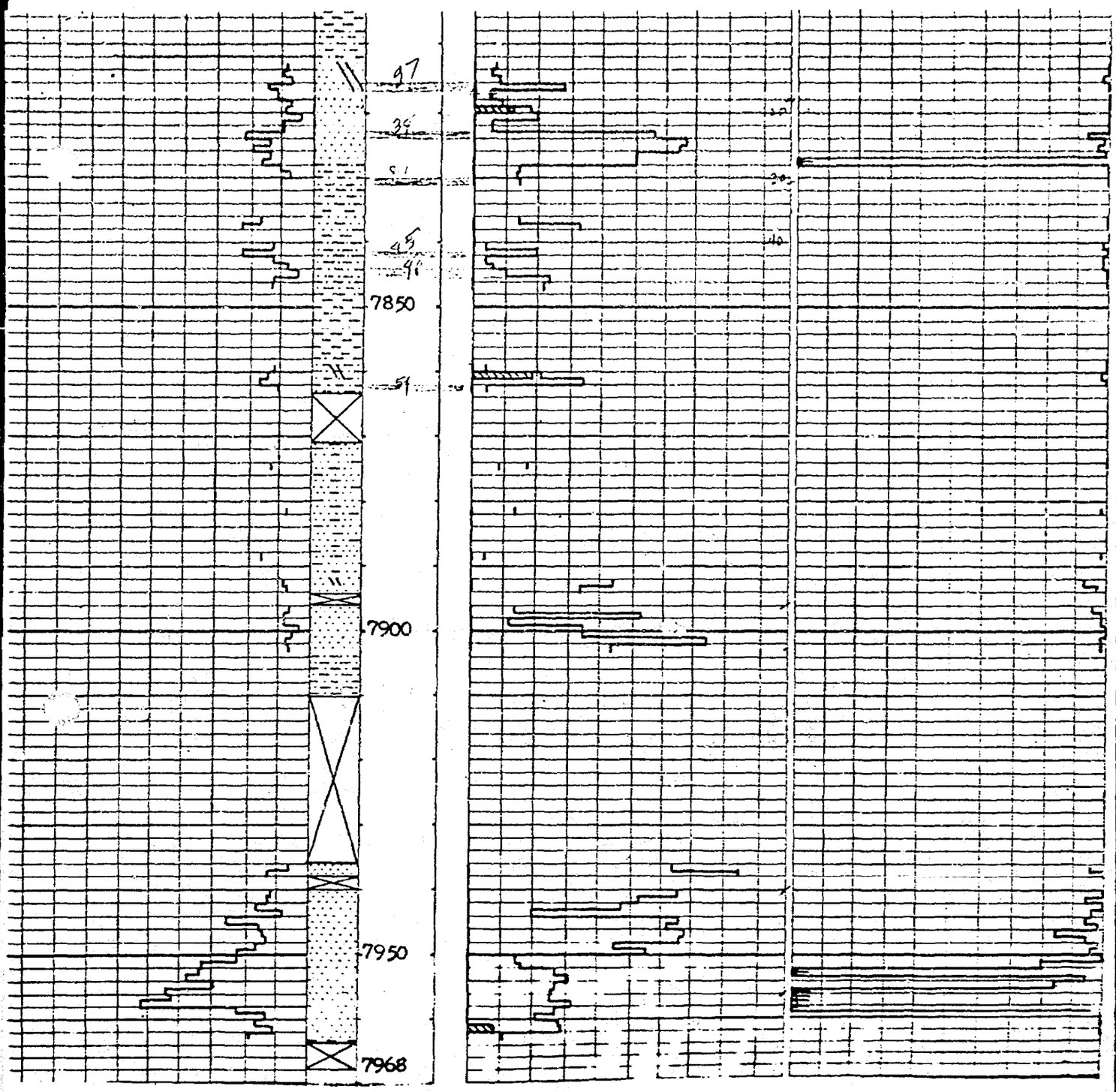
COMPANY	EL PASO NATURAL GAS COMPANY	DATE ON	8/15/62	FILE NO.	RP-3-1663
WELL	SAN JUAN UNIT 32-7 # 37	DATE OFF	8/20/62	ENGRS.	DEPPE
FIELD	BASIN DAKOTA	FORMATION	DAKOTA	ELEV.	6350 KB
COUNTY	SAN JUAN STATE NEW MEX.	DRLG. FLD.	WATER BASE MUD	CORES	DIAMOND CONV.
LOCATION	SEC 9 T32N R7W	REMARKS	SAMPLED BY CLI BY DIRECTION OF CLIENT		

COMPLETION COREGRAPH

SAND | LIMESTONE | CONGLOMERATE | CHERT | SHALE | DOLOMITE | VERTICAL FRACTURES

VERTICAL SCALE: 5" = 100'



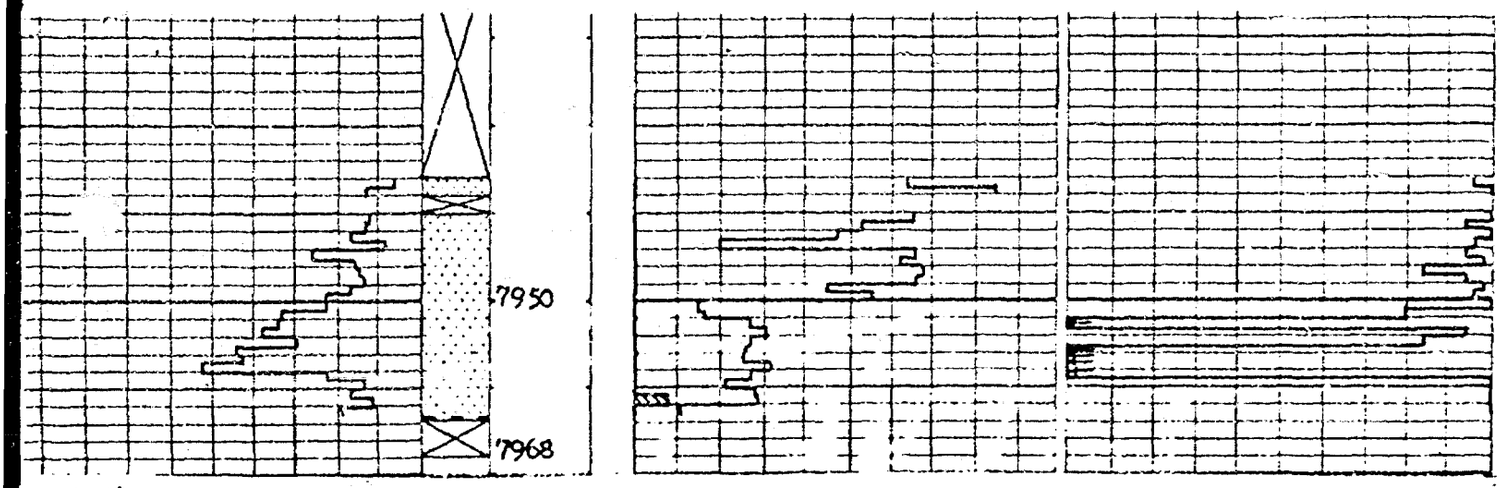


CL-939

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

FORMATION NAME AND DEPTH INTERVAL: Dakota - 7763.0 - 7779.0

FEET OF CORE RECOVERED FROM ABOVE INTERVAL	16	AVERAGE TOTAL WATER SATURATION: PER CENT OF PORE SPACE	27.6
OF CORE CLUDED IN AVERAGES	16	AVERAGE CONNATE WATER SATURATION: PER CENT OF PORE SPACE	
AVERAGE PERMEABILITY: MILLIDARCYS	0.07	OIL GRAVITY: °API	
PRODUCTVE CAPACITY: MILLIDARCY-FEET	1.12	ORIGINAL SOLUTION GAS-OIL RATIO: CUBIC FEET PER BARREL	
AVERAGE POROSITY: PER CENT	6.9	ORIGINAL FORMATION VOLUME FACTOR: BARRELS SATURATED OIL PER BARREL STOCK TANK OIL	



EL-939

CORE SUMMARY AND CALCULATED RECOVERABLE OIL

FORMATION NAME AND DEPTH INTERVAL: Dakota - 7763.0 - 7779.0

FEET OF CORE RECOVERED FROM ABOVE INTERVAL	16	AVERAGE TOTAL WATER SATURATION: PER CENT OF PORE SPACE	27.6
FEET OF CORE INCLUDED IN AVERAGES	16	AVERAGE CONNATE WATER SATURATION: PER CENT OF PORE SPACE	
AVERAGE PERMEABILITY: MILLIDARCYS	0.07	OIL GRAVITY: °API	
PRODUCTVE CAPACITY: MILLIDARCY-FEET	1.12	ORIGINAL SOLUTION GAS-OIL RATIO: CUBIC FEET PER BARREL	
AVERAGE POROSITY: PER CENT	6.9	ORIGINAL FORMATION VOLUME FACTOR: BARRELS SATURATED OIL PER BARREL STOCK-TANK OIL	
AGE RESIDUAL OIL SATURATION: CENT OF PORE SPACE	0.9	CALCULATED ORIGINAL STOCK-TANK OIL IN PLACE: BARRELS PER ACRE-FOOT	

Calculated maximum solution gas drive recovery is barrels per acre-foot, assuming production could be continued until reservoir pressure declined to zero psig. Calculated maximum water drive recovery is barrels per acre-foot, assuming full maintenance of original reservoir pressure, 100% areal and vertical coverage, and continuation of production to 100% water cut. *(Please refer to footnotes for further discussion of recovery estimates.)*

FORMATION NAME AND DEPTH INTERVAL:

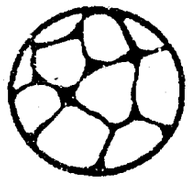
FEET OF CORE RECOVERED FROM ABOVE INTERVAL		AVERAGE TOTAL WATER SATURATION: PER CENT OF PORE SPACE	
FEET OF CORE INCLUDED IN AVERAGES		AVERAGE CONNATE WATER SATURATION: PER CENT OF PORE SPACE	
AVERAGE PERMEABILITY: MILLIDARCYS		OIL GRAVITY: °API	
PRODUCTVE CAPACITY: MILLIDARCY-FEET		ORIGINAL SOLUTION GAS-OIL RATIO: CUBIC FEET PER BARREL	
AVERAGE POROSITY: PER CENT		ORIGINAL FORMATION VOLUME FACTOR: BARRELS SATURATED OIL PER BARREL STOCK-TANK OIL	
AVERAGE RESIDUAL OIL SATURATION: PER CENT OF PORE SPACE		CALCULATED ORIGINAL STOCK-TANK OIL IN PLACE: BARRELS PER ACRE-FOOT	

Calculated maximum solution gas drive recovery is barrels per acre-foot, assuming production could be continued until reservoir pressure declined to zero psig. Calculated maximum water drive recovery is barrels per acre-foot, assuming full maintenance of original reservoir pressure, 100% areal and vertical coverage, and continuation of production to 100% water cut. *(Please refer to footnotes for further discussion of recovery estimates.)*

(c) Calculated (e) Estimated (m) Measured (*) Refer to attached letter.

INTERPRETATION OF DATA

7763.0 - 7779.0 - Interval interpreted to be gas productive with no water cut. Sand Frac stimulation is believed to be necessary to increase the effective permeability of the zone.



Effect of Overburden Pressure and Water Saturation on Gas Permeability of Tight Sandstone Cores

Rex D. Thomas, SPE-AIME, U. S. Bureau of Mines
Don C. Ward, SPE-AIME, U. S. Bureau of Mines

EXHIBIT

Introduction

Research on the potential of nuclear explosions to stimulate gas production from low-permeability (tight) sandstone reservoirs is being conducted by the U. S. Bureau of Mines in cooperation with the Atomic Energy Commission. This report describes the part of that research that was conducted to establish correlation between permeability measured on dry cores at low external pressure (routine analysis) and permeability at reservoir conditions.

Cores used in this research were obtained from two Plowshare gas-stimulation projects. Project Gasbuggy cores from the Pictured Cliffs formation, Choza Mesa field, Rio Arriba County, N. M., can be described as very fine grained, slightly calcareous, well indurated sandstone. Project Wagon Wheel cores from the Fort Union formation, Pinedale field, Sublette County, Wyo., can be described as very fine grained, slightly calcareous, very well indurated sandstone.

Underground reservoirs are under considerable compressive stress as a result of the weight of overlying rocks (offset somewhat by internal-fluid pressure). The resultant net confining pressure or effective overburden pressure is referred to in this report simply as overburden pressure. The resulting effects on the physical properties of the reservoir rock have been studied.[1-5] Overburden pressure causes only a small decrease in porosity, which can usually be ignored.[5] This was confirmed for Project Gasbuggy and Project Wagon Wheel cores. A commercial laboratory found that the porosity of these cores is reduced by about 5 percent of the original porosity. The effect of overburden pressure on permeability, however, is appreciable and varies considerably for different reservoir rocks,[1,2] causing greater reductions in permeability for low-permeability rocks.[2,3] The effect of overburden pressure on relative permeability has been found to be small[4] or nonexistent.[5]

This report presents material that confirms and extends previous research findings on the effect that overburden pressure has upon the permeability of dry cores. Also presented are the results of research on the relative gas permeability of low-permeability cores under overburden pressure.

Apparatus and Procedure

Cylindrical cores 2.0 to 7.5 cm long and 2.5 cm in diameter were cut parallel to the bedding plane. After the cores were dried overnight in a vacuum oven (4.5 psia, 70°C), the gas (N_2) permeability of each core was measured in a Hassler cell. An external pressure of 100 psi over the inlet pressure was used to maintain a good seal between the rubber sleeve and the core.[6] Permeability was measured at inlet pressures of 45, 60, and 100 psia, with atmospheric pressure at the outlet. A bubble tube and timer were used to measure gas flow rate. Initial permeability (K_i) then was calculated by the Klinkenberg technique to correct for the effect of gas slippage. All other permeabilities reported here were calculated by this method.

In the same manner, permeability was measured at

Research conducted to determine the potential of nuclear explosions to stimulate gas production verifies that the gas permeability of tight sandstone cores is markedly decreased with increasing overburden pressure. Water saturation also reduces the gas permeability by a large amount. The relative permeability, however, does not change significantly with overburden pressure.

increasing external pressures of about 500, 1,000, 2,000, 3,000, 4,000, 5,000, and 6,000 psi. External pressures actually were somewhat higher to compensate for internal pressure. The core and staniless steel end pieces were placed in a rubber sleeve (piece of bicycle innertube) 0.1 cm thick. Rubber cement was used to seal the stainless steel end pieces to the rubber sleeve. Shrinkable plastic tubing proved unsatisfactory because high pressure was required to seal the core. The jacketed core was mounted in a high-pressure cell with distilled water as the external fluid.

Cores used in relative permeability studies were first subjected to high external pressure and then allowed to recover their initial permeability. Bulk volume, dry weight, and porosity were measured by conventional gas-expansion techniques. Cores then were subjected to a vacuum (0.3 psia) for 2 hours, immersed in water, and allowed to stand under a vacuum overnight. The cores were weighed and again subjected to vacuum overnight and weighed again to assure complete saturation. Most of the cores were completely saturated after one night. Porosity values calculated on the basis of water saturation are in good agreement with those measured by conventional gas-expansion techniques.

Water in the core was allowed to evaporate at atmospheric conditions to a saturation of about 70 percent and the core was placed in the holder for 2 hours under external pressure (100 psi above inlet) only so the water saturation was uniform. Gas permeability then was measured at three inlet pressures between 30 and 100 psia with atmospheric pressure at the outlet. This procedure was repeated for decreasing water saturations at the same external pressure. After the permeability was measured the core was weighed to determine if any water was lost. In all cases the amount lost was negligible. After the core was dried in a vacuum oven, the gas permeability at this external pressure was measured. The procedure was repeated for external pressures of 3,000 and 6,000 psi.

Results and Discussion

Effect of Overburden Pressure on Permeability

Core number, length, porosity, and initial permeability of the cores used in this research are shown in Table 1. The core number refers to the depth in feet at which the core was obtained. Typical plots of the effect of simulated overburden pressure on Gasbuggy cores are shown in Fig. 1. The permeability is decreased by about 75 percent at an overburden pressure of 3,000 psi and by 90 percent at 6,000 psi. The hydrostatic loading used in these experiments does not reproduce subsurface conditions exactly; in an actual reservoir the horizontal component of stress is usually less than the vertical component. Since the actual loading is not known, this method probably is as realtistic as any other. Cores that contain microfractures are affected to a greater extent, as shown in Fig. 2. In these cores the permeability is decreased by about 95 percent at a simulated overburden pressure of 3,000 psi, with most of the reduction occurring below 2,000 psi.

The data shown in Table 1 and Figs. 1 and 2 were obtained by subjecting the core to successive incre-

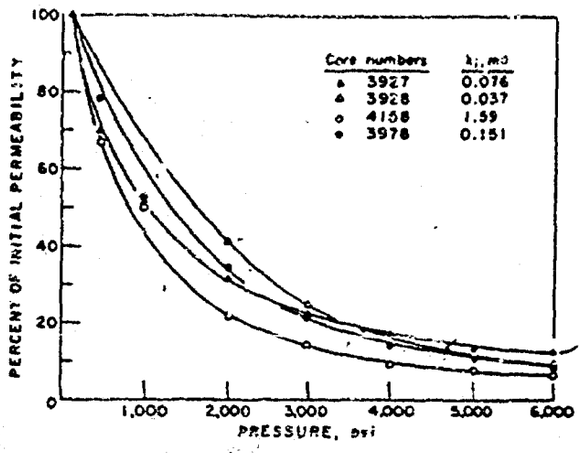


Fig. 1—Effect of overburden pressure on gas permeability of Gasbuggy cores.

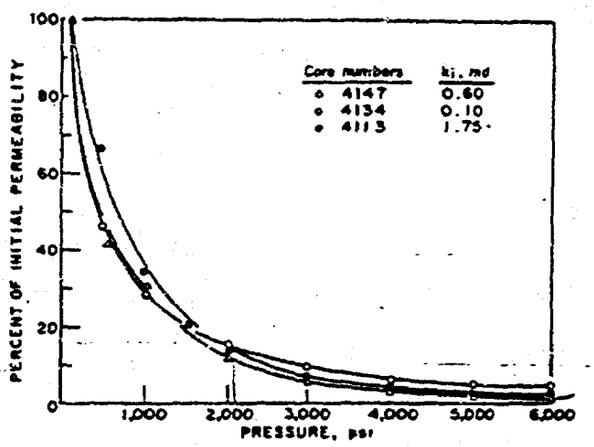


Fig. 2—Effect of overburden pressure on gas permeability of fractured Gasbuggy cores.

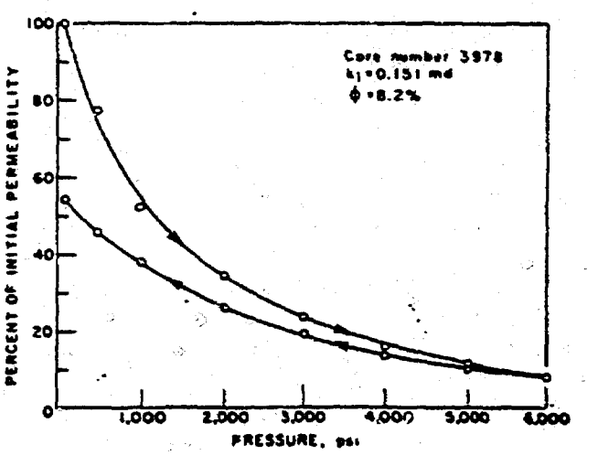


Fig. 3—Hysteresis effect at decreasing confining pressures.

TABLE 1—EFFECT OF OVERBURDEN PRESSURE ON GAS PERMEABILITY

Effective Overburden Pressure (psi):				500	1,000	2,000	3,000	4,000	5,000	6,000
Core Number*	Length (cm)	Porosity (percent)	k_i†	Permeability (md)						
Gasbuggy										
3927	2.1	8.1	0.076	0.053	0.040	0.024	0.0175	0.0132	0.0105	0.0095
3928	7.5	8.3	0.037	0.031	0.024	0.015	0.0093	0.0059	0.0046	0.0035
3978	2.1	8.2	0.151	0.118	0.078	0.052	0.036	0.024	0.0175	0.0132
4113**	2.1	10.1	1.75	1.16	0.602	0.252	0.113	0.068	0.042	0.029
4134**	2.1	11.5	0.10	0.046	0.029	0.0153	0.0095	0.0065	0.0055	0.0047
4146**	7.5	11.6	2.40	1.73	1.32	0.31	0.14	0.069	0.052	0.022
4147**	7.5	11.3	0.60	0.247	0.161	0.071	0.034	0.0186	0.0118	0.0082
4158	2.1	13.6	1.59	1.06	0.80	0.35	0.225	0.152	0.116	0.100
Wagon Wheel										
8084	3.8	7.7	0.028	0.022	0.020	0.010	0.0070	0.0047	0.0035	0.0030
8122	3.8	11.4	0.071	0.055	0.048	0.034	0.027	0.024	0.021	0.019
8975**	3.8	8.7	0.039	0.029	0.024	0.0114	0.0073	0.0048	0.0032	0.0025
10156	3.8	8.5	0.088	0.067	0.051	0.032	0.025	0.022	0.018	0.016
10990**	3.8	9.0	0.048	0.020	0.0175	0.0080	0.0050	0.0040	0.0025	0.0019

*Number denotes depth in feet.
**Slightly fractured.
†Initial permeability.

mental increases in external pressure. The core was assumed to be in equilibrium at each pressure when permeability measurements remained constant for 15 minutes, which required between 1 and 2 hours. A period of 30 minutes to an hour was required to attain equilibrium when the inlet pressure was changed. Consequently, each external pressure was maintained for a minimum of 2 hours.

The effect of decreasing external pressure was determined on a few cores, and typical results are shown in Fig. 3. Other researchers[2,3] have observed and shown that this hysteresis is mainly dependent on the stress history of the core. Cores generally recover their original permeability after 3 to 6 weeks at atmospheric conditions. This time could be shortened by storing the core in an oven at 70°C.

The effect of overburden pressure on the permeability of cores from Project Wagon Wheel is similar to that on cores from Project Gasbuggy, and typical results are shown in Fig. 6. The permeability is decreased to about 30 percent of initial permeability at an overburden pressure of 3,000 psi and to 20 percent at 6,000.

A study of the data in Table 1 indicates that the original porosity of the core and the reduction in permeability caused by overburden pressure are not related. Pore structure (fractures to uniform pores) is probably the governing factor.

Water Saturation Effects

The data in Table 2 show that the permeability decreased with increasing water saturation. The values at 20-, 40-, and 60-percent water saturation were obtained from individual relative-permeability curves for Gasbuggy and Wagon Wheel cores. Relative-permeability curves for three cores from Project Gasbuggy are shown in Fig. 4 with the data points for Core 3978. Data points were omitted for the other cores to avoid confusion. This figure shows that although gas permeability is reduced, the relative gas permeability of Gasbuggy cores is not significantly affected by increased overburden pressure. This conclusion is in agreement with the results of others.[4,5]

Extremely low values of permeability that resulted from water saturation and overburden pressure required that either long flow times or high inlet pressures (high differential across the core) be used. Since a high inlet pressure increases the end effects by changing the distribution of water in the core, long flow times were required. Although end-effect problems were encountered with the short cores (Cores 3978 and 4158), the permeability of these cores was

TABLE 2—EFFECT OF OVERBURDEN PRESSURE AND WATER SATURATION ON GAS PERMEABILITY

Water Saturation (percent):		0	20	40	60
Core Number	Pressure (psi)	Permeability (md)			
Gasbuggy					
3927	100	0.115	0.059	0.041	0.0023
3927	3,000	0.026	0.023	0.009	0.0005
3927	6,000	0.012	0.010	0.003	0.0002
3978	100	0.112	0.080	0.034	0.011
3978	3,000	0.036	0.026	0.011	0.004
3978	6,000	0.013	0.009	0.004	0.0013
4158	100	0.447	0.335	0.156	0.045
4158	3,000	0.075	0.056	0.026	0.0074
4158	6,000	0.027	0.020	0.010	0.0026
Wagon Wheel					
8084	100	0.038	0.030	0.014	0.0042
8084	3,000	0.012	0.0096	0.0043	0.0013
8084	6,000	0.0070	0.0056	0.0025	0.0008
8122	100	0.074	0.054	0.017	0.006
8122	3,000	0.027	0.020	0.008	0.002
8122	6,000	0.020	0.015	0.006	0.002
10156	100	0.100	0.074	0.029	0.009
10156	3,000	0.028	0.020	0.008	0.0008
10156	6,000	0.017	0.013	0.005	0.0005

high enough to yield reasonable results. Permeability measurements for Core 4161 (7.5 cm long, 0.053 md) required more than 2 hours per reading. These extremely long flow times can cause errors.

End effects, long flow times, and changes in permeability due to water saturation tend to decrease the accuracy of permeability measurements, especially at the higher water saturations.

The initial permeability of many of the dry cores used in this research was not reproducible following saturation and drying. The changes probably were caused by solution of material in the pores and by particle movement. These caused both increases and decreases in permeability. The variation, although sometimes large, usually was less than 5 percent; however, we feel that the relative permeability curves are essentially correct. To eliminate the effects of solution and particle movement, the permeability of the dry core following saturation, rather than the permeability initially measured, was used in calculating relative permeability.

A composite of the relative permeability curves for Gasbuggy cores is shown in Fig. 5. These curves are representative of permeabilities encountered in this formation. At a water saturation of 50 percent, the relative permeability of the cores ranges from 15 to 20 percent and is not affected by overburden pressure.

Similar results were obtained on cores from Project Wagon Wheel, as shown in Table 2 and Fig. 6 with data points for Core 8122. These cores were cut to a length of 3.8 cm to alleviate some of the long flow time and end-effect difficulties encountered with Gasbuggy cores. These curves are representative of the permeabilities encountered in the formation. At a water saturation of 50 percent, the relative permeability of these cores ranges from 12 to 21 percent. The data in these figures show, as do the data from Gasbuggy cores, that relative gas permeability is not significantly affected by increased overburden pressure.

Correlation with Nuclear Stimulation Projects

Many of the basin areas of the Rocky Mountain region consist of thick, low-permeability sandstones containing large quantities of natural gas. This type of reservoir has been the object of the AEC's Plowshare Program experiments, Projects Gasbuggy and Rulison, and proposed Projects Wagon Wheel, WASP, and Rio Blanco. Because most wells in these reservoirs have not been commercial, only limited reservoir-analysis and production-test data are available. Reservoir analysis is most difficult because low permeability requires long-term testing. Also, it is difficult to determine permeability and net pay from these tests. Knowledge of the gas permeability is necessary in predicting gas recovery, and because it is not economical to define the characteristics of different strata by well test, it is desirable to be able to relate laboratory-measured permeability to the true in-situ permeability.

Conventional analysis by a commercial laboratory (confirmed in our laboratory) of about 200 Gasbuggy cores gave an average initial gas permeability of 0.16 md on dry cores and an average water saturation of 48 percent. The effective overburden pressure of this

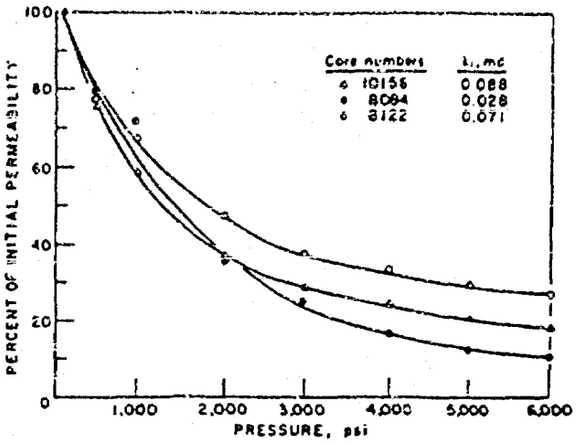


Fig. 4—Effect of overburden pressure on gas permeability of Wagon Wheel cores.

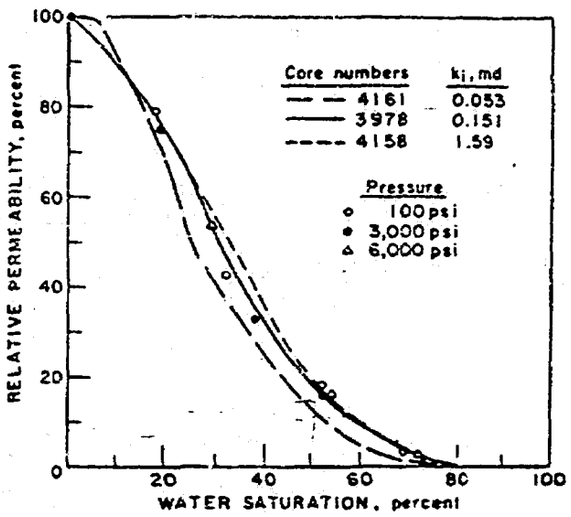


Fig. 5—Relative gas permeability of Gasbuggy cores.

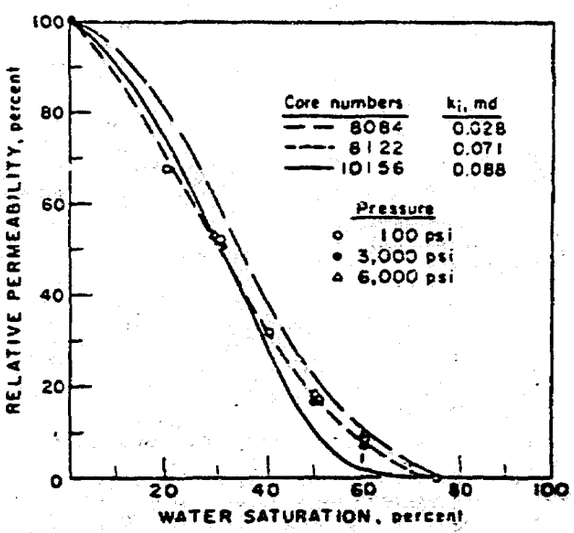


Fig. 6—Relative gas permeability of Wagon Wheel cores.

reservoir is about 3,000 psi. From Fig. 1, the reduction factor resulting from the overburden pressure is 0.25, and the reduction factor for a water saturation of 48 percent (Fig. 5) is 0.20; thus the total reduction is 5 percent of the initial permeability, or 0.008 md. This value compares favorably with permeability determinations of about 0.01 md from both preshot and postshot flow testing at Gasbuggy. The gas reservoir at Project Rulison is similar to that at Gasbuggy, having an average initial dry permeability of 0.11 md and an average water saturation of 45 percent. Simulated in-situ permeability has not yet been measured in the laboratory on Rulison cores; however, using an effective overburden pressure of 5,000 psi and curves of Gasbuggy core data (Figs. 1 and 5), the reduction factor because of overburden pressure would be 0.12 and that for water saturation 0.24. This results in a combined reduction to 3 percent of the initial permeability, or 0.003 md. Postshot production testing at Rulison is not complete, and the only preshot determination of permeability was made from tests of a 32-ft isolated zone that gave an average value of 0.008 md. No cores are available from this zone. Rulison reservoir rock is said to be less compressible than that of Gasbuggy; therefore Gasbuggy pressure-effect data would be expected to indicate a greater reduction for Rulison than actually exists.

The average initial permeability of dry Wagon Wheel cores is 0.068 md, with an average water saturation of 50 percent. An estimated effective overburden pressure of 3,000 psi gives a reduction factor of 0.28 (Fig. 4). Water saturation further reduces permeability by a factor of 0.18 (Fig. 6). Therefore, the total reduction in permeability is to approximately 5 percent of the initial permeability, or 0.0034 md. This value can be used to predict postshot gas recovery from the proposed Wagon Wheel experiment.

Cores are not yet available from Projects Rio Blanco and WASP.

Original manuscript received in Society of Petroleum Engineers office June 16, 1971. Revised manuscript received Dec. 20, 1971. Paper (SPE 3634) was presented at SPE 46th Annual Fall Meeting, held in New Orleans, Oct. 3-6, 1971.

Conclusions

The gas permeability of tight sandstone cores is markedly decreased with increasing overburden pressure. Most of the decrease takes place at pressures to 3,000 psi. At 3,000 psi, the permeability of unfractured samples ranges from 14 to 37 percent of the initial permeability. In fractured samples, permeability may be reduced to as low as 6 percent of initial permeability.

Water saturation also reduces the gas permeability greatly; however, the relative permeability does not change significantly with overburden pressure.

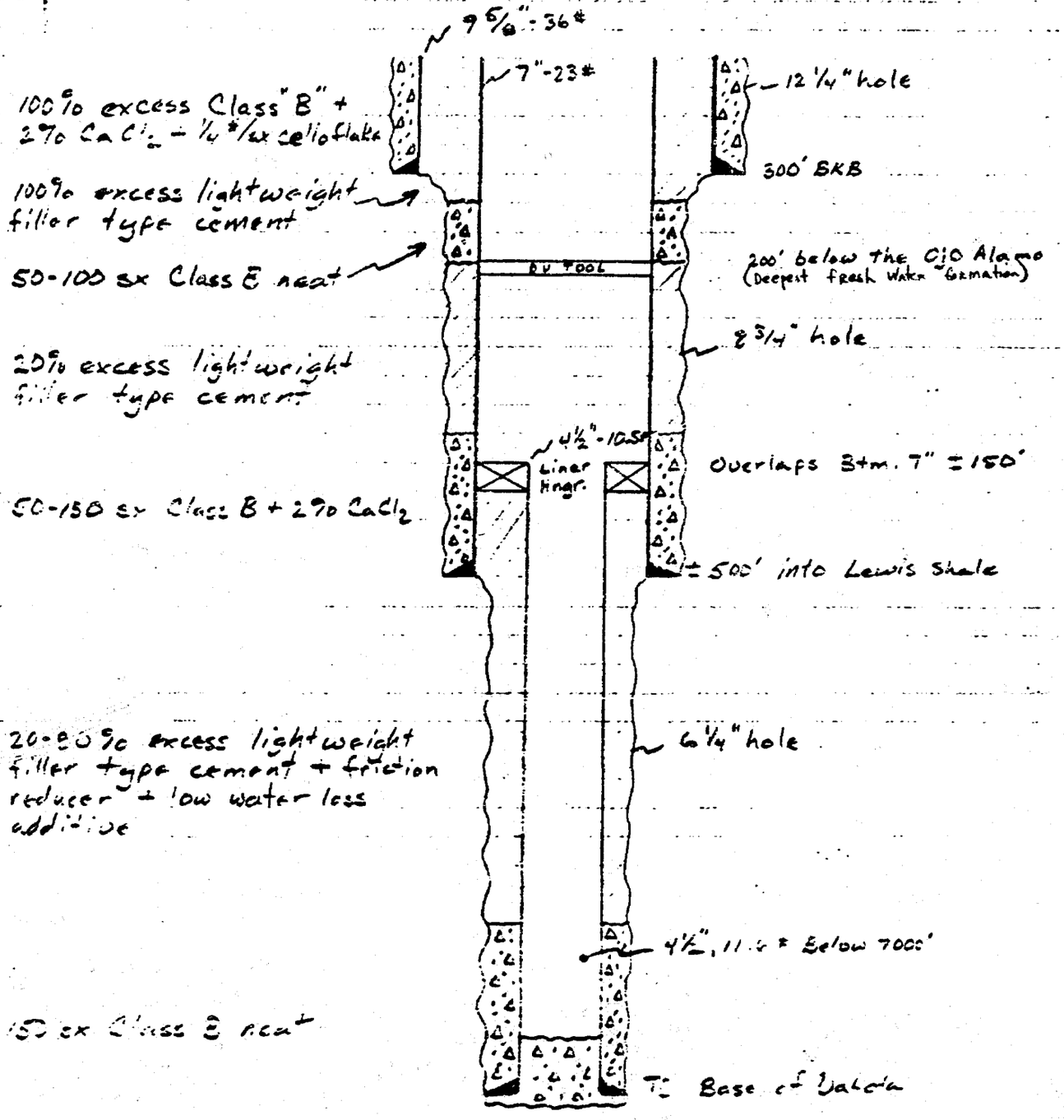
Permeability calculated from laboratory results are in good agreement with in-situ permeabilities determined from production test data. Although not confirmed, predictions for other projects appear to be reasonable.

References

1. Fatt, I. and Davis, T. H.: "The Reduction in Permeability with Overburden Pressure," *Trans.*, AIME (1952) 195, 329.
2. McLatchie, L. S., Hemstock, R. A. and Young, J. W.: "Effective Compressibility of Reservoir Rocks and Its Effects on Permeability," *Trans.*, AIME (1958) 213, 386-388.
3. Vairogs, Juris, Hearn, C. L., Dareing, D. W. and Rhoades, V. W.: "Effect of Rock Stress on Gas Production from Low-Permeability Reservoirs," *J. Pet. Tech.* (Sept., 1971) 1161-1167.
4. Wilson, J. W.: "Determination of Relative Permeability Under Simulated Reservoir Conditions," *AIChE Jour.* (1956) 2, 94.
5. Fatt, I.: "The Effect of Overburden Pressure on Relative Permeability," *Trans.*, AIME (1953) 198, 325-326.
6. *API Recommended Practice for Core-Analysis Procedure*, API RP 40, Dallas (1960) 35.

JPT

TYPICAL DAKOTA WELLBORE SCHEMATIC



TOC

SUPPLEMENTARY EXHIBIT K

APPLICATION AREA PRODUCTION DATA
DAKOTA FORMATION
SAN JUAN COUNTY, NEW MEXICO

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
32N-7W				
SJU 32-7 #55 Northwest Pipeline NESW Sec. 7	7/81	8.9	8904	49
SJU 32-7 #36 Northwest Pipeline NENW Sec. 8	N/A	1100.3	35108	96
Allison Unit #26 El Paso Natural Gas NESE Sec. 9	11/64	323.1	Inactive	-
SJU 32-7 #37 Northwest Pipeline NWNW Sec. 9	7/63	258.0	Inactive	-
Allison Unit 5-A El Paso Natural Gas NESE Sec. 16	9/81	34.9	34863	290
SJU 32-7 #56 Northwest Pipeline SWNW Sec. 17	7/81	12.8	12758	70

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
SJU 32-7 #57 Northwest Pipeline NESE Sec. 17	7/81	19.6	19626	109
SJU 32-7 #58 Northwest Pipeline SWNE Sec. 18	7/81	14.7	14592	81
SJU 32-7 #60 Northwest Pipeline NENE Sec. 20	8/81	17.7	17651	118
SJU 32-7 #43 Northwest Pipeline NWNE Sec. 21	11/73	57.0	3577	10
Allison Unit #18 El Paso Natural Gas NWNE Sec. 25	8/74	198.6	19679	54
SJU 32-7 #34 Northwest Pipeline NENE Sec. 27	1/74	162.5	10474	29
SJU 32-7 #62 Northwest Pipeline SWSW Sec. 27	8/81	20.7	20684	138
SJU 32-7 #63 Northwest Pipeline SWNE Sec. 28	8/81	17.0	16998	113
SJU 32--7 #22 Northwest Pipeline SESW Sec. 29	P & A	-	-	-

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
SJU 32-7 #68 Northwest Pipeline SESE Sec. 34	10/81	13.7	13688	152
SJU 32-7 #69 Northwest Pipeline NWNE Sec. 35	10/81	17.6	17563	195
SJU 32-7 #67 Northwest Pipeline NWSW Sec. 36	Well not yet on production (12/81)			
32N-8W				
Reese Mesa #6 Southland Royalty NWSE Sec. 10	4/81	40.0	39951	148
Reese Mesa #4 Southland Royalty NESW Sec. 11	3/75	187.2	16991	46
Reese Mesa #1 Southland Royalty NENE Sec. 12	5/70	835.4	52839	145
Reese Mesa #2 Southland Royalty NWSW Sec. 12	3/75	493.9	43740	120
Reese Mesa #3 Southland Royalty SENE Sec. 13	2/75	206.6	20082	55

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Reese Mesa #5 Southland Royalty NENW Sec. 13	6/80	16.0	7896	22
Trail Canyon #1 Southland Royalty SWSW Sec. 21	P & A	-	-	-
Wilmer Canyon #1 Southland Royalty SWSW Sec. 24	P & A	-	-	-
Schalk #94 John E. Schalk NENE Sec. 26	3/75	31.4	1330	4
Rattlesnake Canyon #1 Southland Royalty SESW Sec. 32	P & A	-	-	-
Albino Canyon #1 Southland Royalty SWSW Sec. 36	P & A	-	-	-
32N-9W				
SJU 32-9 #70X El Paso Natural Gas SENE Sec. 21	TA	-	-	-

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
31N-8W				
Oxnard #1-A Supron Energy NENW Sec. 8	5/81	7.8	7775	32
Oxnard 3-A Supron Energy SESE Sec. 8	11/81	10.1	10140	169
SJU 32-8 #35 El Paso Natural Gas SWSW Sec. 13	P & A	-	-	-
Quinn 7-A Supron Energy SESE Sec. 17	4/81	11.9	11946	44
Quinn 4-A Supron Energy NESE Sec. 19	Well not yet on production (12/81)			
Quinn 6-A Supron Energy SESE Sec. 20	8/79	64.9	13656	37
SJU 32-8 #12A Northwest Pipeline SWNW Sec. 21	11/81	10.1	10112	168
Fletcher #2 Tenneco Oil SWSE Sec. 29	12/79	62.6	20350	56

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Howell D-5 El Paso Natural Gas NESE Sec. 31	11/80	312.8	263226	721
Fletcher #1 Tenneco Oil SWSW Sec. 33	10/68	213.2	14321	39
Hale #4 Southland Royalty SENE Sec. 34	1/69	95.2(1978)	Inactive	
Hale #5 Southland Royalty SWSW Sec. 34	4/80	73.2	31987	88
31N-9W				
Nordhaus 6-A Supron Energy NWNW Sec. 1	11/81	2.8	2835	47
Nordhaus 2-A Supron Energy NENW Sec. 11	11/80	17.9	12911	35
Nordhaus 5-A Supron Energy SENW Sec. 12	11/81	3.5	3466	58
Barrett #1 Tenneco NWSW Sec. 20	P & A (4-15-73)	52.3		

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Barrett A-1 Tenneco Oil SESE Sec. 20	11/80	163.3	126868	348
Riddle B-1 Tenneco Oil SWSW Sec. 22	2/81	16.6	16603	50
Hunsaker #2-R Supron Energy NWNE Sec. 26	1/79	83.5	15294	42
Sheets Com #1 Tenneco Oil NWNE Sec. 29	1/80	54.1	21673	59
Pritchard #5 Tenneco Oil NWNE Sec. 34	11/77	280.2	62687	172
Pritchard #6 Tenneco Oil NWSW Sec. 34	12/79	99.8	36052	99
30N-8W				
State Com AM #37 Mesa Petroleum SWNW Sec. 2	1/69	563.3	6173	17
Florance #37 Tenneco Oil SENE Sec. 6	P & A	-	-	-

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Moore #1 Jerome McHugh NENE Sec. 7	9/68	207.4	5220	14
Moore #1 Tenneco Oil SESW Sec. 8	12/65	138.6	4858	13
Lawson #1R Tenneco Oil NWSW Sec. 10	Well not yet on production (12/81)			
Florance #50 Tenneco SENW Sec. 14	8/65	233.6(as of 1/76)	P & A'd (12/15/75)	
Florance #35 Tenneco Oil NENE Sec. 18	5/66	307.2	7699	21
Florance 111 Tenneco SWNE Sec. 19	Well not yet on production (12/81)			
Patterson #1 Tenneco Oil NESE Sec. 20	Well not yet on production (12/81)			
Florance #40 Tenneco Oil SWNE Sec. 21	12/65	121.1	15105	41
Florance #29 Tenneco Oil NESW Sec. 25	11/65	265.6	12127	33

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Florance #46 Tenneco SENE Sec. 29	P & A	-	-	-
Lively #25 Lively Expl. NWSW Sec. 29	3/76	132.7	14935	41
Gartner #3 Tenneco Oil SENE Sec. 31	10/80	91.4	46487	127
Florance #44 Tenneco Oil SENE Sec. 31	12/65	113.2	13018	36
Lively #15 Lively Expl. SENE Sec. 32	8/73	285.0	17373	48
Gartner #9 El Paso Natural Gas NENE Sec. 32	2/62	213.7	4465	12
Lively #14 Lively Expl. SWNW Sec. 36	3/74	217.2	10689	29
30N-9W				
Pritchard #1 Tenneco Oil SWSW Sec. 1	12/69	28.4(1973)	TA	

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Turner-B Com #2 Tenneco Oil NENW Sec. 2	7/81	23.3	23266	129
Florance #19 Tenneco SENE Sec. 3	10/65	766.0	20014	55
Florance #16 Tenneco Oil NENE Sec. 6	12/65	159.9	7889	22
Elliott Gas Com-X #1 Amoco Prod. NESE Sec. 9	5/79	54.6	12624	35
Florance #122 Tenneco Oil SWNW Sec. 10	10/81	6.6	6582	73
Florance #114 Tenneco Oil NWSW Sec. 11	11/80	27.1	18789	51
Florance 9-A Tenneco Oil NWSE Sec. 13	P & A	-	-	-
Florance #8 Tenneco Oil SESW Sec. 14	12/65	57.6	2780	8
Florance #13 Tenneco Oil NWNE Sec. 18	TA	-	-	-

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Riddle Com #8 Tenneco Oil NESE Sec. 18	Well not yet on production (12/81)			
Mansfield #1 Tenneco Oil SESE Sec. 19	4/66	317.3(as of 1-77)		
Florance #2 Tenneco Oil NENE Sec. 20	12/65	143.5(as of 7-80)		
Lively #30 Lively Expl. SWSW Sec. 20	5/76	252.3	25866	71
Florance #49 Tenneco SWSE Sec. 22	8/65	215.5(as of 1-74)		
Florance #5 Tenneco Oil NENE Sec. 22	2/66	152.7	7005	19
Florance #6 Tenneco Oil SWSW Sec. 23	12/65	384.6	18146	50
Florance #20 Tenneco Oil NWNE Sec. 24	12/65	243.5	9449	26
Jacques #3 Tenneco Oil SWNW Sec. 25	Well not yet on production (12/81)			

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Elliott B-9 Amoco NESW Sec. 26	9/65	282.5	10918	30
Elliott B-8 Amoco NESW Sec. 27	8/65	543.9	10892	30
Elliott B-7 Amoco SEME Sec. 27	1/65	394.9	14542	40
Lindsey B #1 Tenneco SWSW 28	7/80	146.1	84221	231
Federal 28-1 J. Glenn Turner SESE Sec. 28	Well not yet on production (12/81)			
Mansfield #11 El Paso Natural Gas SESW Sec. 29	9/72	401.8	13210	36
Mansfield Com #4 Tenneco Oil NWSE Sec. 30	Well not yet on production (12/81)			
Ulibarri Gas Unit #3 Amoco SESW Sec. 35	11/65	620.5	25909	71

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Sandoval C-1 Amoco NWNE Sec. 35	4/66	197.6	10583	29
30N-10W				
Schumacher #12 El Paso Natural Gas SWSW Sec. 17	2/63	603.8	22826	62
Schumacher #11 El Paso Natural Gas NESW Sec. 18	7/61	639.5	20822	57
Schumacher #3 Lynco Oil SWNW Sec. 18	8/74	540.6(1/80)	-	-
W. H. Riddle #3 Amoco SWSW Sec. 24	11/69	915.0	51475	141
Florance #121 Tenneco Oil SWSW Sec. 24	10/80	119.9	84509	231
29N-8W				
Florance 30 Tenneco SWSW Sec. 1	10/65	428.3	15518	42

WELL NAME OPERATOR LOCATION	DATE OF FIRST PROD	CUMMULATIVE AS OF 1-1-82 MMCF	1981 CUMMULATIVE MCF	1981 AVG DAILY RATE - MCFPD
Gonzales #1 Koch Industries SESE Sec. 1	3/81	62.7	62662	232
Lively #9 Lively Exploration SWSE Sec. 3	7/73	182.9	7236	20
Florance #123 Tenneco SWNW Sec. 3	10/80	158.3	90906	249
Pritchard #8 Tenneco Oil SESE Sec. 4	11/81	43.7	43678	728
29N-9W				
Lively #5 Lively Exploration SESE Sec. 1	6/73	62.3	3739	10
Florance 125 Tenneco Oil SWNW Sec. 1	10/81	13.8	13828	154
Lopez Gas Com-1 Amoco Prod. NWNW Sec. 2	5/79	156.0	44073	121

SUPPLEMENTARY EXHIBIT L-1, 2, 3

ESTIMATED ULTIMATE RECOVERIES

INSIDE AND IMMEDIATELY OUTSIDE WINDOWS

SAN JUAN DAKOTA TIGHT GAS AREA

SUPPLEMENTARY EXHIBIT L-1

WINDOW 30N-8W SECTIONS 3-5 AND 31N-8W SECTION 32

WELLS INSIDE WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY (MMCF)
EPNG Com 1 #10 EPNG SENW 32-31N-8W	880
State Com AL #36E Mesa NWNE 32-31N-8W	350
State Com AL #36 Mesa SWSE 32-31N-8W	1820
Moore #1 Koch NENW 5-30N-8W	325
Moore #6 Tenneco NENE 5-30N-8W	2475
Moore #6E Tenneco NWNE 5-30N-8W	130
Howell A #4 EPNG SWNW 4-30N-8W	1120
Moore #7 Tenneco NENE 4-30N-8W	950
Howell #1E Koch NENW 3-30N-8W	435
Florance #36 Tenneco SENE 3-30N-8W	1200
Howell #1 Koch SWSW 3-30N-8W	2980
Florance #36E Tenneco SESE 3-30N-8W	330

Cumulative = 12995 MMCF

Avg Cum Per Well $\frac{12995}{12}$ = 1083 MMCF

WELLS IMMEDIATELY SURROUNDING WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY (MMCF)
Hale #5 Southland Royalty SWSW 34-31N-8W	300
Fletcher #1 Tenneco SWSW 33-31N-8W	300
Fletcher #2 Tenneco SWSE 29-31N-8W	300
Howell D #5 EPNG NESE 31-31N-8W	1560
Florance #37 Tenneco SENE 6-30N-8W	0(D&A)
Moore #1 McHugh NENE 7-30N-8W	250
State Com AM #37 Mesa SWNW 2-30N-8W	620

Cumulative = 3330 MMCF

Avg Cum Per Well $\frac{3330}{7}$ = 476 MMCF

2351 PLOT SYMBOLS — WHSIP = O, BHPZ = Z, Common = C

GHOS TOTAL MMCF/G = R (RATE LIM SCALE ON RIGHT SIDE)

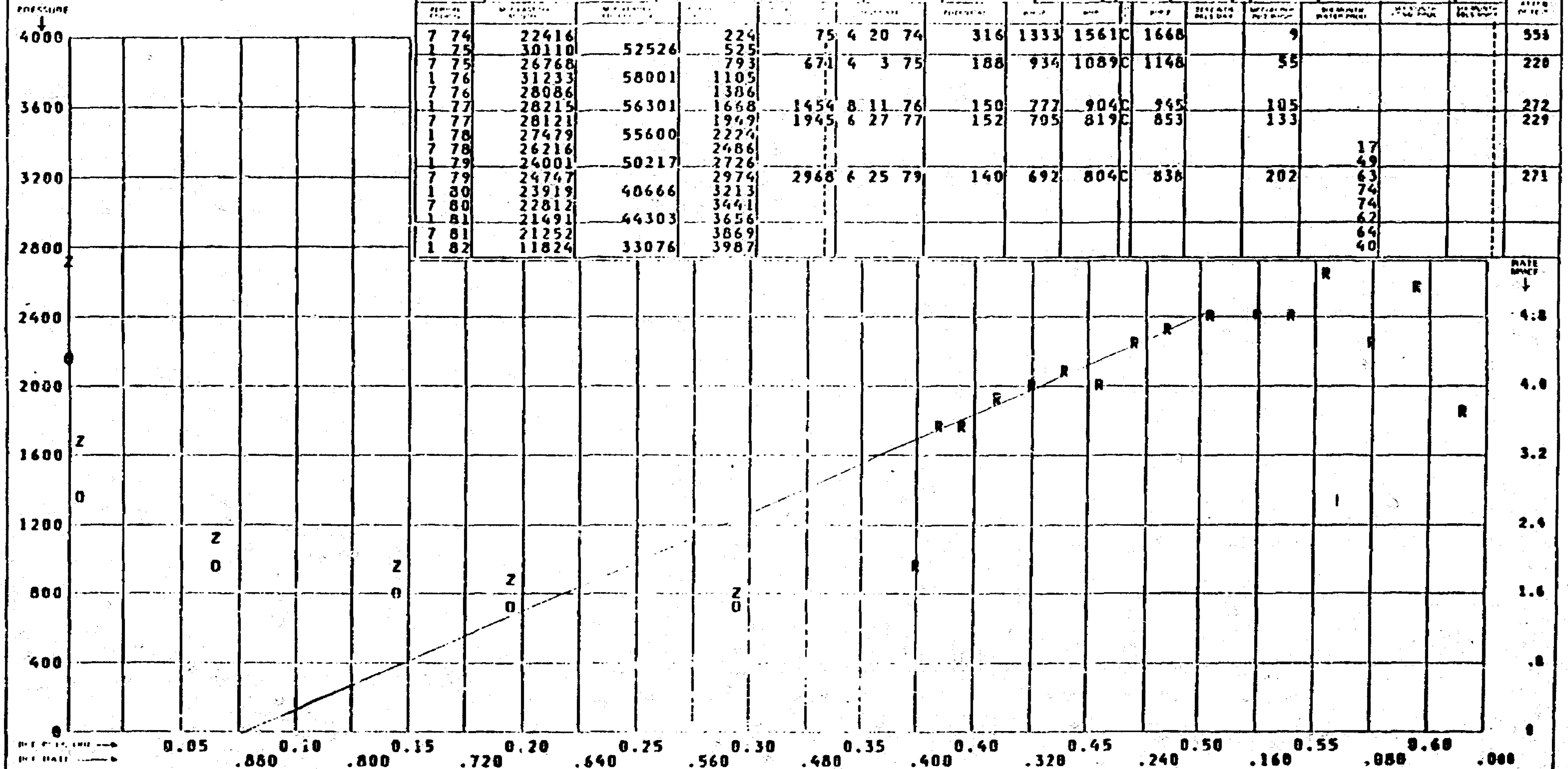
TEMP GRAD 2.250

PAGE NO 4479

431N08W32F00DK	32F 31N 08	WEL PASO NATURAL GAS CO	EPNG COM I		10
NEW MEXICO	8004950	BASIN DAKOTA (PRORATED GAS)	ACT	EPG	EPG 21304

4	SAN JUAN	120373	03-74	.59	120373	2392	2164	.750	2745C	7987	7724- 7922

7 74	22416		224	75	4 20 74	316	1333	1561	C	1668		9				558
1 75	30110	52526	525													
7 75	26768		793	671	4 3 75	188	934	1089	C	1148		55				220
1 76	31233	58001	1105													
7 76	28086		1386													
1 77	28215	56301	1668	1454	8 11 76	150	777	904	C	945		105				272
7 77	28121		1949	1945	6 27 77	152	705	819	C	853		133				229
1 78	27479	55600	2224													
7 78	26216		2486										17			
1 79	24001	50217	2726										49			
7 79	24747		2974	2968	6 25 79	140	692	804	C	838		202	63			271
1 80	23919	48666	3213										74			
7 80	22812		3441										74			
1 81	21491	44303	3656										62			
7 81	21252		3869										64			
1 82	11824	33076	3987										40			



J51 | PAGE NO 4480 | 431N08W32G00DK 32G 31N 08W MESA PETROLEUM CO | STATE COM AL | 36E

WHSIP = O
BHPZZ = Z
Common = C

6 MOS TOTAL MMCF/G = R
(RATE/CUM SCALE ON RIGHT SIDE)

2.250

NEW MEXICO | 8004950 BASIN DAKOTA (PRORATED GAS) | ACT | EPG | PER

4 | SAN JUAN | 111880 | 12-80 | 111880 | 2763 | - | 7821 | -

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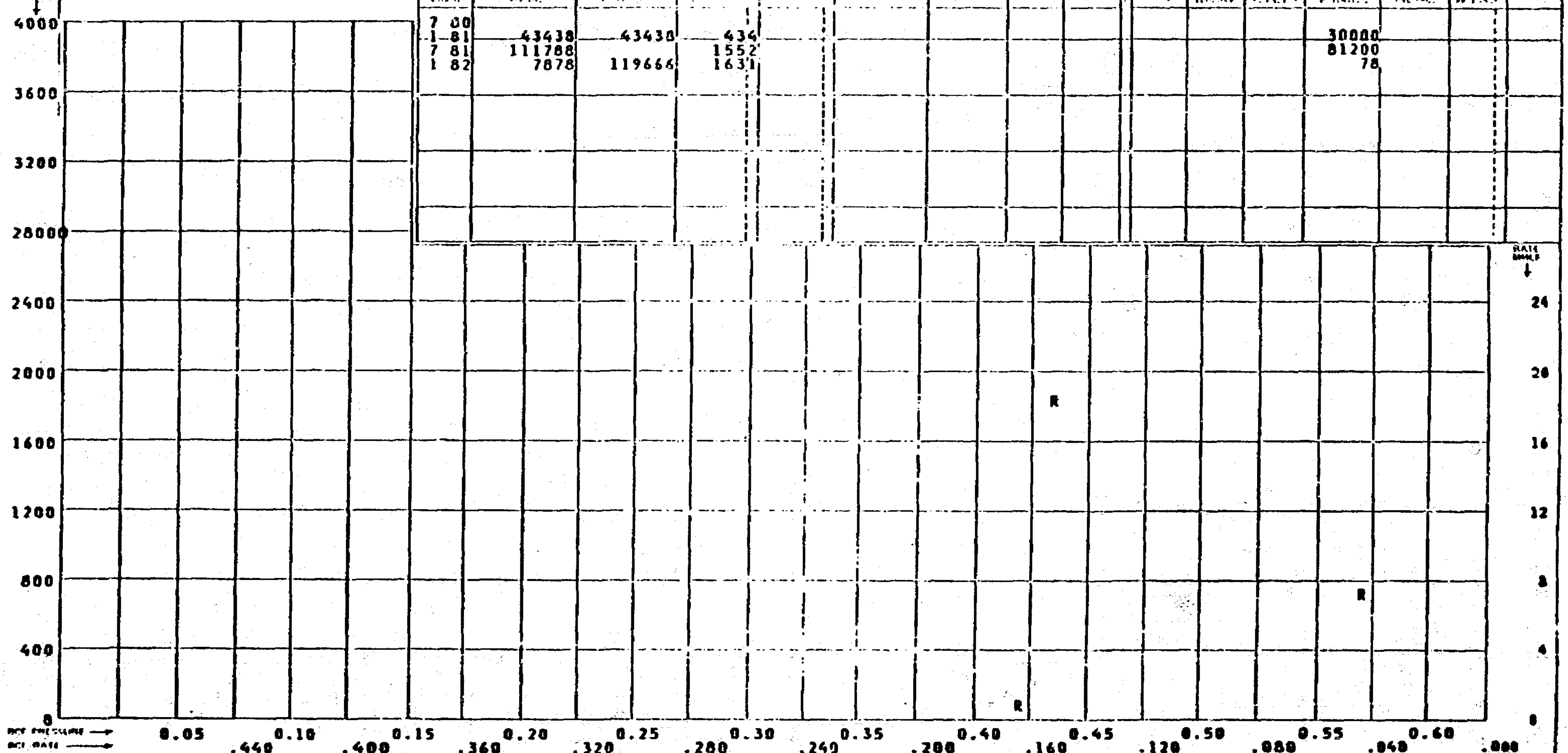
7 81	111788		1552	81200
1 82	7878	119666	1631	78



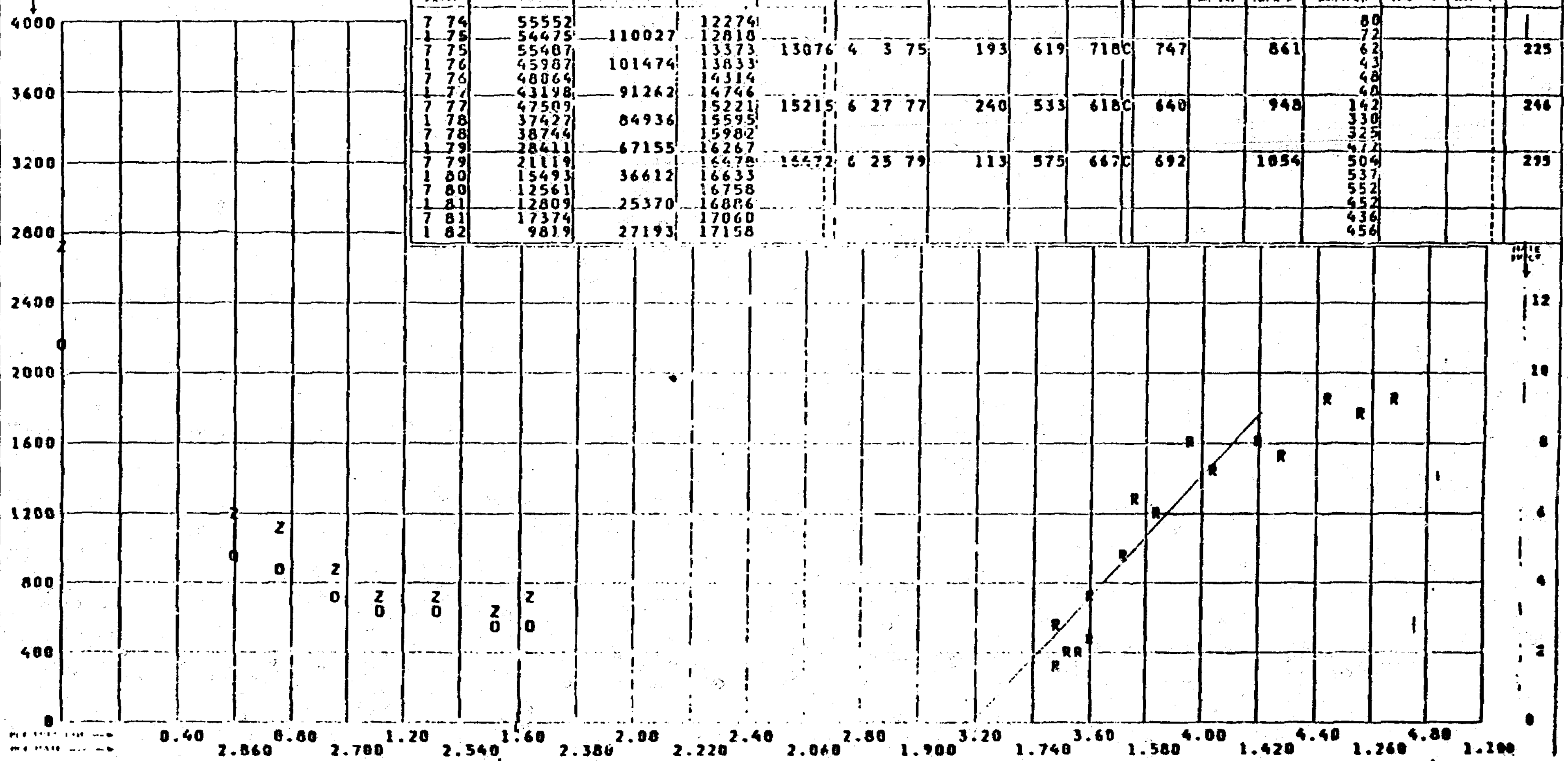
2351 PLOT SYMBOLS — P/Z = Z — Common = C — RATE/CUM SCALE ON RIGHT SIDE — TEMP GRAD. 2.250 — PAGE NO 4481

431N08W32000DK 320 31N 08W MESA PETROLEUM CO — STATE COM AL — 36

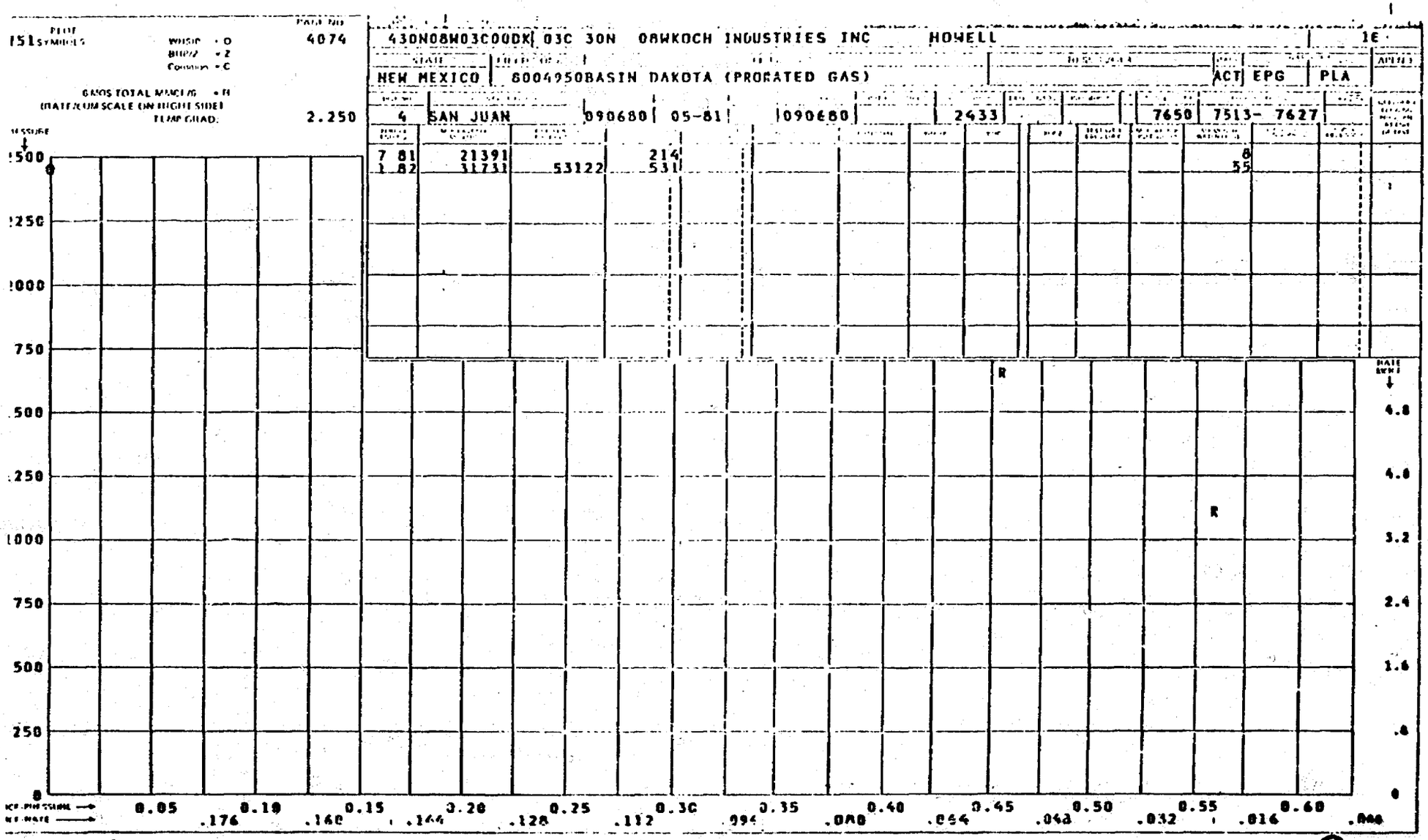
NEW MEXICO — 8004950 BASIN DAKOTA (PRORATED GAS) — ACT EPG PER 12090

4 SAN JUAN — 081067 — 11-67 — .60 — 081067 — 4015 — 2138 — .750 — 2733C — 7755 — 7518- 7698

7 74	55552		12274									80			
1 75	54475	110027	12818									72			
7 75	55407		13373	13076	4 3 75	193	619	718C	747		861	62			225
1 76	45987	101474	13833									43			
7 76	48064		14314									48			
1 77	43198	91262	14746									40			
7 77	47509		15221	15215	6 27 77	240	533	618C	640		948	142			246
1 78	37427	84936	15595									330			
7 78	38744		15982									325			
1 79	28411	67155	16267									472			
7 79	21119		16478	16472	6 25 79	113	575	667C	692		1054	504			295
1 80	15493	36612	16633									537			
7 80	12561		16758									552			
1 81	12809	25370	16886									452			
7 81	17374		17060									436			
1 82	9819	27193	17158									456			



RICHARDSON, TEXAS


430N08W03C00DX 03C 30N 08WKOCH INDUSTRIES INC HOWELL 1E
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS) ACT EPG PLA
4074
2.250
4 SAN JUAN 090680 05-81 090680 2433 7650 7513- 7627
7 81 21391 214 8
1 82 31731 53122 531 55
1500
1250
1000
750
500
250
1000
750
500
250
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4.8
4.0
3.2
2.4
1.6
.8
0
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
.176 .160 .144 .128 .112 .096 .080 .064 .048 .032 .016 .000

2J51 PLOT SYMBOLS WHSIP = O, BHP/Z = Z, Common = C

6 MOS TOTAL MMCF/M = R (RATE/CUM SCALE ON RIGHT SIDE)

TEMP GRAD 2.250

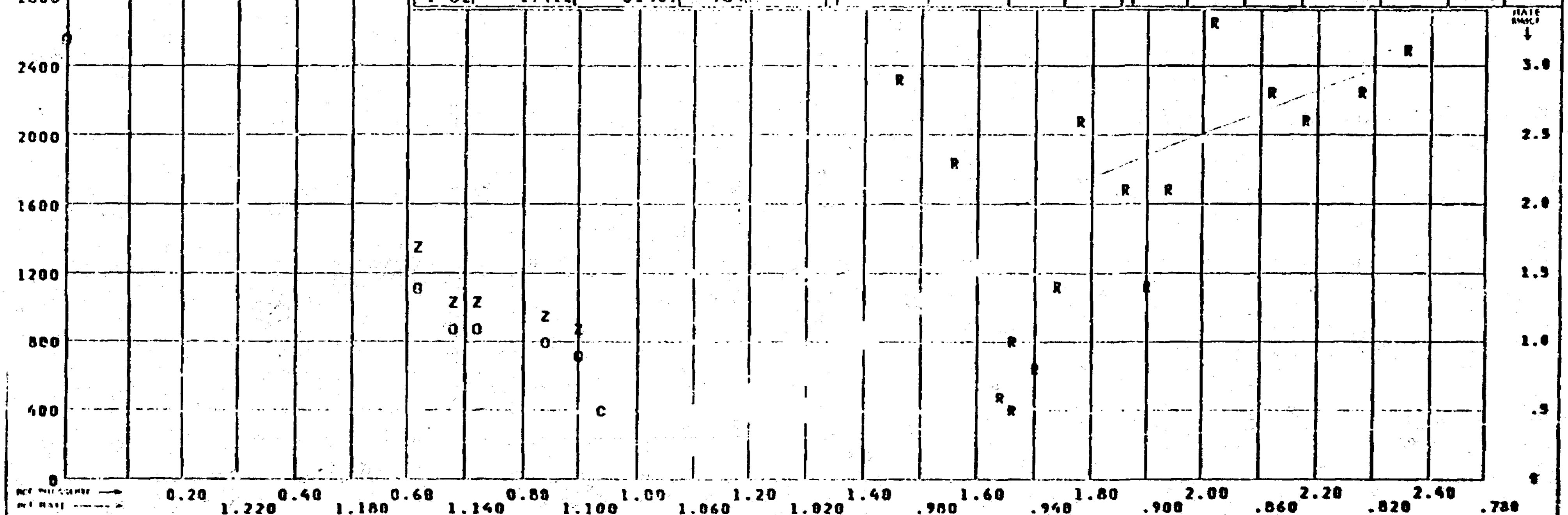
PAGE NO. 4075

430N08W03H00DK 03H 30N 08WTENNECO OIL CO FLORANCE 36.

NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS) ACT EPG PLA 9986

4 SAN JUAN 102465 .59 102465 6850 2538 3214C 7830 7574- 7754

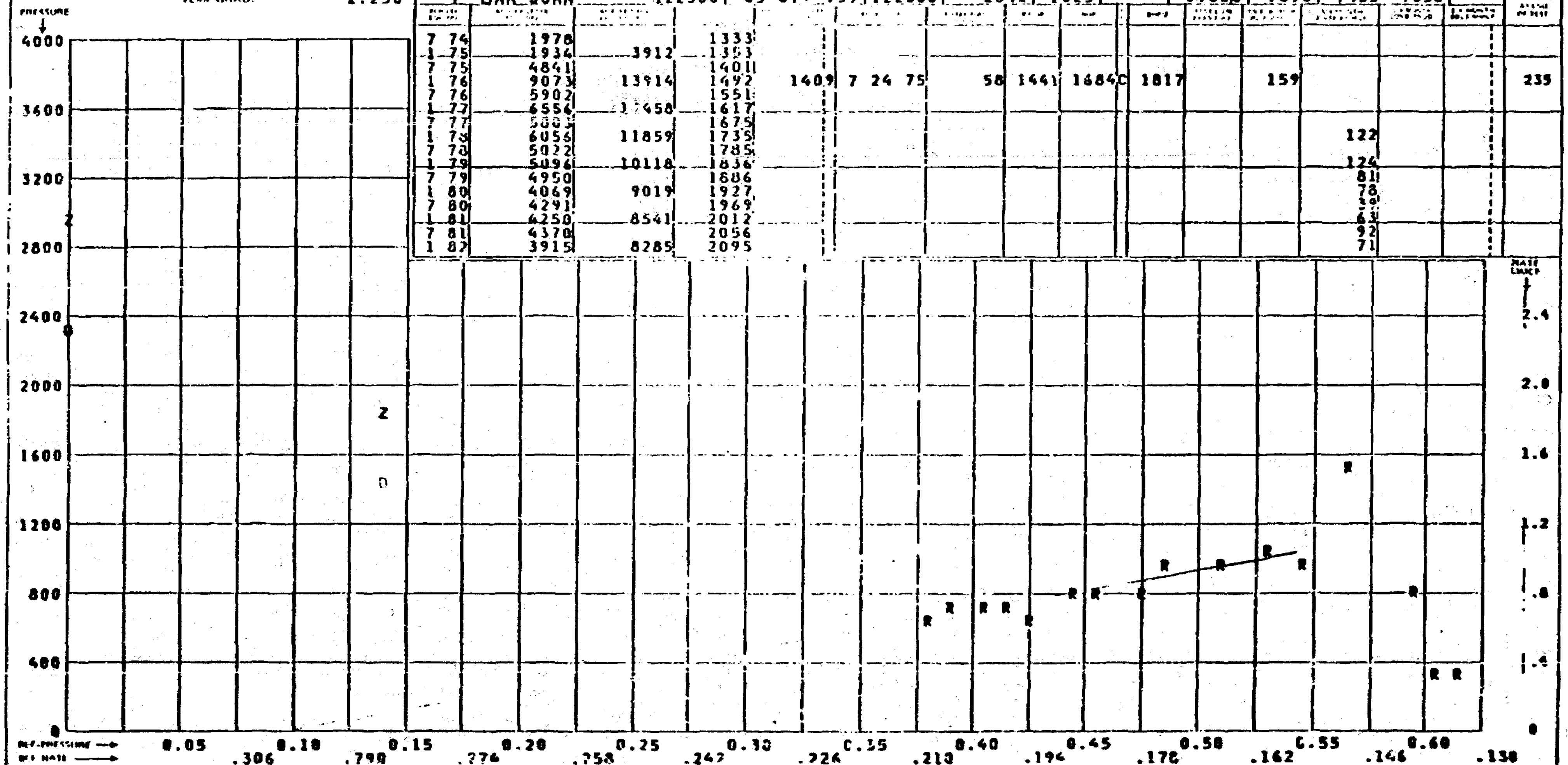
7 74	18410		8081														
1 75	16609	35019	8247														
7 75	15743		8404	8310	4 16 75		56	790	918C	963		475					260
1 76	16677	32420	8571														
7 76	19878		8770														
1 77	12641	32519	8896														
7 77	8367		8980	8963	5 23 77		55	739	858C	898		498					286
1 78	12854	21221	9108														
7 78	15425		9263														
1 79	8444	23869	9347														
7 79	4930		9396	9388	5 28 79		31	369	426C	436		433					290
1 80	6418	11340	9461														
7 80	3446		9495														
1 81	3275	7221	9533														
7 81	13995		9673														
1 82	17412	31407	984[illegible]														



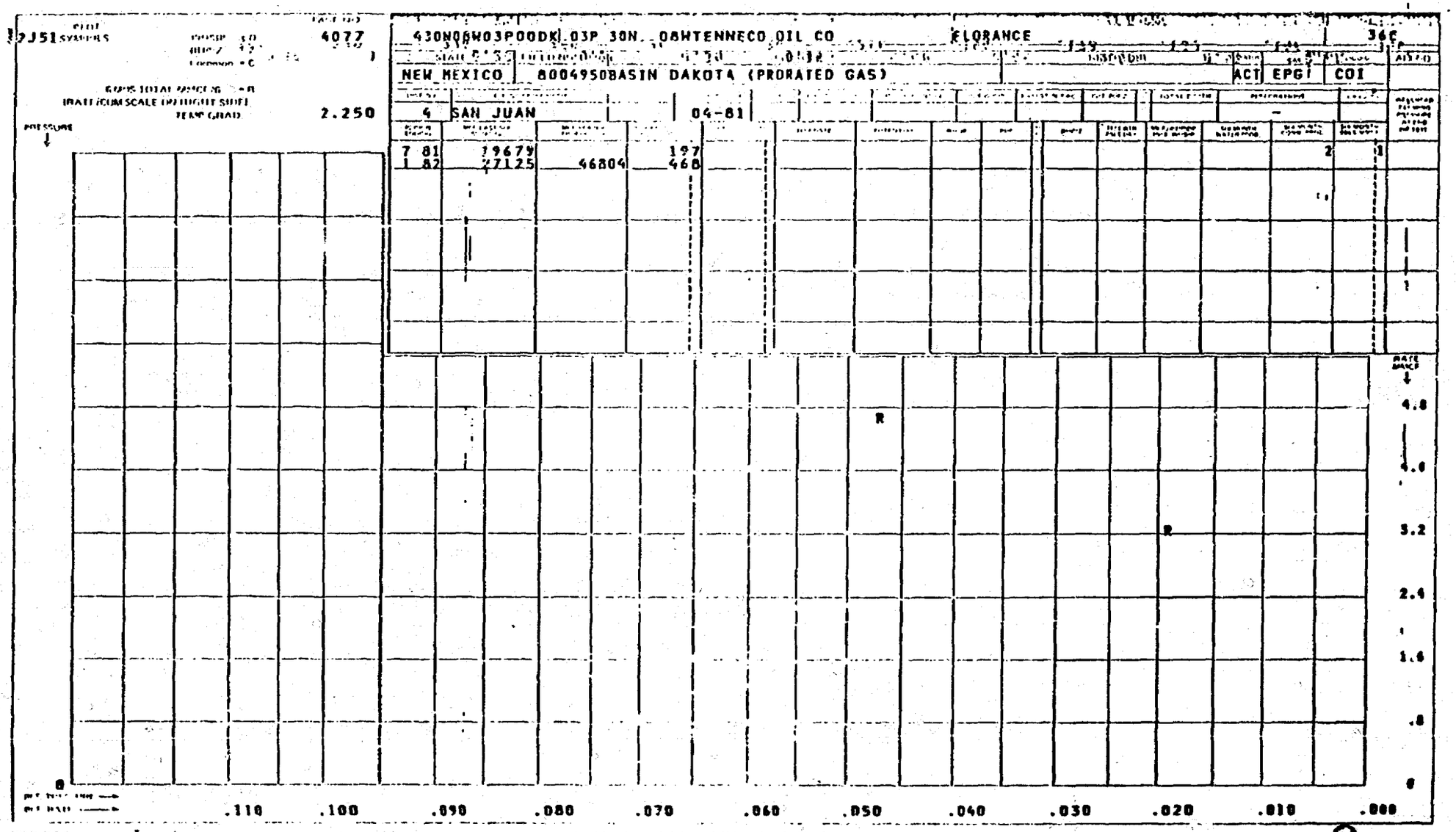
2351 PLOT SYMBOLS:	WHSIP = O BHP/Z = Z Common = C	PAGE NO 4076
	8 LIOS TOTAL MMCF/8 = R (RATE/CUM SCALE ON RIGHT SIDE)	
	TEMP GRAD:	2.250

430N08W03M00DX	03N 30N	08WKOCH INDUSTRIES INC	HOWELL			1
NEW MEXICO	8004950BASIN DAKOTA (PRORATED GAS)		ACT	EPG	PLA	11855
4 SAN JUAN	122366	05-67	.59	122366	2342	2325
2962C	7690	7455- 7650				

7 74	1978		1333											
1 75	1934	3912	1353											
7 75	4841		1401											
1 76	9073	13914	1492	1409	7 24 75	58	1441	1684C	1817		159			235
7 76	5902		1551											
1 77	6556	17458	1617											
7 77	5803		1675											
1 78	6056	11859	1735									122		
7 78	5022		1785											
1 79	5096	10118	1836									124		
7 79	4950		1886									81		
1 80	4069	9019	1927									78		
7 80	4291		1969									39		
1 81	4250	8541	2012									63		
7 81	4370		2056									92		
1 82	3915	8285	2095									71		



1201 EXCHANGE DR RICHARDSON TEXAS 75081


4077
430N08W03P0ODKL 03P 30N 08WTENNECO OIL CO
FLORANCE
NEW MEXICO
8004950BASIN DAKOTA (PRORATED GAS)
ACT
EPGI
COI
2.250
4 SAN JUAN
04-81
7 81 19679 46804 197
1 82 27125 468
2
1
PRESSURE
R
R
4.8
4.0
3.2
2.4
1.6
.8
0
.110
.100
.090
.080
.070
.060
.050
.040
.030
.020
.010
.000

35 SYMBOLS

PAGE NO 4079

6 MOS TOTAL MMCF/6

RATE/CUM SCALE ON RIGHT SIDE

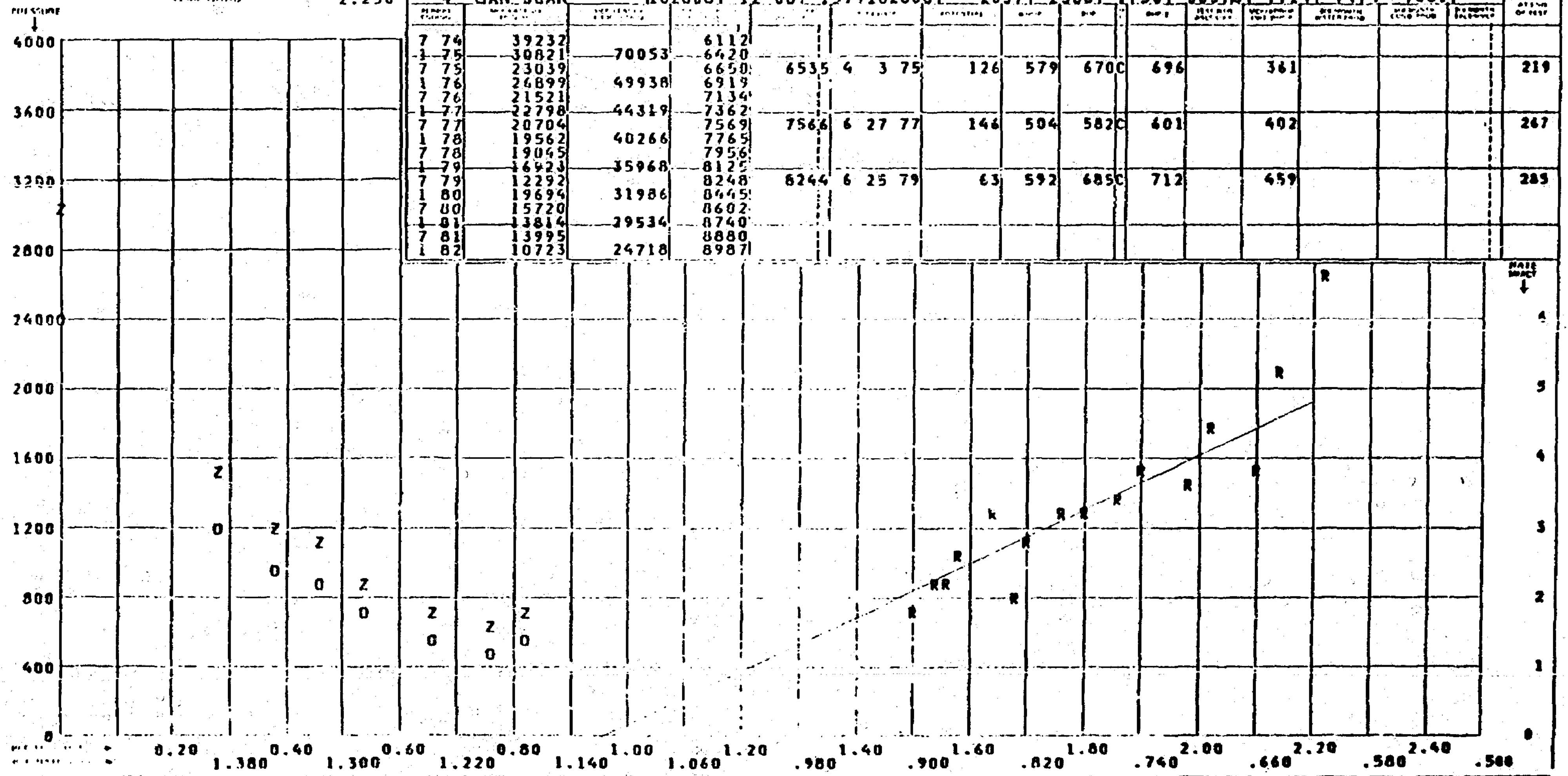
TEMP GRAD 2.250

430N08W04E00DK 04E 30N 08W EL PASO NATURAL GAS CO HOWELL A 4

NEW MEXICO 8004950 BASIN DAKOTA (PRORATED GAS) ACT EPG EPG 20346

4 SAN JUAN 102868 12-68 .59 102868 2037 2388 .750 3037C 7714 7474- 7681

7 74	39232		6112													
1 75	30821	70053	6420													
7 75	23039		6650	6535	4 3 75	126	579	670C	696		361					219
1 76	24899	49938	6919													
7 76	21521		7134													
1 77	22798	44319	7362													
7 77	20704		7569	7566	6 27 77	146	504	582C	601		402					267
1 78	19562	40266	7765													
7 78	19045		7956													
1 79	16923	35968	8125													
7 79	12292		8248	8244	6 25 79	63	592	685C	712		459					285
1 80	19694	31986	8445													
7 80	15720		8602													
1 81	13814	29534	8740													
7 81	13995		8880													
1 82	10723	24718	8987													



1351 PLOT SYMBOLS: WHSIP = O; BHP/Z = Z; Common = C

6 MOS TOTAL MMCF/D = R (RATE/CUM SCALE ON RIGHT SIDE)

TEMP GRAD 2.250

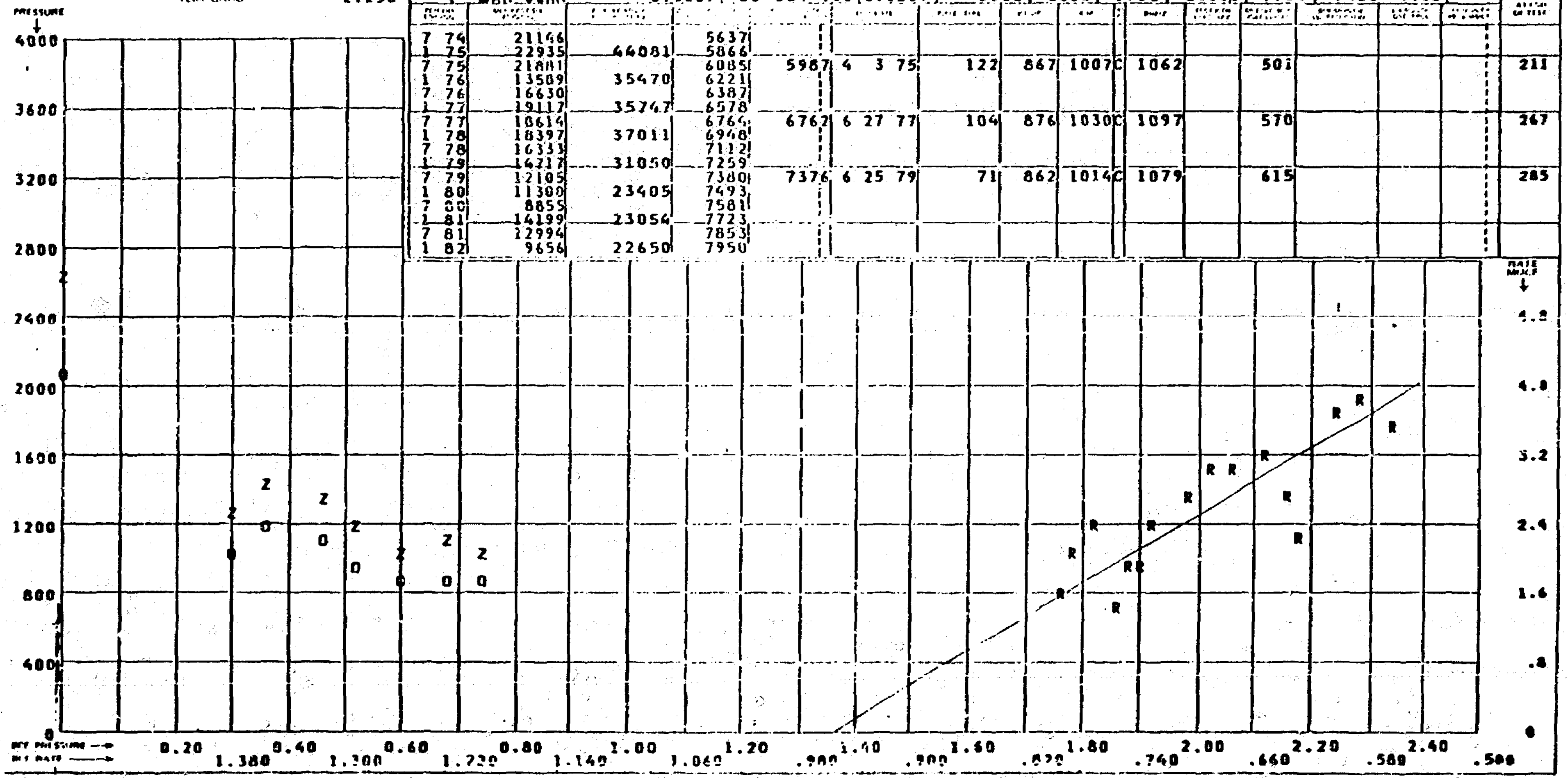
PAGE NO 4078

430N08W04A00DK Q4A 30N 08W TENNECO OIL CO MOORE 7

STATE			RESERVOIR				API NO
NEW MEXICO	8004950 BASIN DAKOTA (PRORATED GAS)			ACT	EPG	PLA	12055

4	SAN JUAN	071267	01-68	.63	071267	3118	2062	.750	2430C	7726	7481- 7682

7 74	21146		5637												
1 75	22935	44081	5866												
7 75	21881		6085	5987	4 3 75	122	867	1007C	1062		501				211
1 76	13589	35470	6221												
7 76	16630		6387												
1 77	19117	35747	6578												
7 77	18614		6764	6762	6 27 77	104	876	1030C	1097		570				267
1 78	18397	37011	6948												
7 78	16333		7112												
1 79	14717	31050	7259												
7 79	12105		7380	7376	6 25 79	71	862	1014C	1079		615				285
1 80	11300	23405	7493												
7 80	8855		7581												
1 81	14199	23054	7723												
7 81	12994		7853												
1 82	9656	22650	7950												

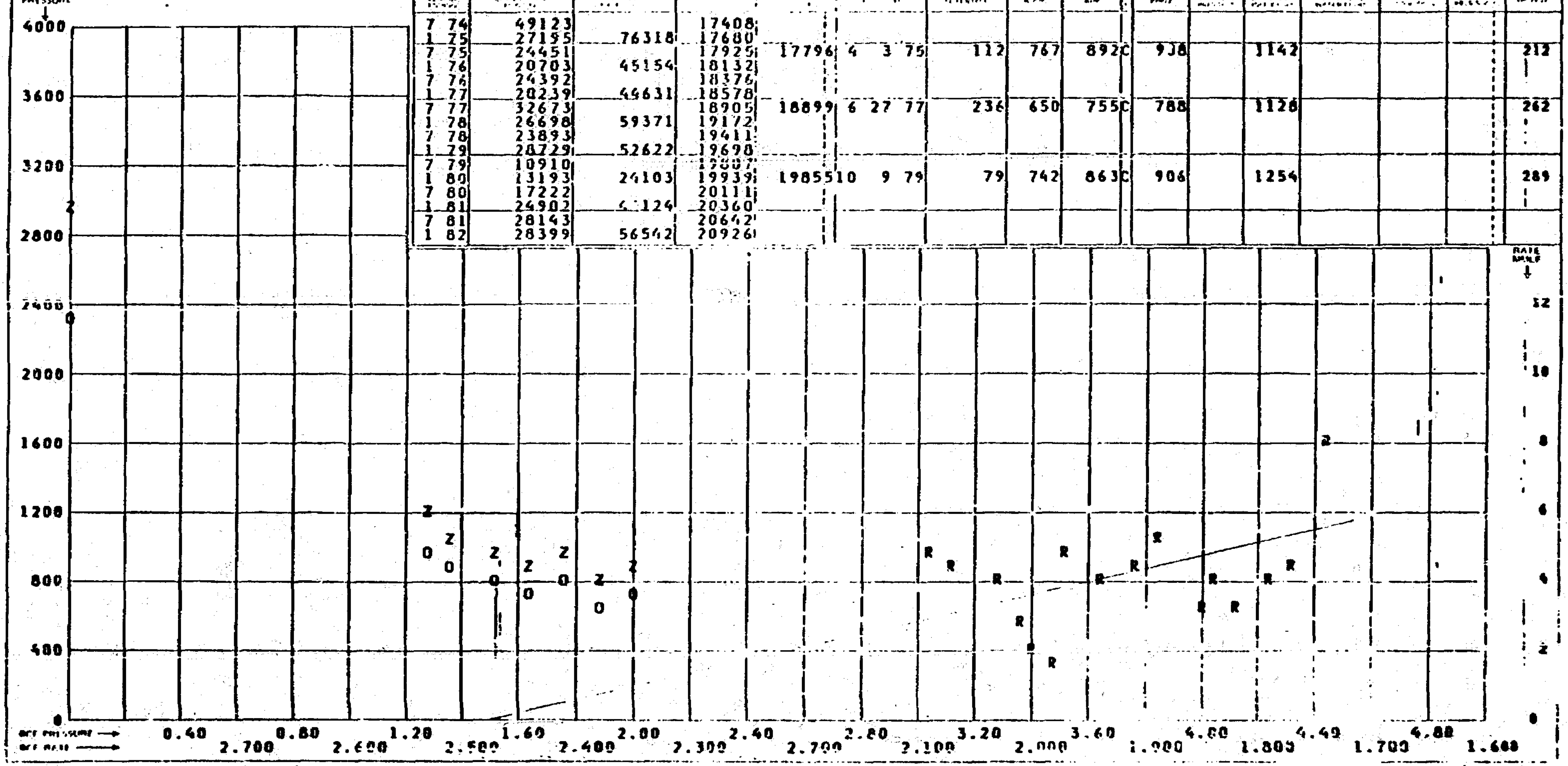


PLOT SYMBOLS		PAGE NO
2J51	WHSIP = O	4080
	BHP/Z = Z	
	Common = C	
	6 MOS TOTAL MMCF/G = R (RATE/CUM SCALE ON RIGHT SIDE)	
	TEMP GRAD:	2.250

430N08W05A00DK	05A	30N	08W	TENNECO OIL CO	MOORE		6
NEW MEXICO	8004950	BASIN DAKOTA (PRORATED GAS)		ACT	EPG	INL	13110

4	SAN JUAN	031863	08-65	.60	031863	3852	2325	.750	2985C	7750	7488- 7702

7 74	49123		17408														
1 75	27195	76318	17680														
7 75	24451		17925	17796	4 3 75	112	767	892C	938		1142						212
1 76	20703	45154	18132														
7 76	24392		18376														
1 77	20239	44631	18578														
7 77	32673		18905	18899	6 27 77	236	650	755C	788		1128						262
1 78	26698	59371	19172														
7 78	23893		19411														
1 79	28729	52622	19698														
7 79	10910		19807														
1 80	13193	24103	19939	19855	10 9 79	79	742	863C	906		1254						289
7 80	17222		20111														
1 81	24902	[illegible]	20360														
7 81	28143		20642														
1 82	28399	56542	20926														



2J51 PLOT SYMBOLS — WHSIP = 0, BHP/Z = Z, Common = C

PAGE NO. 4081

6 MOS TOTAL MMCF/D = R (RATE/CUM SCALE ON RIGHT SIDE)

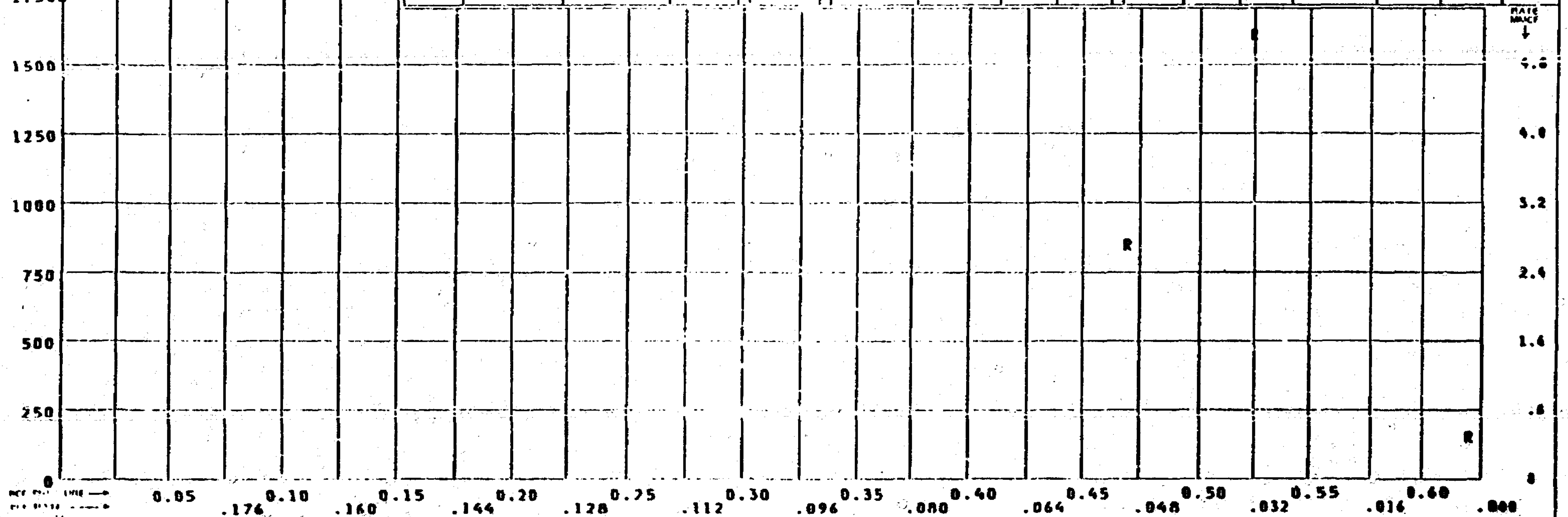
TEMP GRAD. 2.250

430N08W05C00DK 05C 30N 08W KOCH INDUSTRIES INC MOORE 1

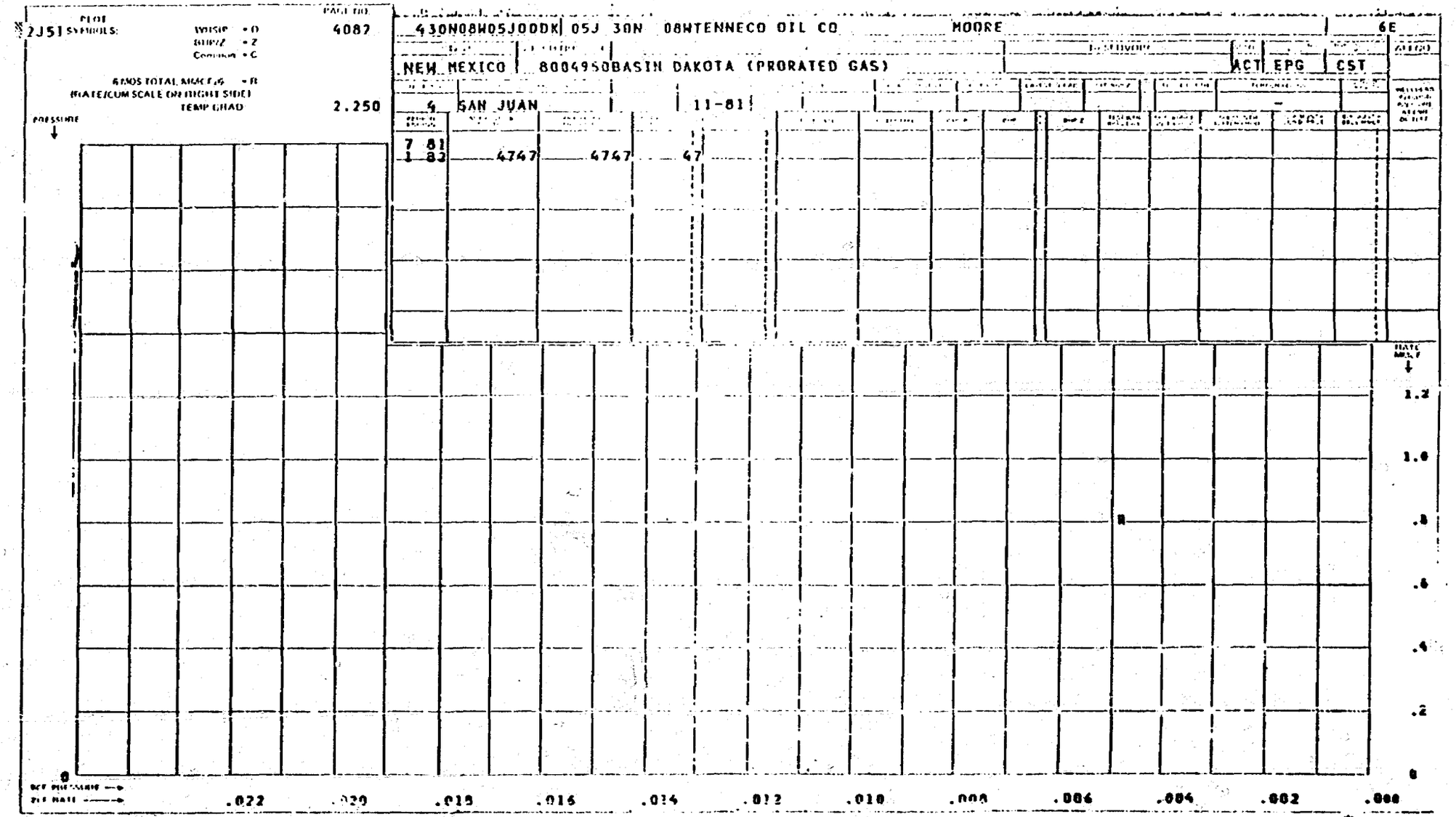
NEW MEXICO 8004950 BASIN DAKOTA (PRORATED GAS) ACT EPG

4 SAN JUAN 012480 12-80 012480 1763 7746 7440- 7642

Date					
7 80					
1 81	2750	2750	28	4	
7 81	30593		333	39	
1 82	16682	47275	500	8	



DWIGHTS ENERGYDATA INC., RICHARDSON, TEXAS



DWIGHT'S

1201 EXCHANGE DR RICHARDSON TEXAS 75081

2351 PLOT SYMBOLS WHSIP = O PHPZ = Z Common = C 4073

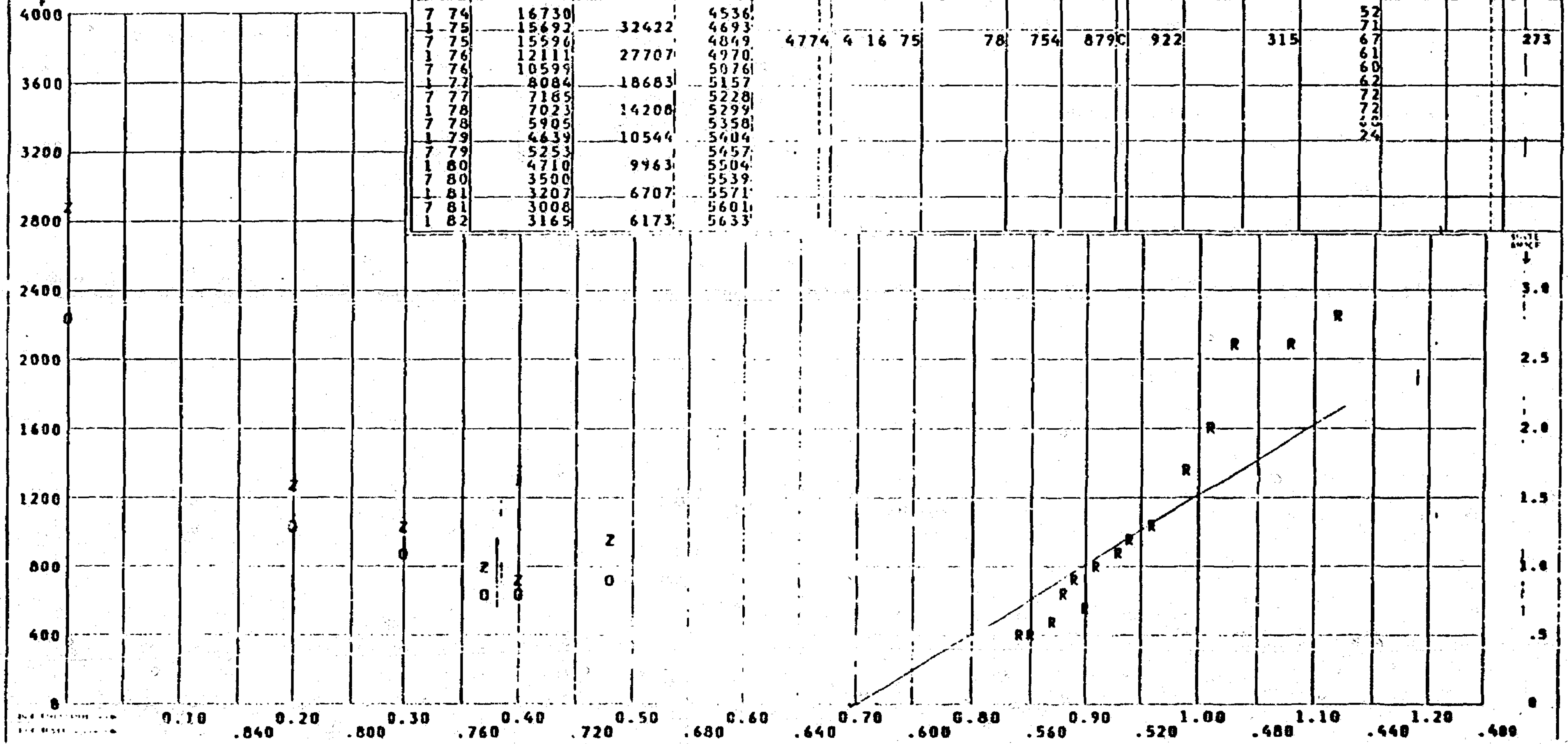
GBDS TOTAL GAS CUM = R (RATE/CUM SCALE ON RIGHT SIDE) TEMP GRAD 2.250

430N08W02ECODX 02E 30N G8WMESA PETPOLEUM CO STATE CCM AM 37

NEW MEXICO 80649500ASIN DAKOTA (PRORATED GAS) ACT EPG INL 20324

4 SAN JUAN 091168 01-69 .60 091168 3823 2269 .750 2896C 7840 7614- 7815

7 74	16730		4536								52	
1 75	15692	32422	4693								71	
7 75	15596		4849	4774	4 16 75	78	754	879C	922	315	67	273
1 76	12111	27707	4970								61	
7 76	10599		5076								60	
1 77	8084	18683	5157								62	
7 77	7165		5228								72	
1 78	7023	14208	5299								72	
7 78	5905		5358								[illegible]	
1 79	4639	10544	5404								24	
7 79	5253		5457									
1 80	4710	9963	5504									
7 80	3500		5539									
1 81	3207	6707	5571									
7 81	3008		5601									
1 82	3165	6173	5633									

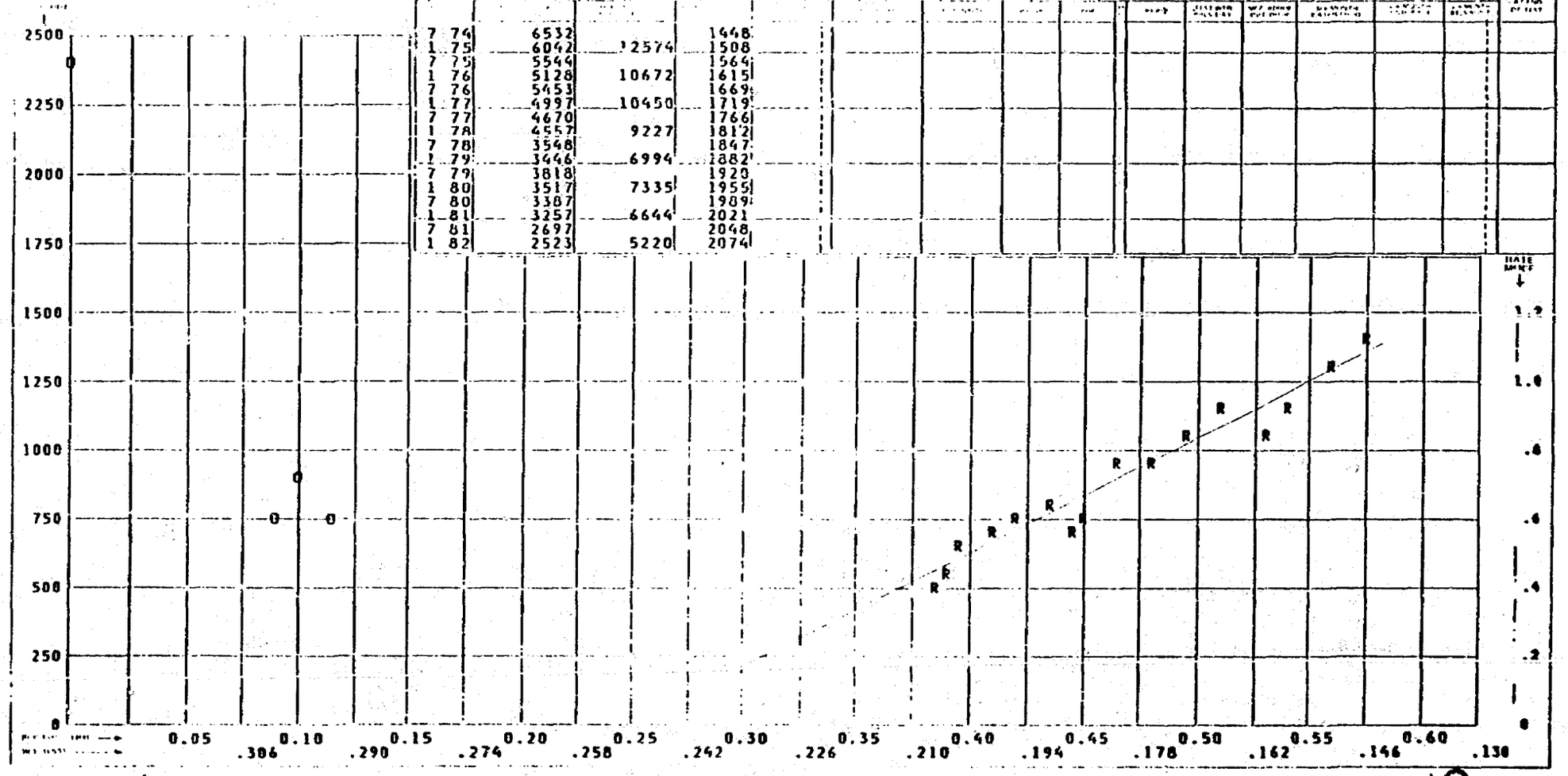


2J51 4083 430N08W07A00DK 07A 30N 08WMCHUGH JEROME P. & ASSOC MOORE

NEW MEXICO 80049500BASIN DAKOTA (PRORATED GAS) ACT EPG 7WC 28272

2.250 4 SAN JUAN 061268 09-68 061268 1478 2420 7373 7236- 7336

7	74	6532		1448
1	75	6042	12574	1508
7	75	5544		1564
1	76	5128	10672	1615
7	76	5453		1669
1	77	4997	10450	1719
7	77	4670		1766
1	78	4557	9227	1812
7	78	3548		1847
1	79	3446	6994	1882
7	79	3818		1920
1	80	3517	7335	1955
7	80	3387		1989
1	81	3257	6644	2021
7	81	2697		2048
1	82	2523	5220	2074



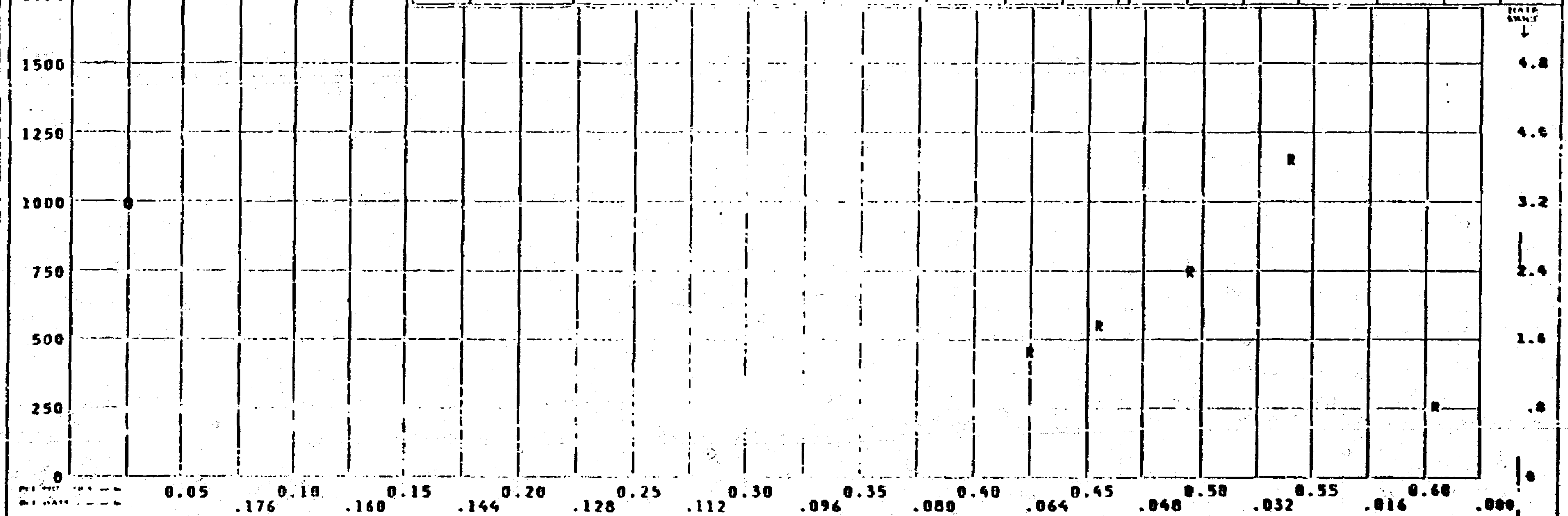
2J51 | 4477 | 431N08H29000DK 290 31N 08WTENNECO OIL CO | FLETCHER | 2

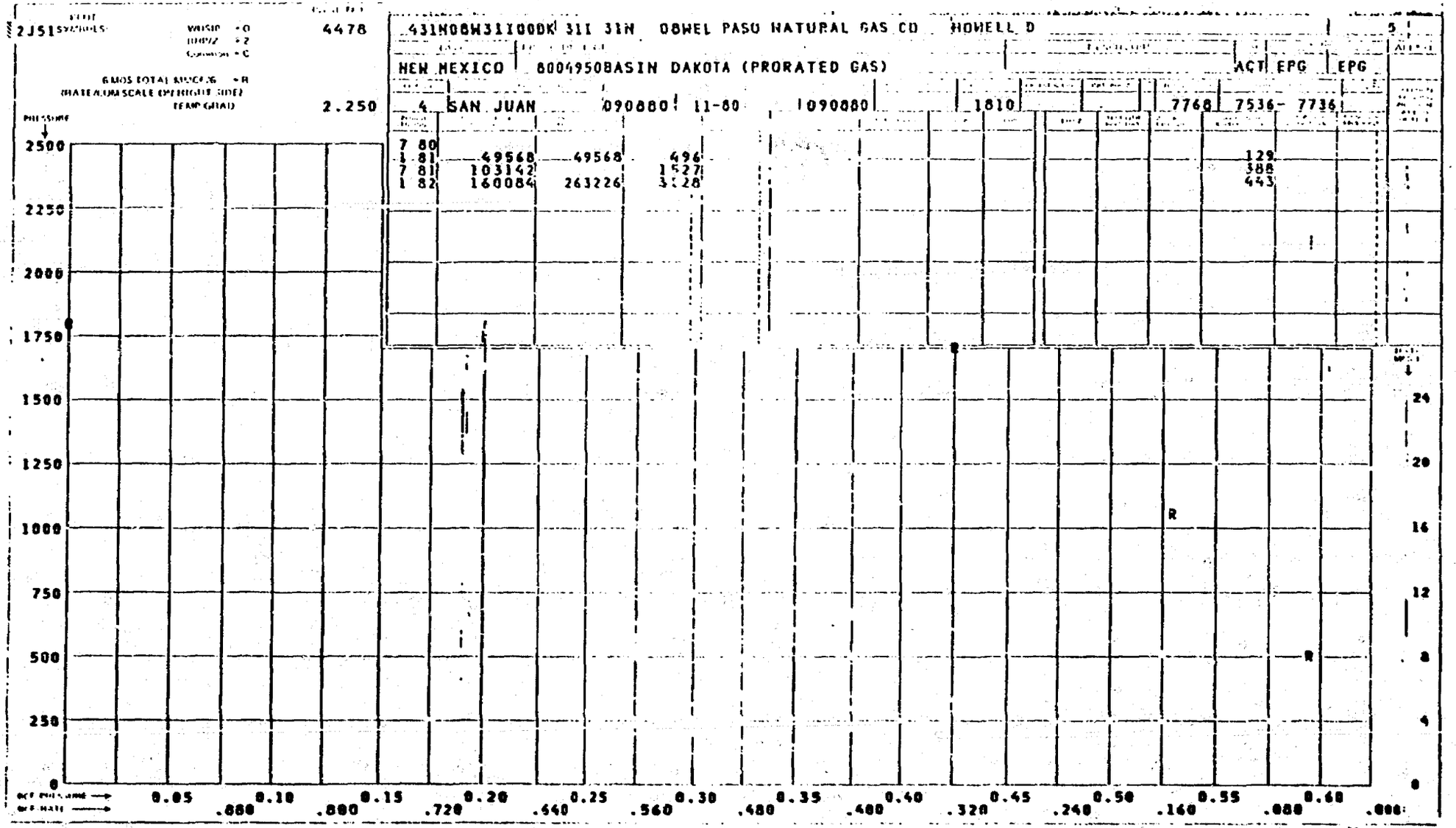
NEW MEXICO | 8004950 BASIN DAKOTA (PRORATED GAS) | ACT | EPG | PER

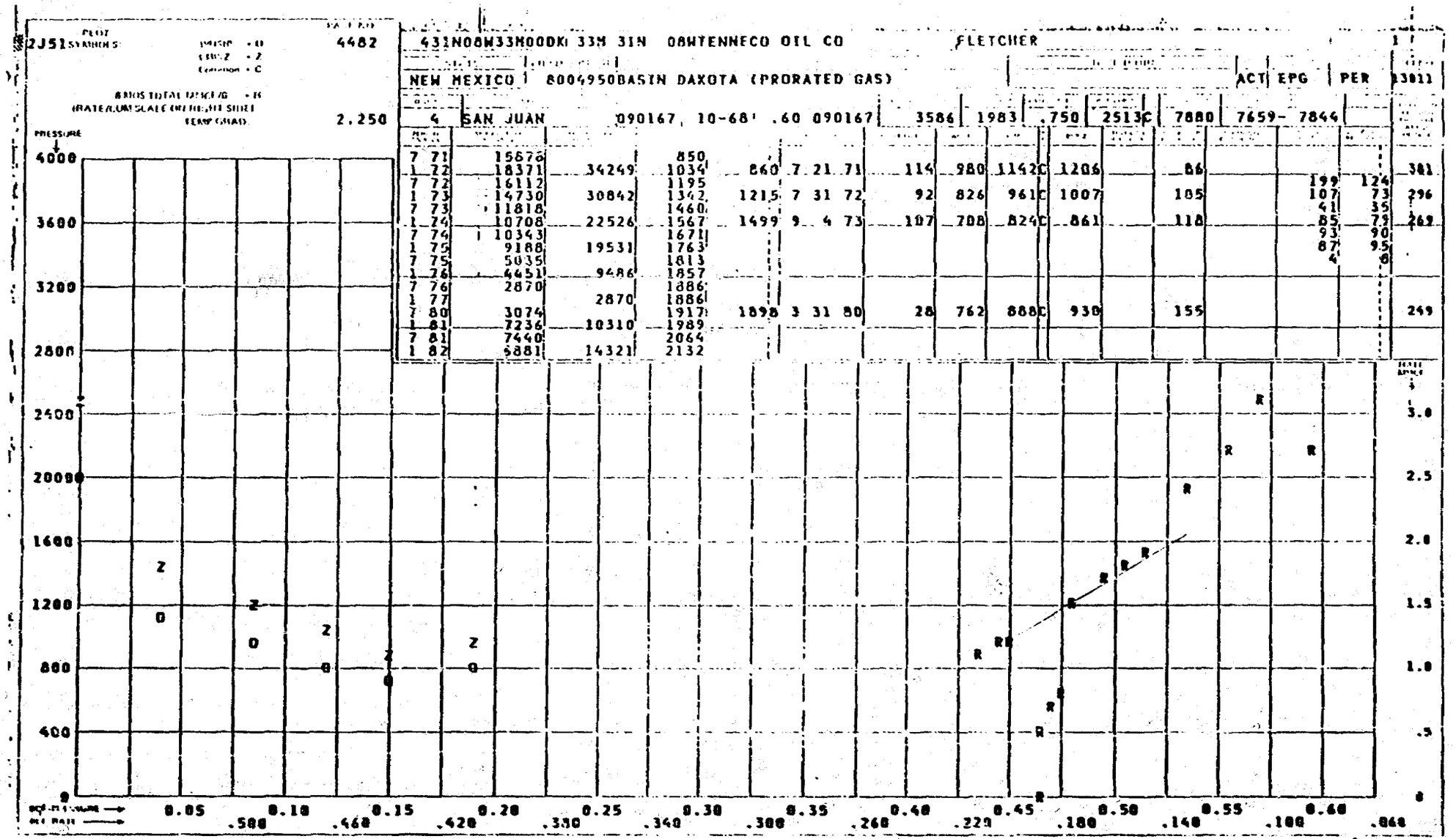
GAS OIL RATIO / TEMP GRAD. 2.250

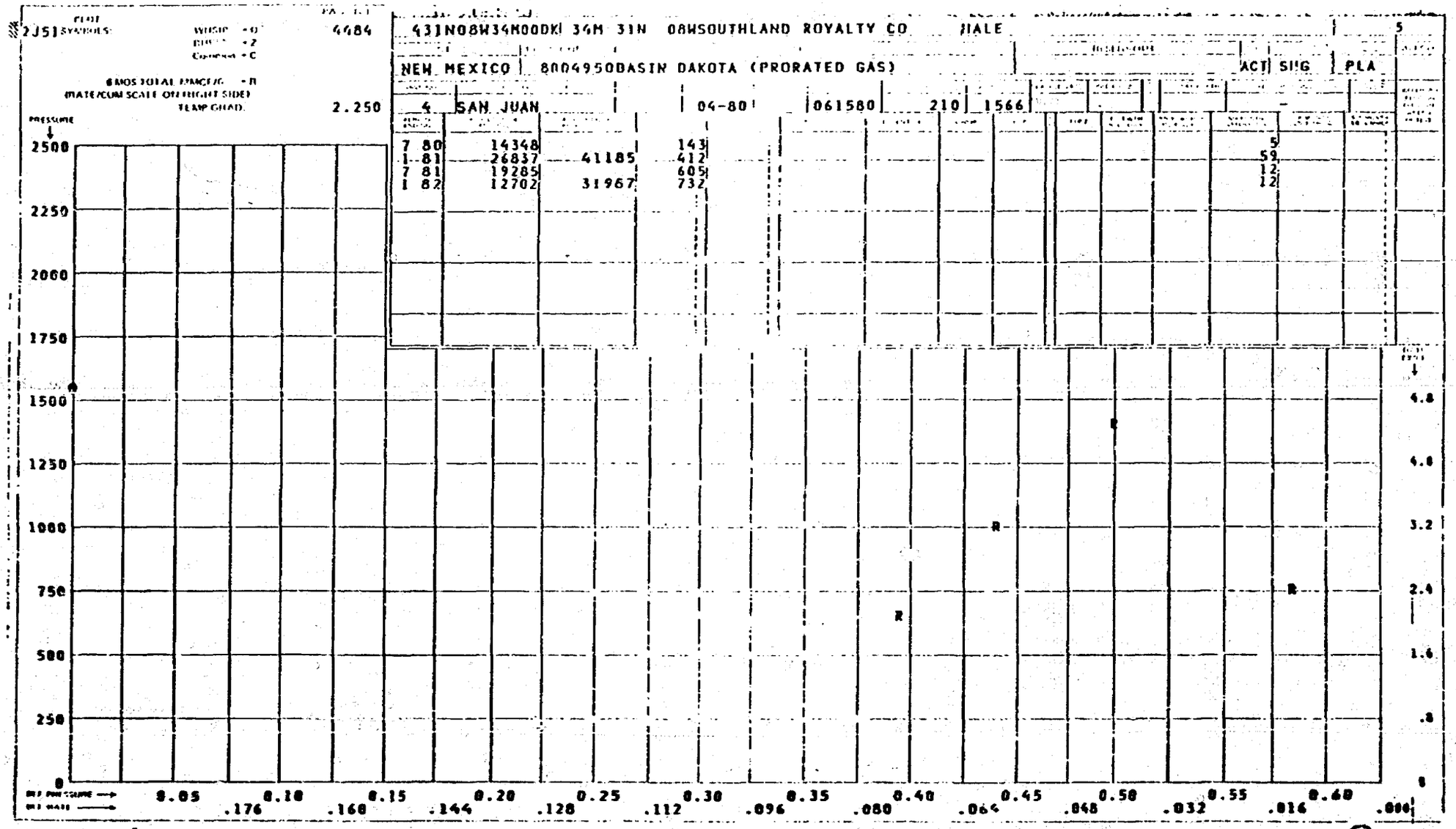
4 | SAN JUAN | 091579 | 12-79 | 091579 | 2899 | 2463 | 7930 | 7650- 7814

7 79									
1 80	4978	4978	50						
7 80	22691		277	228	5 2 80	86	1002	16	269
1 81	14566	37257	422						
7 81	11083		533						
1 82	9267	20350	626						




2J51
4478
2.250
431N08W31I00DK 31I 31N 08WEL PASO NATURAL GAS CO HOWELL D
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
ACT EPG EPG
4 SAN JUAN 090880 11-80 1090080 1810 7768 7536- 7736
7 80
1 81 49568 49568 496 129
7 81 103142 1527 388
1 82 160084 263226 443
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
.880
.800
.720
.640
.560
.480
.400
.320
.240
.160
.080
.000
24
20
16
12
8
4
0


PLOT
2J51 SYMBOLS
4482
2.250
PRESSURE
4000
3600
3200
2800
2400
2000
1600
1200
800
400
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
.588
.468
.420
.330
.340
.300
.260
.220
.180
.140
.100
.060
431N08W33H00DKI 33M 31N 08WTENNECO OIL CO FLETCHER
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
ACT EPG PER 33011
4 SAN JUAN 090167 10-68 .60 090167 3586 1983 .750 2513C 7880 7659- 7844
7 71 15676 850
1 72 18371 34249 1034 860 7 21 71 114 980 1142C 1206 86 199 124 381
7 72 16112 1195
1 73 14730 30842 1342 1215 7 31 72 92 826 961C 1007 105 107 73 296
7 73 11818 1460 41 35
1 74 10708 22526 1567 1499 9 4 73 107 708 824C 861 118 85 79 262
7 74 10343 1671 93 90
1 75 9188 19531 1763 87 95
7 75 5035 1813 4 8
1 76 4451 9486 1857
7 76 2870 1886
1 77 2870 1886
7 80 3074 1917 1898 3 31 80 28 762 888C 930 155 249
1 81 7236 10310 1989
7 81 7440 2064
1 82 6881 14321 2132


4484
2.250
431N08W34M00DK 34M 31N 08WSOUTHLAND ROYALTY CO
NEW MEXICO 800495ODASIN DAKOTA (PRORATED GAS)
4 SAN JUAN
04-80
061580
210 1566
7 80 14348 143
1-81 26837 41185 412
7 81 19285 605
1 82 12702 31967 732
PRESSURE
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
.176 .160 .144 .128 .112 .096 .080 .064 .048 .032 .016 .000
4.8
4.0
3.2
2.4
1.6
.8
0

SUPPLEMENTARY EXHIBIT L-2

WINDOW 31N-9W SECTIONS 27-28

WELLS INSIDE WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY(MMCF)
Horton #1 Tenneco SENW 28-31N-9W	1500
Horton #1 E Tenneco SENE 28-31N-9W	300
Sheets #4 EPNG SWSE 28-31N-9W	350
Schwerdtfeger Com #1E Tenneco SENW 27-31N-9W	90
Schwerdtfger Com #1 Tenneco SWSW 27-31N-9W	2500
Bolack D#1 Tenneco SwSE 27-31N-9W	375

Cumulative = 5115 MMCF

Avg Cum Per Well = $\frac{5115}{6}$ = 853 MMCF

WELLS IMMEDIATELY SURROUNDING WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY(MMCF)
Riddle B #1 Tenneco SWSW 23-31N-9W	90
Barrett A #1 Tenneco SESE 20-31N-9W	700
Sheets Com #1 Tenneco NWNE 29-31N-9W	220
Pritchard #5 Tenneco NWNE 34-31N-9W	720
Hunsaker #2R Supron NWNE 26-31N-9W	210

Cumulative = 1940 MMCF

Avg Cum Per Well = $\frac{1940}{5}$ = 388 MMCF

7353 PLOT SYMBOLS: WRSIP = O, BHP/Z = Z, Common = C

BASIS TOTAL MCF/DAY = 0 (RATE/CUM SCALE ON RIGHT SIDE)

PAGE NO. 4492

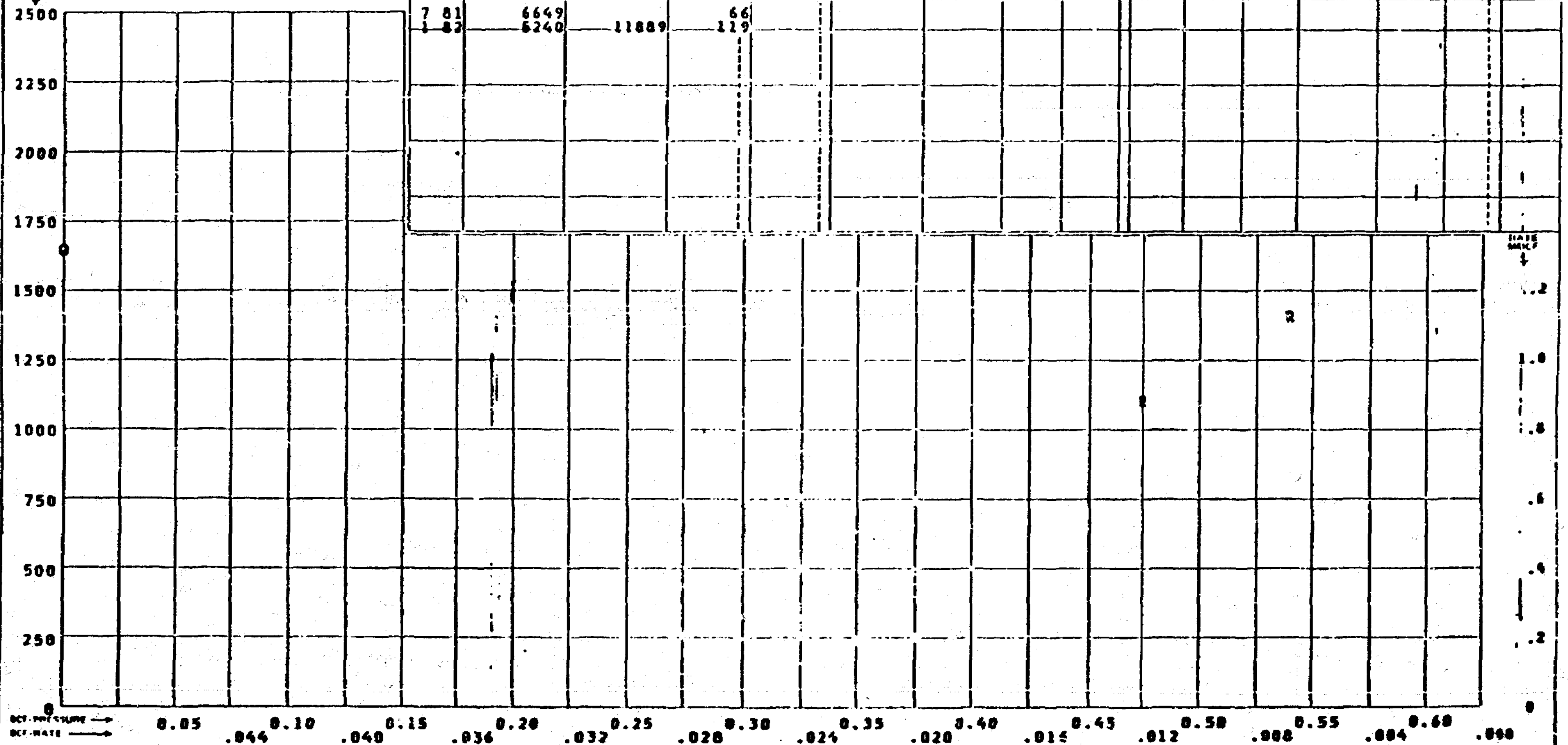
TEMP GRAD. 2,250

431N09W27F00DK 27F 31N 09W TENNECO OIL CO — SCHWERDTFEGER COM — 1E

STATE: NEW MEXICO — FIELD: 8004950 BASIN DAKOTA (PRORATED GAS) — ACT EPG COI

4 SAN JUAN 091080 01-81 091080 1164 1663 7744 7530- 7728

7 81	6649		66
1 82	6240	11889	119



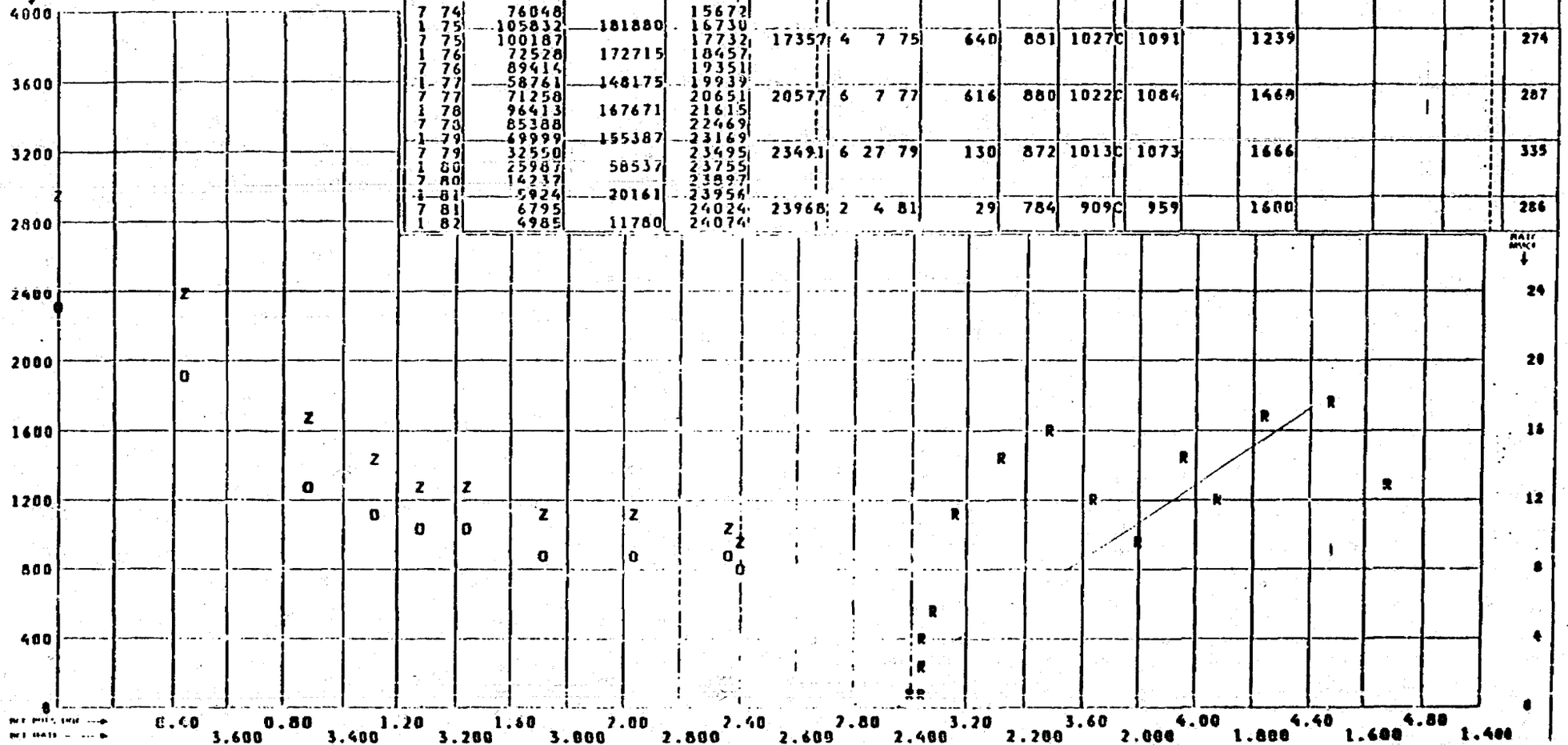
INSIGHTS — EXCHANGE DR. RICHARDSON, TEXAS 75081

J51 4493 | 431N09W27M00DK 27M 31N 09WTENNECO OIL CO SCHWERDTFEGER COM

NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS) ACT EPG PER 12151

2.250 | 4 SAN JUAN 20767 10-68 .60 120767 4649 2282 .750 2940C 7492 7276- 7460

7 74	76048		15672														
1 75	105832	181880	16730														
7 75	100187		17732	17357	4	7	75	640	881	1027C	1091		1239				274
1 76	72528	172715	18457														
7 76	89414		19351														
1 77	58761	148175	19939														
7 77	71258		20651	20577	6	7	77	616	880	1022C	1084		1469				287
1 78	96413	167671	21615														
7 78	85388		22469														
1 79	69999	155387	23169														
7 79	32550		23495	23491	6	27	79	130	872	1013C	1073		1666				335
1 80	25987	58537	23755														
7 80	14237		23897														
1 81	5924	20161	23956														
7 81	6795		24024	23968	2	4	81	29	784	909C	959		1600				286
1 82	4985	11780	24074														



2351 PLOT SYMBOLS WHSIP = O BHPSZ = Z Common = C RATIO TOTAL MMCF/G = R (RATE/CUM SCALE ON RIGHT SIDE) TEMP GRAD. 2.250

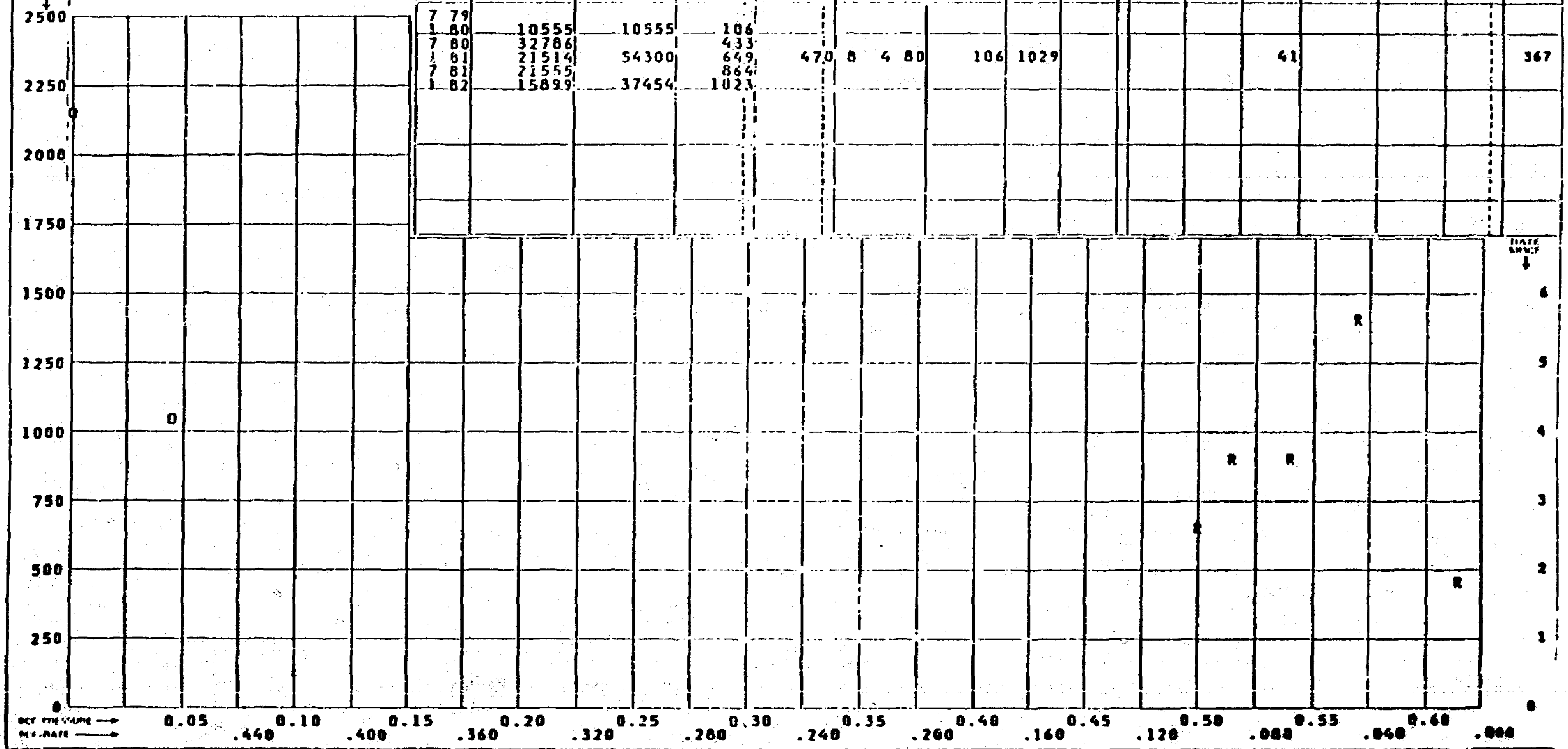
PAGE NO. 6494

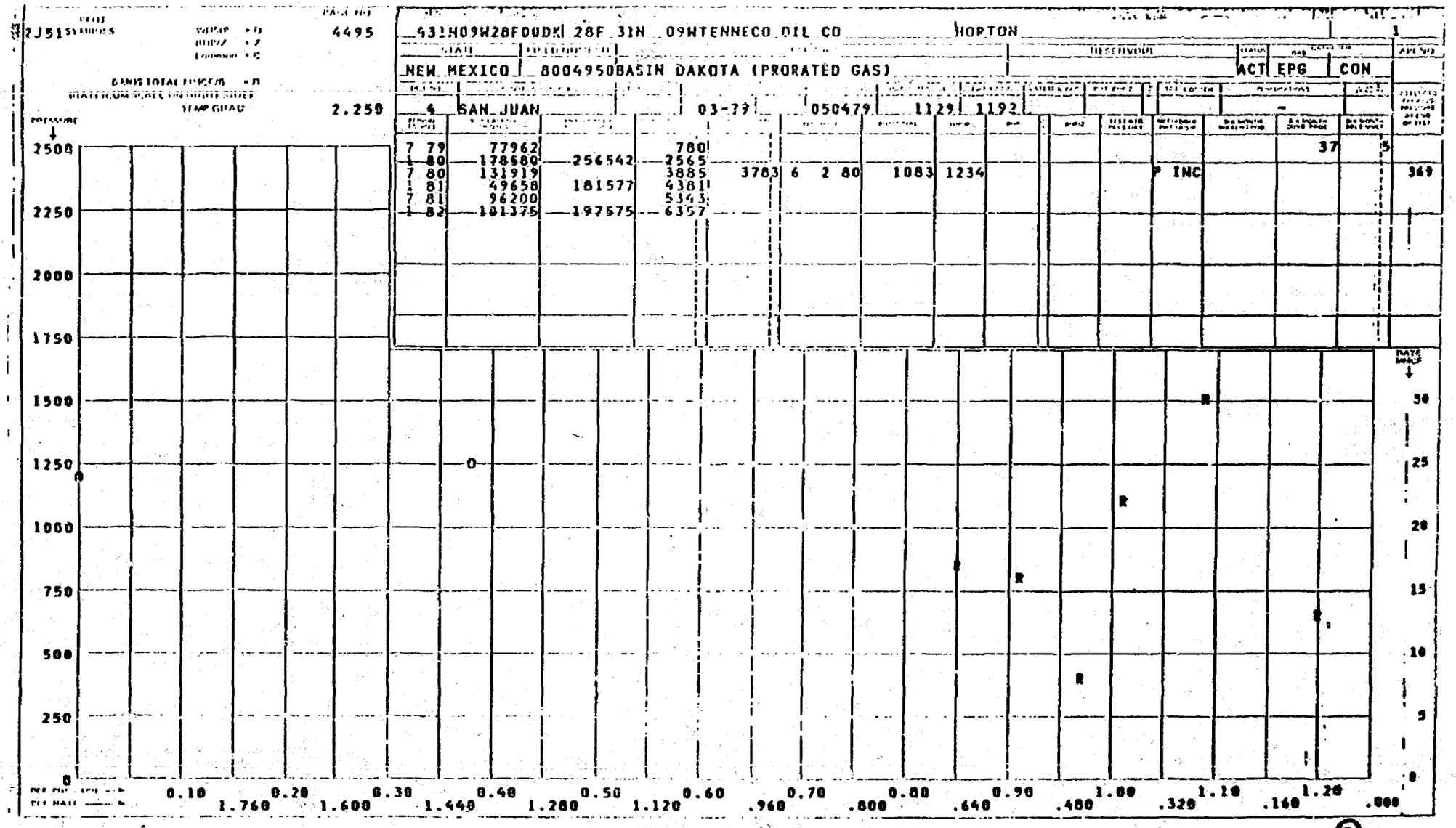
43 N09W27000DK 270 31N 09W TENNECO OIL CO BULACK D 1

NEW MEXICO 8004950 BASIN DAKOTA (PRORATED GAS) ACT EPG G R

4 SAN JUAN 090679 12-79 090679 2423 2163 7603 7332- 7574

7 79											
1 80	10555	10555	106								
7 80	32786		433								
1 81	21514	54300	649	470	8	4 80	106	1029	41		367
7 81	21555		864								
1 82	15899	37454	1023								




2J51
4495
2.250
431H09W28F00DK 28F 31N 09WTENNECO OIL CO
HOPTON
1
NEW MEXICO
8004950BASIN DAKOTA (PRORATED GAS)
ACT EPG CON
4 SAN JUAN
03-29
050479
1129
1192
7 79 77962 780
1 80 178580 256542 2565
7 80 131919 3885 3783 6 2 80 1083 1234 P INC 37 5 369
1 81 49658 181577 4381
7 81 96200 5343
1 82 101375 197575 6357
PRESSURE
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
DATE
30
25
20
15
10
5
0
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00 1.10 1.20
1.760 1.600 1.440 1.280 1.120 .960 .800 .640 .480 .320 .160 .000

2J51 PLOT SYMBOLS: WHSIP = O; BHP/Z = Z; Correction = C; 6 MOS TOTAL MMCF/G = R; (RATE/CUM SCALE ON RIGHT SIDE)

TEMP GRAD 2.250

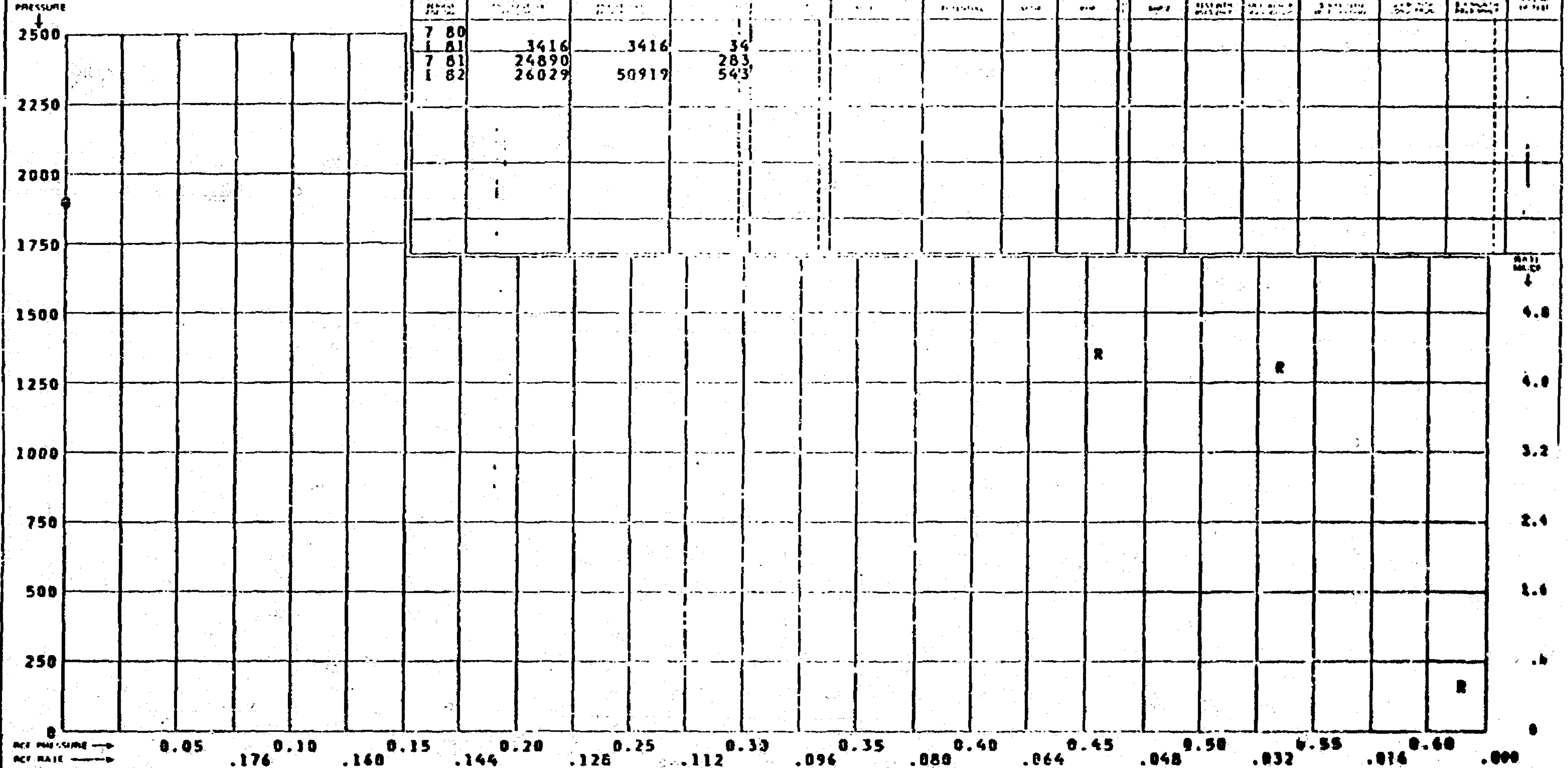
PAGE NO 4496

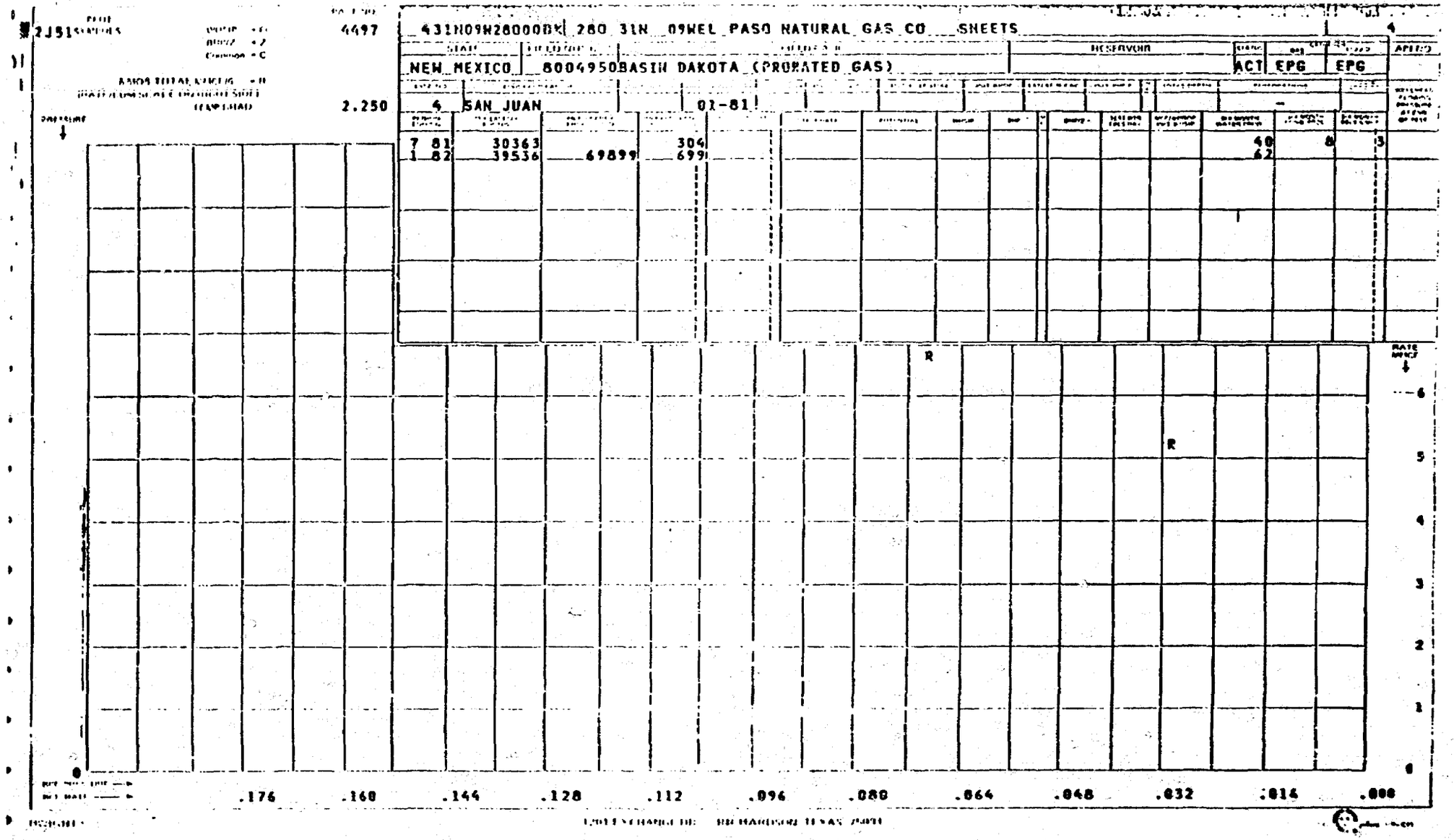
431N09W28H00DK | 28H 31N 09HTENNECO OIL CO HORTON 1E

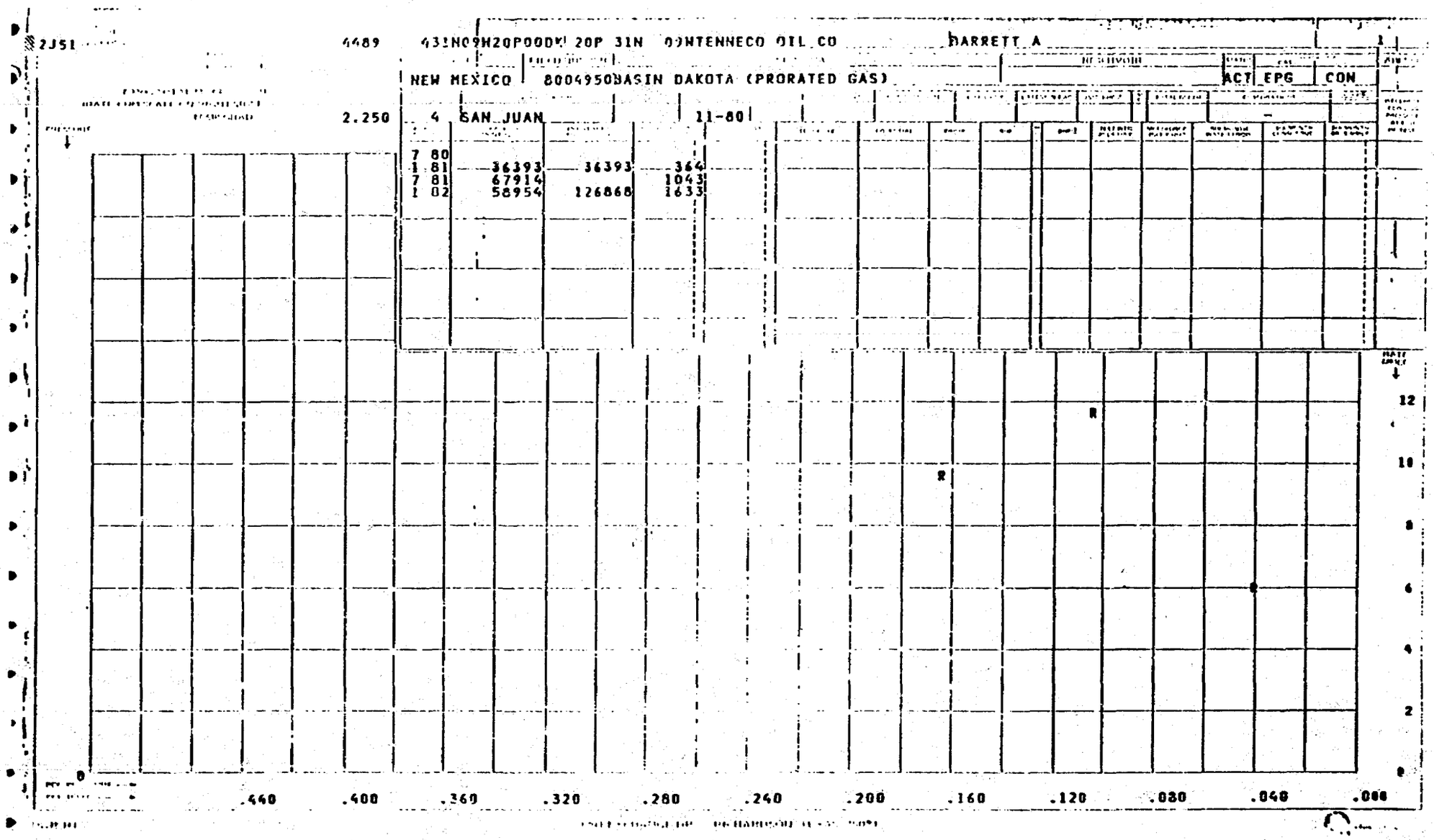
NEW MEXICO | 8004950BASIN DAKOTA (PRORATED GAS) ACT | EPG | COI

4 | SAN JUAN | 073180 | 12-80 | 073180 | 1512 | 1888 | 7560 | 7322- 7530

7 80			
1 81	3416	3416	34
7 81	24890		283
1 82	26029	50919	543




4497
2.250
431N09W28000BK 28O 31N 09WEL PASO NATURAL GAS CO SHEETS
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
RESERVOIR
ACT EPG EPG
4 SAN JUAN 01-81
7 81 30363 304
1 82 39536 69899 699
40
82
8
3
R
R
RATE MMCF
6
5
4
3
2
1
0
.176
.160
.144
.128
.112
.096
.080
.064
.048
.032
.016
.000


2J51 4489 43:NO9M20POODY 20P 31N 09NTENNECO OIL CO BARRETT A
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS) ACT EPG CON
2.250 4 SAN JUAN 11-80
7 80
1 81 36393 36393 364
7 81 67914 1043
1 02 58954 126868 1633
12
10
8
6
4
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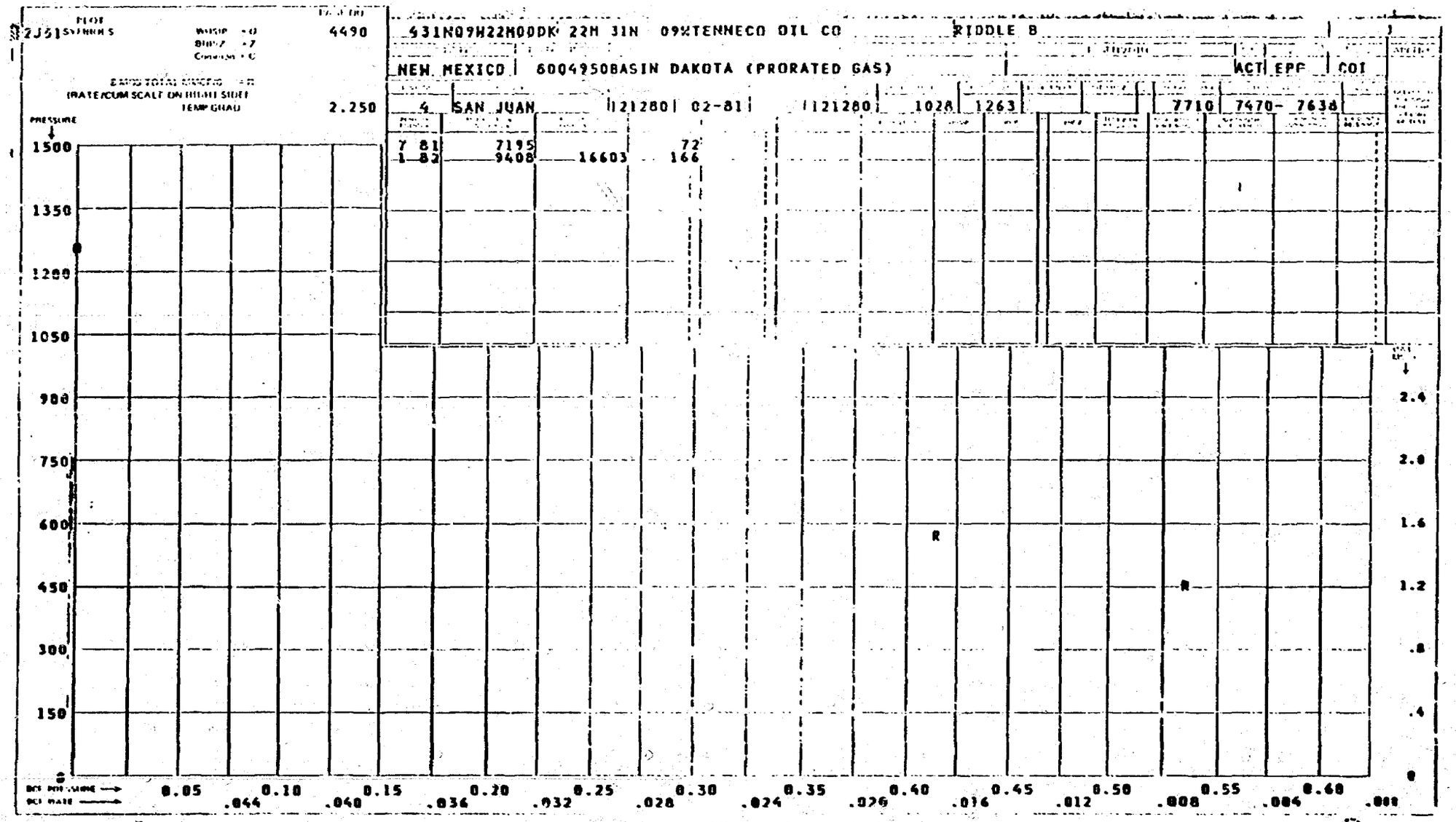
.400
.360
.320
.280
.240
.200
.160
.120
.080
.040
.000


PLOT
WHSIP = 0
BHSIP = 7
4490
(RATE/CUM SCALE ON RIGHT SIDE)
TEMP GRAD
2.250
431N09W22M00DK 22M 31N 09%TENNECO OIL CO
RIDDLE B
NEW MEXICO
6004950BASIN DAKOTA (PRORATED GAS)
ACT EPF
COI
4
SAN JUAN
121280
02-81
121280
1028
1263
7710
7470- 7638
7 81
1 82
7195
9408
16603
72
166
PRESSURE
1500
1350
1200
1050
900
750
600
450
300
150
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2.4
2.0
1.6
1.2
.8
.4
0
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
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.008
.004
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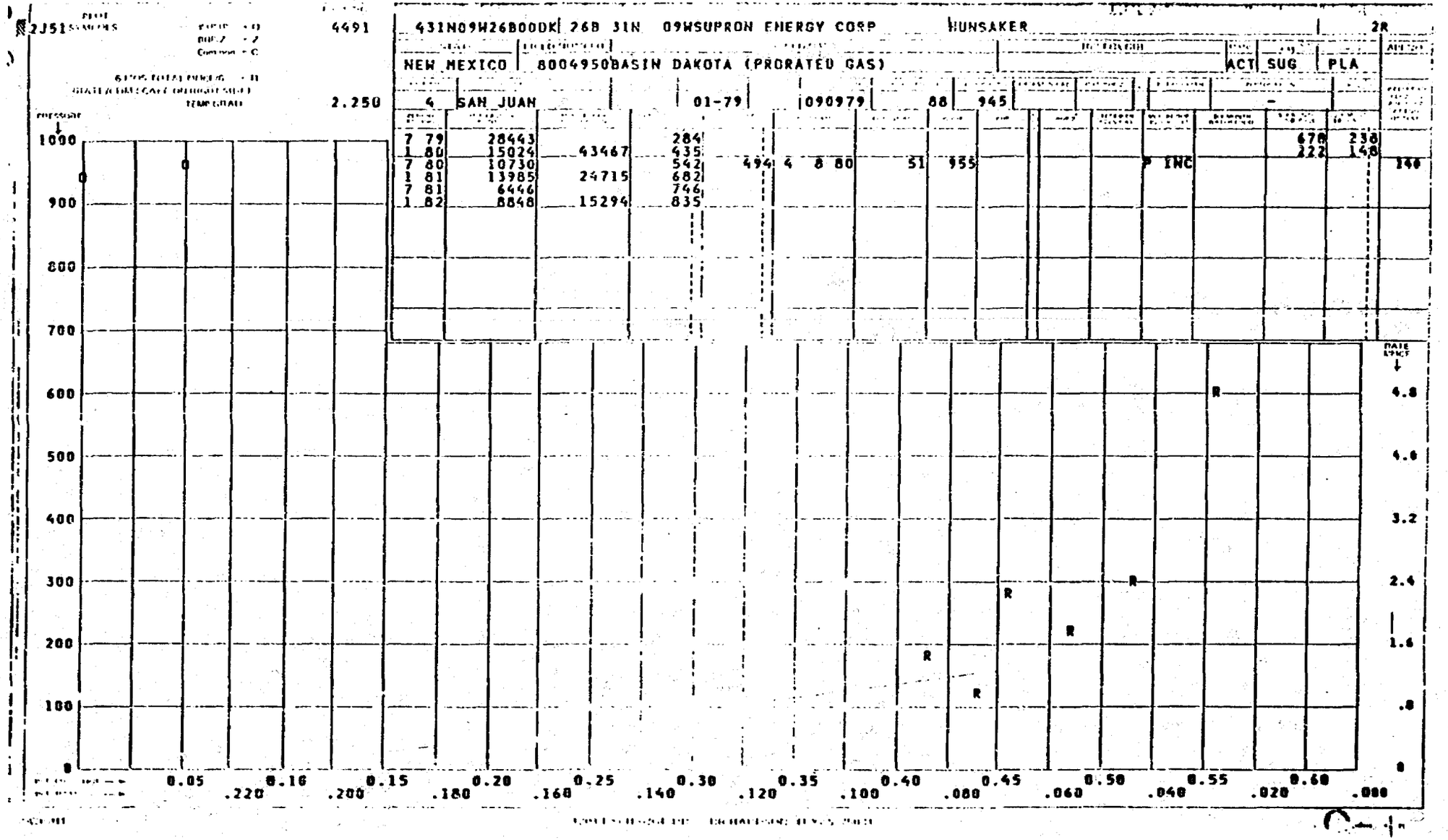
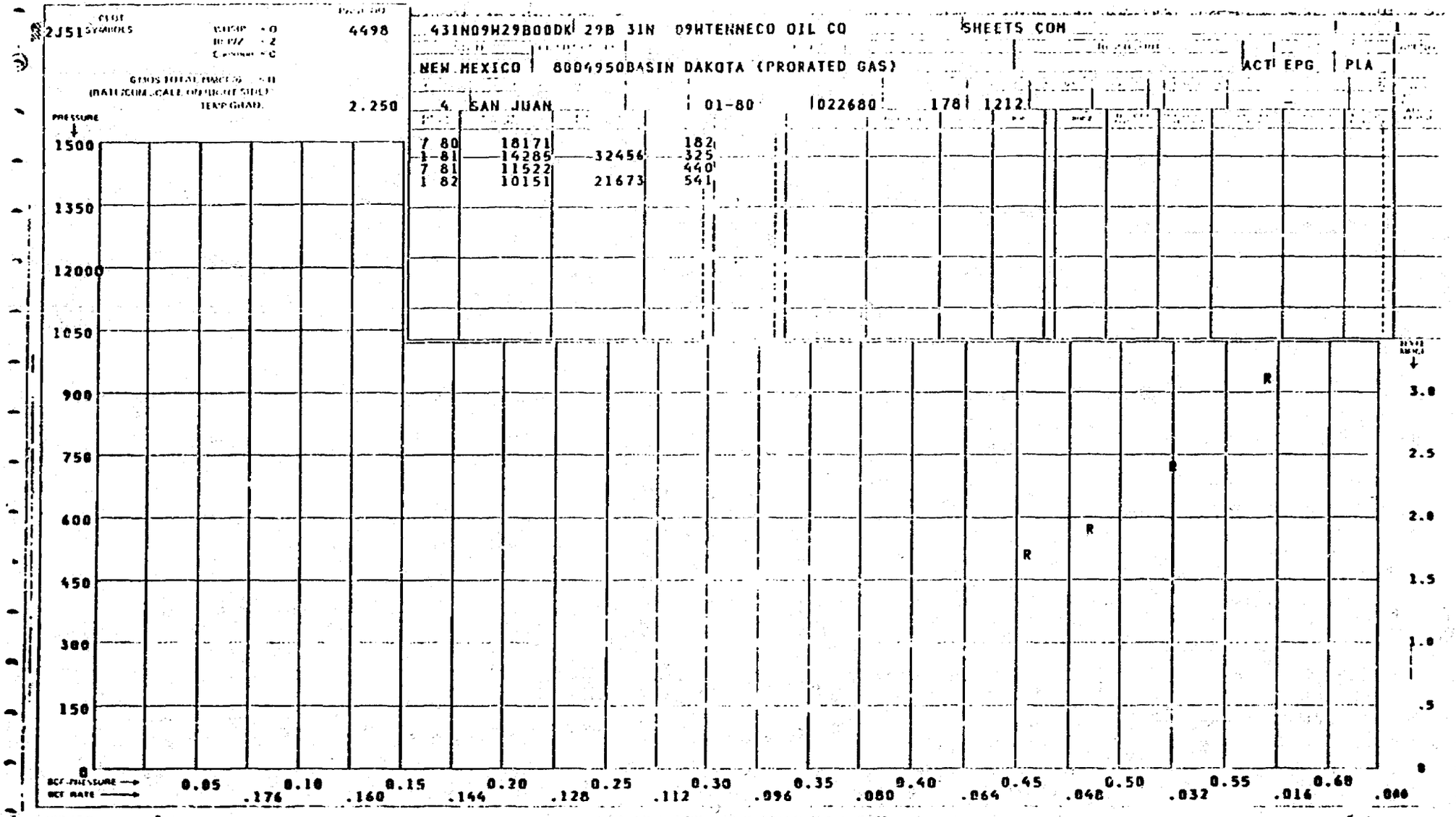

2J51
4491
2.250
431N09W26B00DK 26B 31N 09WSUPRON ENERGY CORP HUNSAKER 2R
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
ACT SUG PLA
4 SAN JUAN 01-79 090979 88 945
7 79 28443 284
1 80 15024 43467 435 678 238
7 80 10730 542 494 4 8 80 51 955 P INC 222 148 148
1 81 13985 24715 682
7 81 6446 746
1 82 8848 15294 835
PRESSURE
1000
900
800
700
600
500
400
300
200
100
0
RATE PRICE
4.8
4.0
3.2
2.4
1.6
.8
0
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
.220 .200 .180 .160 .140 .120 .100 .080 .060 .040 .020 .000


2J51
4498
2.250
431N09W29B00DK 29B 31N 09WTENNECO OIL CO
SHEETS COM
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
ACTI EPG PLA
4 SAN JUAN 01-80 022680 178 1212
7 80 18171 182
1-81 14285 32456 325
7 81 11522 440
1 82 10151 21673 541
PRESSURE
1500
1350
1200
1050
900
750
600
450
300
150
0
3.0
2.5
2.0
1.5
1.0
.5
0
R
MCF/PRESSURE
MCF RATE
0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
.176 .160 .144 .128 .112 .096 .080 .064 .048 .032 .016 .000

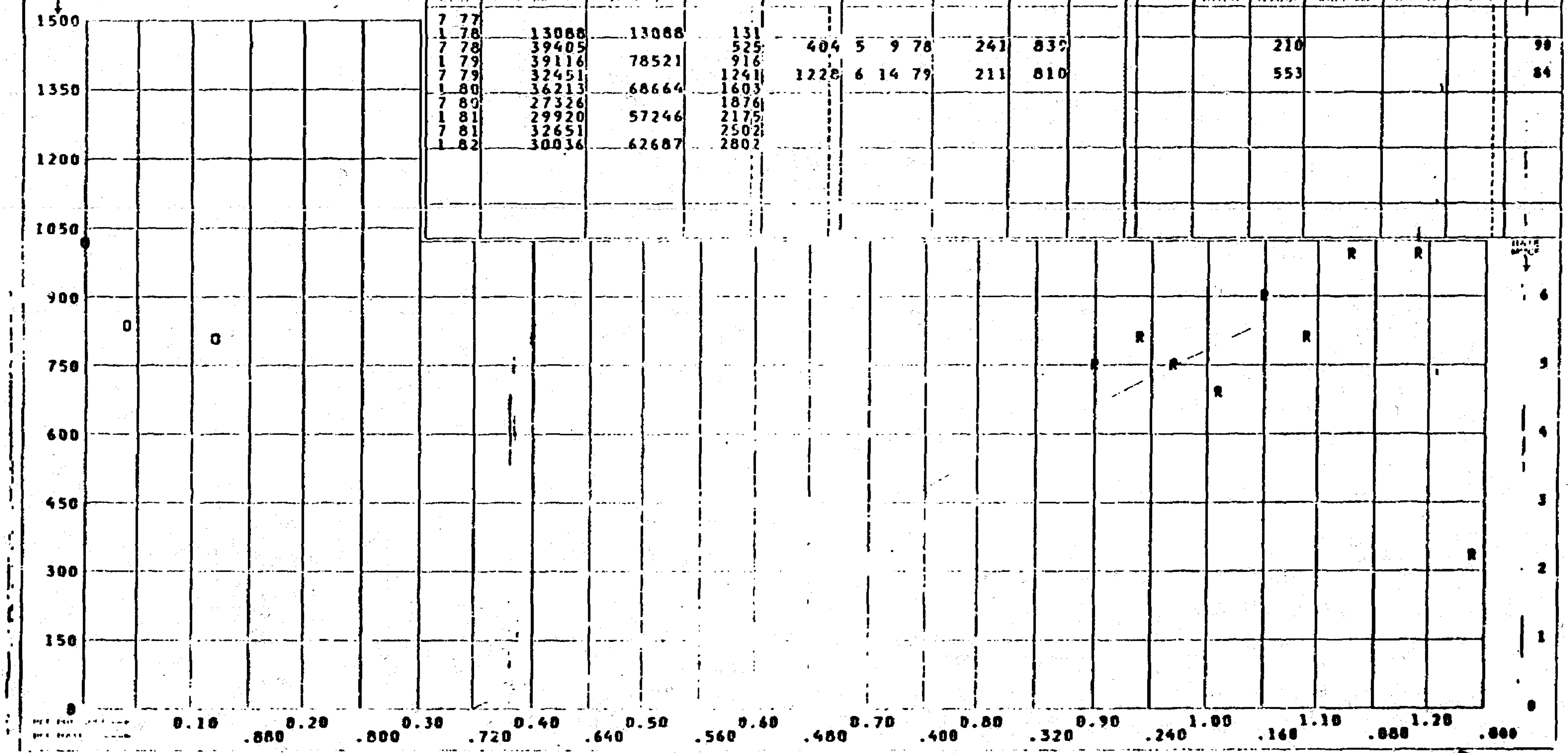
2J51 4499

431N09W34B00DK 34B 31N 09WTENNECO OIL CO PRITCHARD 9

NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS) ACT EPG PLA 20738

2.250 4 SAN JUAN 11-77 010677 246 1032

7 77									
1 78	13088	13088	131						
7 78	39405		525	404	5 9 78	241	839	210	98
1 79	39116	78521	916						
7 79	32451		1241	1228	6 14 79	211	810	553	84
1 80	36213	68664	1603						
7 80	27326		1876						
1 81	29920	57246	2175						
7 81	32651		2502						
1 82	30036	62687	2802						



2J51 PLOT SYMBOLS

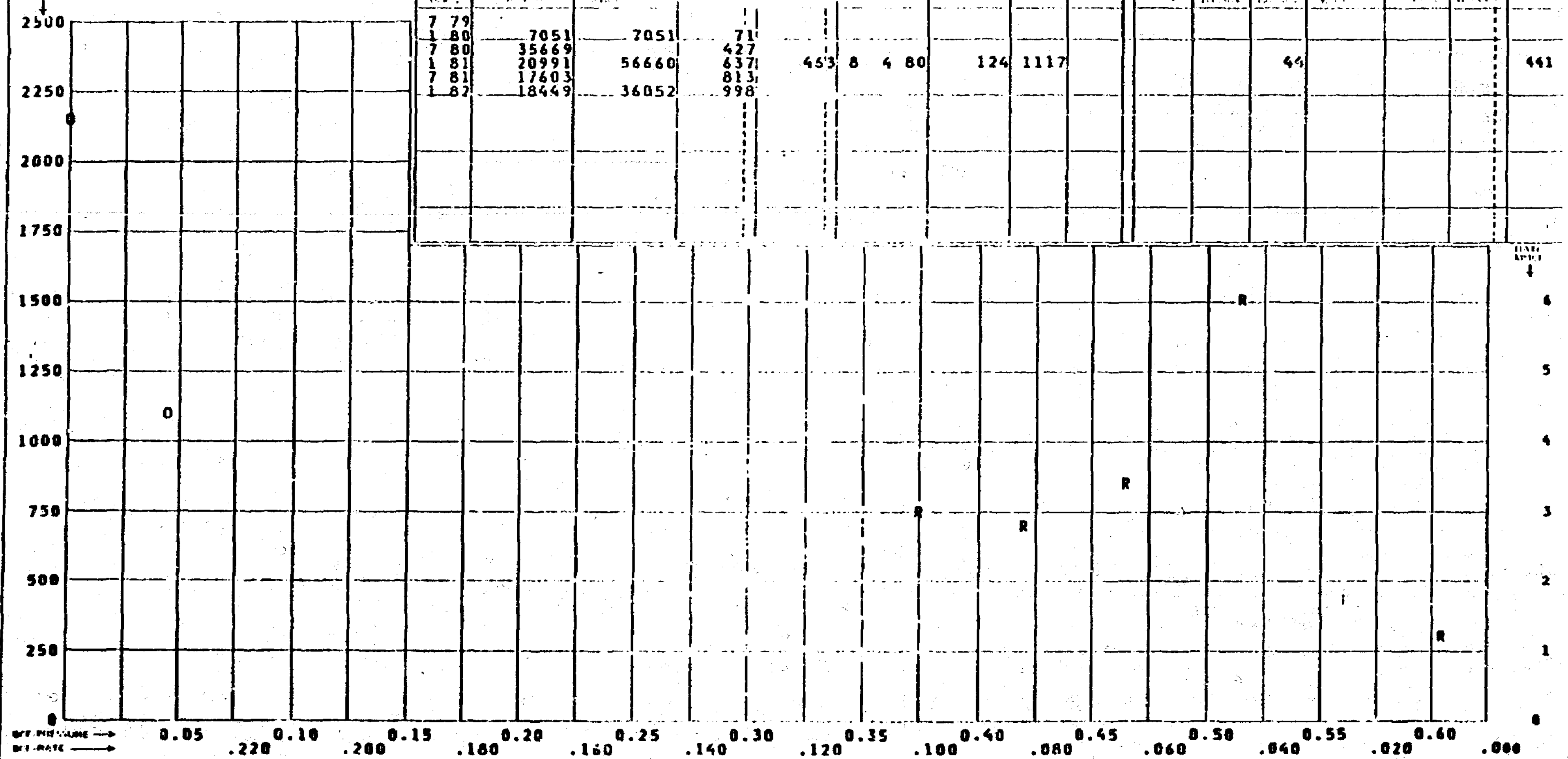
4500

431N09W34L00DK 34L 31N 09WTENNECO OIL CO PRITCHARD 6

NEW MEXICO | 8004950BASIN DAKOTA (PRORATED GAS) | ACT EPG | PLA

2.250 | 4 SAN JUAN | 082579 | 12-79 | 082579 | 1739 | 2163 | 7688 | 7422- 7636

7 79									
1 80	7051	7051	71						
7 80	35669		427						
1 81	20991	56660	637	453	8 4 80	124	1117	44	441
7 81	17603		813						
1 82	18449	36052	998						



DWIGHTS

SUPPLEMENTARY EXHIBIT L-3

WINDOW 30N-8W SECTION 35

WELLS INSIDE WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY(MMCF)
Florance #39 Tenneco NWNE 35-30N-8W	450
Lively 7Y Lively SWNW 35-30N-8W	480
Lively 7E Lively NWSW 35-30N-8W	Not on as of 3-1-82

Cumulative = 930 MMCF

Avg Cum Per Well = $\frac{930}{2}$ = 465 MMCF

WELLS IMMEDIATELY SURROUNDING WINDOW

WELL NAME OPER/LOC	EST ULTIMATE RECOVERY(MMCF)
Florance #29 Tenneco NESW 25-30N-8W	380
Lively Com #14 Lively NESW 3-30N-8W	400

Cumulative = 780 MMCF

Avg Cum Per Well = $\frac{780}{2}$ = 390 MMCF

2J51 PLOT SYMBOLS: WHSIP = O; BHP/Z = Z; Common = C

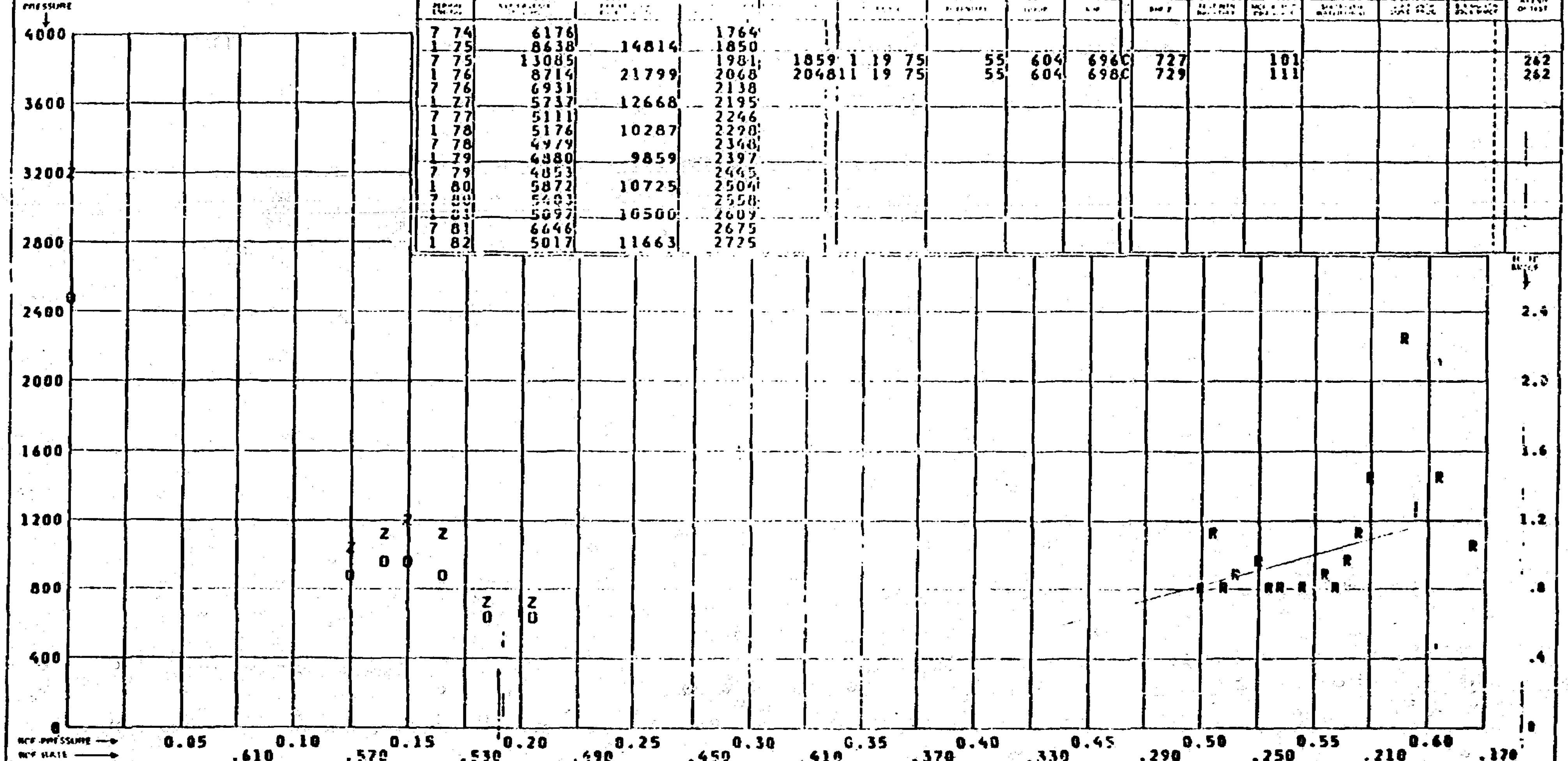
6 MOS TOTAL MMCF/6 = R (RATE/CUM SCALE ON RIGHT SIDE)

TEMP GRAD. 2.250

PAGE 4094

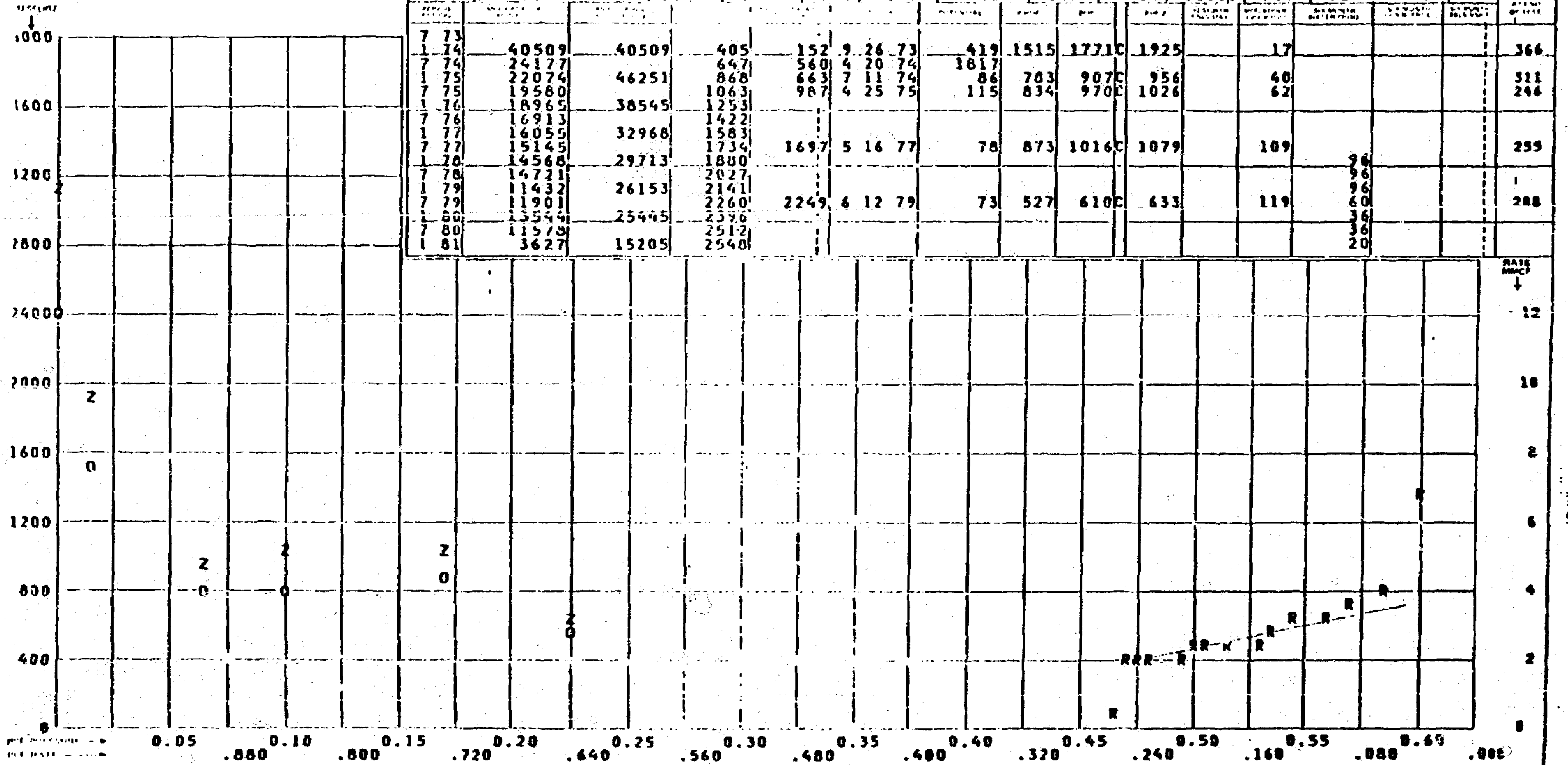
430N08W35D000K	35B 30N	08WTENNECO OIL CO		FLORANCE							39
NEW MEXICO	80049500BASIN DAKOTA (PRORATED GAS)							ACT	EPG	INL	9834
4	SAN JUAN	090665	03-66	.60	090665	3698	2453	.750	3161C	7320	7083- 7296

7 74	6176		1764												
1 75	8638	14814	1850												
7 75	13085		1981	1859 1 19 75	55	604	696C	727		101					262
1 76	8714	21799	2068	2048 1 19 75	55	604	698C	729		111					262
7 76	6931		2138												
1 77	5737	12668	2195												
7 77	5111		2246												
1 78	5176	10287	2298												
7 78	4979		2348												
1 79	4880	9859	2397												
7 79	4853		2445												
1 80	5872	10725	2504												
7 80	5403		2558												
1 81	5097	10500	2609												
7 81	6646		2675												
1 82	5017	11663	2725												



151		4098	430N08W35E000K 35E 30N- 08W LIVELY EXPL CO — LIVELY — 7Y
			NEW MEXICO — 8004950 BASIN DAKOTA (PRORATED GAS) — INA — EPG — PLA — 21237
	TEMP GRAD	2.250	4 — SAN JUAN — 050973 — 08-73 — .61 — 050973 — 1617 — 2423 — .750 — 3100C — 7444 — 7249- 7438

7 73															
1 74	40509	40509	405	152	9 26 73	419	1515	1771C	1925		17				366
7 74	24177		647	560	4 20 74	1817									
1 75	22074	46251	868	663	7 11 74	86	783	907C	956		40				311
7 75	19580		1063	987	4 25 75	115	834	970C	1026		62				246
1 76	18965	38545	1253												
7 76	16913		1422												
1 77	16055	32968	1583												
7 77	15145		1734	1697	5 16 77	78	873	1016C	1079		109				255
1 78	14568	29713	1800									96			
7 78	14721		2027									96			1
1 79	11432	26153	2141									96			
7 79	11901		2260	2249	6 12 79	73	527	610C	633		119	60			288
1 80	13544	25445	2396									36			
7 80	11579		2512									36			
1 81	3627	15205	2548									20			



J51 SYMBOLS WHSIP = O, BHP/Z = Z

6 MOS TOTAL = R (RATE/CUM SCALE ON RIGHT SIDE)

TEMP GRAD. 2.250

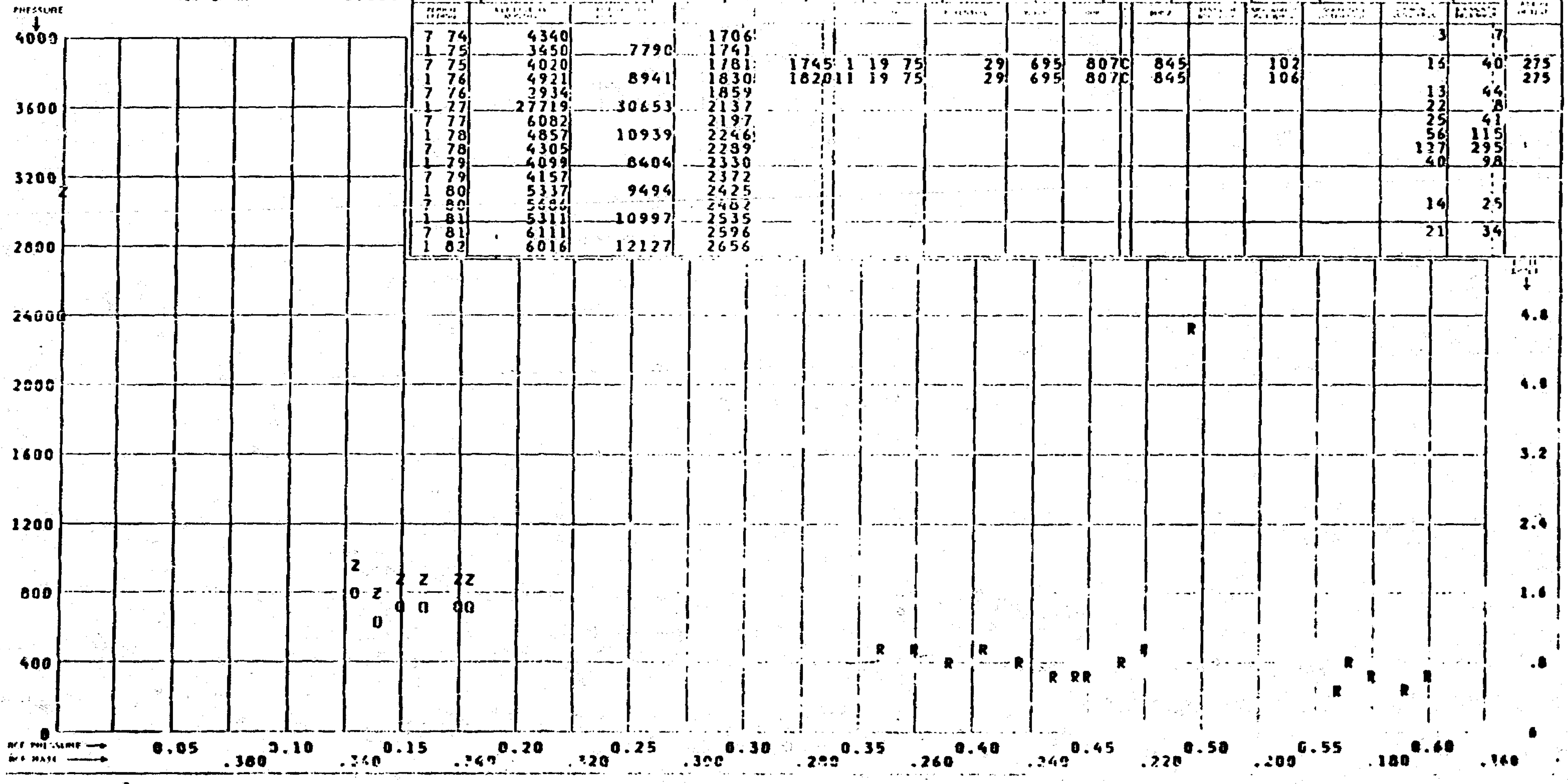
PAGE NO 4088

430N08H25K00DK | 25X 30N 08W TENNECO OIL CO FLORANCE | 29

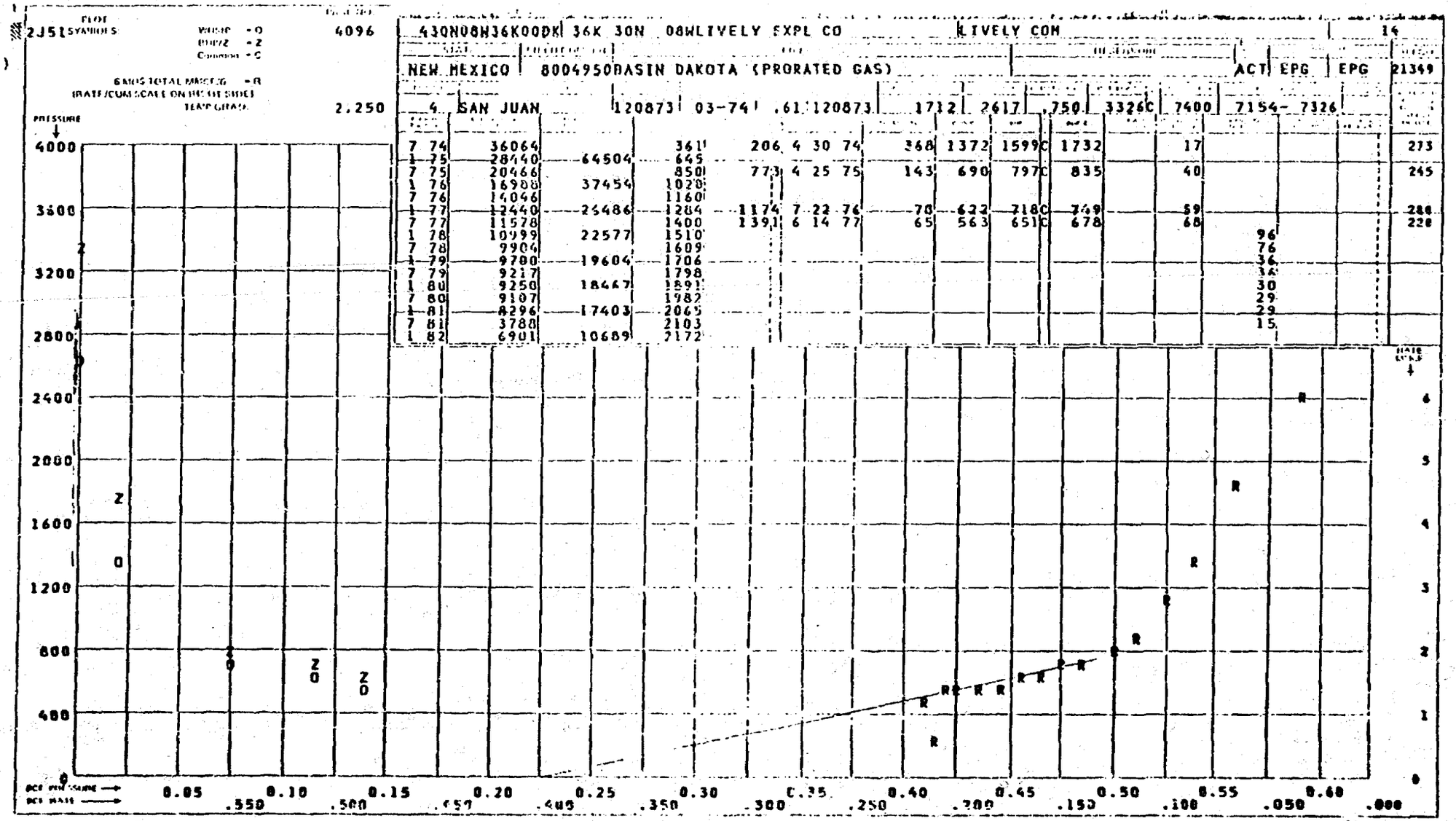
NEW MEXICO | 0004950 BASIN DAKOTA (PRORATED GAS) | ACT | EPG | PLA | 21786

4 | SAN JUAN | 121364 | 11-65 | .60 | 121864 | 2708 | 2413 | .750 | 3092C | 7680 | 7460- 7541

7 74	4340		1706									3	7	
1 75	3450	7790	1741											
7 75	4020		1781	1745 1 19 75	29	695	807C	845		102		15	40	275
1 76	4921	8941	1830	182011 19 75	29	695	807C	845		106				275
7 76	3934		1859									13	44	
1 77	27719	30653	2137									22	8	
7 77	6082		2197									25	41	
1 78	4857	10939	2246									56	115	
7 78	4305		2289									137	295	
1 79	4099	8404	2330									40	98	
7 79	4157		2372											
1 80	5337	9494	2425									14	25	
7 80	5686		2482											
1 81	5311	10997	2535											
7 81	6111		2596									21	34	
1 82	6016	12127	2656											



RICHARDSON TEXAS 75081


2J51
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2.250
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LIVELY COM
NEW MEXICO 8004950BASIN DAKOTA (PRORATED GAS)
ACT EPG
EPG
21369
4 SAN JUAN 120873 03-741 .61 120873 1712 2617 .750 3326C 7400 7154- 7326
7 74 36064 361 206 4 30 74 368 1372 1599C 1732 17 273
1 75 28440 64504 645
7 75 20466 850 773 4 25 75 143 690 797C 835 40 245
1 76 16908 37454 1028
7 76 14046 1160
1 77 12440 26486 1284 1174 7 22 76 78 622 718C 749 59 288
7 77 11578 1400 1391 6 14 77 65 563 651C 678 68 228
1 78 10999 22577 1510
7 78 9904 1609
1 79 9780 19604 1706
7 79 9217 1798
1 80 9250 18447 1891
7 80 9107 1982
1 81 8296 17403 2065
7 81 3788 2103
1 82 6901 10689 2172
96
76
36
36
30
29
29
15
PRESSURE
4000
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3200
2800
2400
2000
1600
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SUPPLEMENTARY EXHIBIT M

ACTIVITY AND DEVELOPMENT DATA
SAN JUAN DAKOTA TIGHT GAS AREA

TWP-RGE	POSSIBLE(1) DRILL SITES	DRILL SITES(2) TESTED	% DEVELOPED (# OF SECTIONS) 0%	25%	50%	75%	100%
32N-9W	108	1	26	1	0	0	0
32N-8W	120	11	21	7	2	0	0
32N-7W	84	18	3	12	3	0	0
31N-9W	136	10	26	6	2	0	0
31N-8W	140	12	25	8	2	0	0
30N-10W	76	5	16	1	2	0	0
30N-9W	128	28	10	16	6	0	0
30N-8W	128	18	16	15	0	1*	0
29N-9W	8	3	0	1	1	0	0
29N-8W	24	5	3	1	2	0	0
TOTAL	952	111	146	68	20	1	0

*Includes replacement well

% of possible locations developed = 111/952 = 11.7%
% of sections with 0% tested = 62.1%
% of sections with 25% tested = 28.9%
% of sections with 50% tested = 8.5%
% of sections with 75% tested = .5%
% of sections with 100% tested = 0%

(1) Estimates made for non-standard sections
(2) Includes all penetrations (P & A, D & A, TA, etc.)

Memo

From

FLORENE DAVIDSON
ADMINISTRATIVE SECRETARY

4/27/82

To

Mr. Kovich called and requested that this application be set for hearing on June 9, 1982.

Tenneco Oil
A Tenneco Company

Tenneco Building
P.O. Box 2511
Houston, Texas 77001
(713) 757-2131

April 22, 1982

Joe Ramey, Director
Oil Conservation Division
State Land Office Bldg., Room 206
Old Santa Fe Trail
Santa Fe, New Mexico 87501

Case 7608

Re: Application of Tenneco Oil Company for hearing, designation of Basin Dakota Gas Pool, San Juan County, New Mexico as a tight formation

Dear Mr. Ramey:

Enclosed are the original and three copies of Tenneco Oil Company's Application for hearing. We wish to have this case heard on May 12, 1982, if at all possible.

Please accept this letter and enclosure as verbal application pursuant to Division Rule 1203 should the enclosed application be insufficient in any respect.

We also request that the extra copy of the Application be returned to us after a case number has been assigned and a hearing date set.

Very truly yours,

M. P. Kovich
Attorney

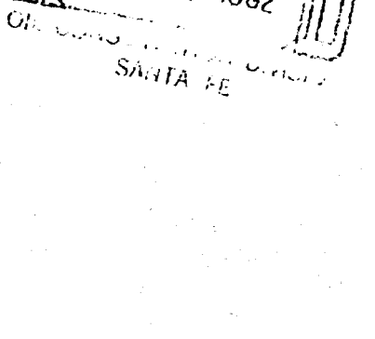
RECEIVED
APR 27 1982
OIL CONSERVATION DIVISION
SANTA FE

MPK/keb

Enclosures

LTOC 101A 8/79

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION



IN THE MATTER OF:

Application of Tenneco Oil Company for designation of the Basin Dakota Gas Pool, San Juan County, New Mexico, as a tight formation.) Case _____

APPLICATION

COMES NOW, Tenneco Oil Company, Applicant, and respectfully requests pursuant to Rule 1203 of Oil Conservation Division Rules and Regulations that a hearing be called to receive evidence that the Basin Dakota Gas Pool underlying certain portions of San Juan County, New Mexico be recommended to the Federal Energy Regulatory Commission (FERC) for designation as a tight formation under Section 107(c)(5) of the Natural Gas Policy Act of 1978.

Applicant would show the Division as follows:

1. The Basin Dakota Gas Pool underlying the lands described below meet the guidelines for designation as a tight formation contained in FERC Regulation Section 271.703(c).

Township 32 North - Range 9 West	all sections
Township 32 North - Range 8 West	all sections
Township 32 North - Range 7 West	sections 7 - 9, 16 - 21 and 25 - 36
Township 31 North - Range 9 West	all sections except 27 and 28
Township 31 North - Range 8 West	all sections except 32
Township 30 North - Range 10 West	section 1 - 18 and 24
Township 30 North - Range 9 West	all sections except 31 - 34
Township 30 North - Range 8 West	all sections except 3 - 5 and 35
Township 29 North - Range 9 West	sections 1 and 2
Township 29 North - Range 8 West	sections 1 - 6

2. Existing State and Federal regulations will assure development of the recommended tight formation will not adversely affect any fresh water aquifers (during both hydraulic fracturing and waste disposal operations) that are or are expected to be used as a domestic or agricultural water supply.

Applicant will provide copies of the exhibits and information it intends to present at the hearing to the Division and the Minerals Management Service office in Albuquergue, New Mexico, no later than fifteen (15) days before the hearing. Applicant reserves the right to present additional evidence at the hearing or modify, change or delete material from the exhibits and information submitted prior to the hearing.

Respectfully submitted,

M. P. Kovich

M. P. Kovich
Attorney for Applicant
Tenneco Oil Company
P.O. Box 2511
Houston, Texas 77001
Phone: (713) 757-2864

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

RECEIVED
JUL 27 1982
OIL CONSERVATION DIVISION
SANTA FE

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 7608
ORDER NO. R-7047

APPLICATION OF TENNECO OIL COMPANY FOR DESIGNATION OF A TIGHT FORMATION, SAN JUAN COUNTY, NEW MEXICO

ORDER OF THE DIVISION

BY THE DIVISION:

This Case came on for hearing at 9:00 a.m. on June 9, 1982, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this ____ day of July, 1982, the Division Director, 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 Division has jurisdiction over this Case and the subject matter thereof.

(2) That the Applicant, Tenneco Oil Company, requests that the Division in accordance with Section 107 of the Natural Gas Policy Act of 1978 and 18 C.F.R. §271.701-703 recommend to the Federal Energy Regulatory Commission (FERC) that the Basin Dakota formation underlying certain lands in San Juan County, New Mexico, as described on Exhibit "A" attached to this Order, hereinafter referred to as the Basin Dakota formation, be designated as a tight formation in the Federal Energy Regulatory Commission's regulations.

(3) That the area proposed for tight formation designation lies within the horizontal limits of the Basin-Dakota Pool, which is a very large area previously defined and described by the Oil Conservation Division in San Juan County, New Mexico.

(4) That within the Basin-Dakota Pool are large areas of extensive development and large areas of very limited development.

(5) That the Dakota formation has been approved for infill drilling which permits the subject area to be developed with one Dakota well on each quarter section or 160-acre tract.

(6) That the area for which tight formation designation is herein sought is comprised of standard sections and a large number of irregularly shaped sections.

(7) That the total potential number of wells required to fully develop said area with an original well and an infill well on each proration unit (standard or non standard size) is approximately 952.

(8) That at the time of the hearing a total of 111 wells had been drilled in the area of which 87 were producers or 12 percent and 9 percent, respectively, of the potential drillable wells.

(9) That no proration unit within the proposed area contains an infill well.

(10) ~~(8)~~ That the area proposed for tight formation designation is a largely undeveloped ~~exploratory~~ area.

(11) That the application excluded from consideration three small areas or windows consisting of the following described sections:

Area No. 1

Township 30 North, Range 8 West, NMPM
Sections 3, 4, and 5: All

Township 31 North, Range 8 West, NMPM
Section ~~27 and 28~~ 32: All

Area No 2

Township 31 North, Range 9 West, NMPM
Section 27 and 28: All

Area No 3

Township 30 North, Range 8 West, NMPM
Section 35: All

(12) - - - - - - - -

(13) That these areas were excluded from ~~the application~~ from consideration by the applicant solely due to anomalous production considered to be of limited extent and unexplainable by ordinary engineering and geological examination.

(13) That there was no evidence available as to the in situ gas permeability or unstimulated gas well production within said areas

(13) ~~(3)~~ That the Basin Dakota formation underlies all of the lands described in Exhibit "A"; that the formation consists of transgressive sands which exhibit poor grain sorting and high silt and clay content due to the processes of the depositional environments; that the top of the formation is found at an average depth of 7575 feet below the surface; and that the gross thickness of productive sand is approximately 250-300 feet.

(14) That the type section for the Basin Dakota formation is described as that 400 foot interval found below a depth of 7251 feet as found on the Induction-Electrical and Gamma Ray log from the El Paso Natural Gas Gartner #9 well located in the NE/4 of Section 33, Township 30 North, Range 8 West, San Juan County, New Mexico.

(15) ~~(7)~~ That the technical evidence presented in this Case demonstrated that no well formerly or currently completed in the Basin Dakota formation within the proposed area exhibited permeability, gas productivity, or crude oil productivity in excess of the following parameters:

(a) average in situ gas permeability throughout the pay section of 0.1 millidarcy; and

(b) stabilized gas production rate, without stimulation, against atmospheric pressure, of 336 MCFPD, the FERC maximum allowable gas production rate for an average formation depth of 7575 feet; and

(c) crude oil production rate of 5 barrels per day.

(16) ~~(12)~~ That the technical evidence presented in this case demonstrated that the predominant percentage of wells which may be completed in the Dakota formation within the proposed tight formation area may reasonably be presumed to exhibit permeability, gas productivity, or crude oil productivity not in excess of the ~~following~~ above described parameters ~~[illegible]~~

(14) that the top of the B.

(b) stabilized production rates, without stimulation, against atmospheric pressure, as found in the table set out in 18 C.F.R. §271.703(c)(2)(B) of the regulations; and

(c) production of more than five barrels of crude oil per day.

(17) ~~(13)~~ That within the proposed area there is a recognized aquifer being the Ojo Alamo, found at ~~a minimum~~ depths of ~~2000~~ 5000 ~~feet or approximately 4000~~ feet above the Dakota formation.

To 6000

(18) ~~(14)~~ That existing State of New Mexico and Federal Regulations relating to casing and cementing of wells will assure that development of the Dakota formation will not adversely affect any overlying aquifers.

(19) ~~(15)~~ That the area described on Exhibit "A" to this order should be recommended to the Federal Energy Regulatory Commission for designation as a tight formation.

IT IS THEREFORE ORDERED:

(1) That it be and hereby is recommended to the Federal Energy Regulatory Commission pursuant to Section 107 of the Natural Gas Policy Act of 1978, and 18 C.F.R. §271.703 of the regulations that the Dakota formation underlying those lands in San Suan County, New Mexico, described on Exhibit "A" to this order, be designated as a tight formation.

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

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

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S E A L
fd/

Case No. 7608
Order No. R-

EXHIBIT "A"

Township 32 North, Range 7 West
Sections 7 through 9: all
Sections 16 through 21: all
Sections 25 through 36: all

Township 32 North, Range 8 West
Sections 7 through 36: all

Township 32 North, Range 9 West
Sections 7 through 36: all

Township 31 North, Range 8 West
Sections 1 through 31: all
Sections 33 through 36: all

Township 31 North, Range 9 West
Sections 1 through 26: all
Sections 29 through 36: all

Township 30 North, Range 8 West
Sections 1 and 2: all
Sections 6 through 34: all
Section 36: all

Township 30 North, Range 9 West
Sections 1 through 30: all
Sections 35 and 36: all

Township 30 North, Range 10 West
Sections 1 through 18: all
Section 24: all

Township 29 North, Range 8 West
Sections 1 through 6: all

Township 29 North, Range 9 West
Sections 1 and 2: all

Containing 149,760 acres more or less