CASE 2520: Application of NEWMONT OIL CO. for an amendment of ORDER NO. R-2178, EDDY COUNTY, NEW MEXICO.

No. 1

2-520

Petition, Transcript,

Bill Exhibits, Etc.

LOSEE AND STEWART
CARPER BUILDING
ARTESIA, NEW MEXICO

21 March 1962

Mr. Richard Morris, Attorney
New Mexico Oil Conservation Commission
Land Office Building
P. O. Box 871
Santa Fe, New Mexico

IS 20

Re: Oil Conservation Commission Case No. ~~2473~~
Newmont Oil Company, Applicant

Dear Mr. Morris:

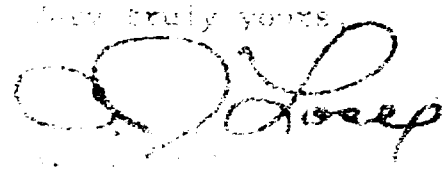
Enclosed herewith you will please find triplicate copies of an Application for a Modification or Amendment of Oil Conservation Commission Order R-2178 duly entered in Case No. 2473. As stated to you on the telephone, I will furnish, in triplicate, Exhibits 1 and 2 to this Application in the next few days.

As a precautionary measure and in order to be assured that you will receive this Application by March 22, we are sending by bus to Santa Fe under separate cover, an additional copy of this Application. We have requested the bus company to call you upon arrival.

On behalf of the Applicant, Newmont Oil Company, I request that this matter be set for hearing before an examiner on April 10, 1962.

Thanking you in advance for your consideration of this request.

Very truly yours,



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

C

April 9, 1962

MEMORANDUM

O

TO: COMMISSIONER E. S. WALKER

FROM: A. L. PORTER, Jr., SECRETARY-DIRECTOR

SUBJECT: THE NEWMONT CASE TO BE HEARD APRIL 10, 1962

P

The applicant in the subject case has applied for what amounts to capacity allowables for a waterflood project in the Loco Hills Pool of Eddy County, and since you were not a member of the Commission when we had the lengthy hearings from which our present waterflood rules evolve, I will give you some of the background on the subject in general, as well as the specifics in this particular case.

Y

Our first major waterflood case came on before Governor Mechem, Commissioner Morgan and myself during 1957 and was known as the "Grarigge" case. The testimony in this case convinced the Commission that for a temporary period until more information could be had, waterflood projects should have capacity allowables, though it was strongly opposed by certain operators at the time.

In October of 1959, after observing the performance of several waterfloods and the effects of unlimited waterflood production on the overall state allowable, the Commission, which was composed of Governor Burroughs, Commissioner Morgan and myself, decided that the whole matter should be reopened for further

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

information. A three day hearing was held in Roswell during which the foremost experts of both the proponents and the opponents of capacity allowables were heard.

As a result of the above-mentioned project, the Commission concluded that unrestricted waterflood production had had an adverse impact upon the market available for primary production, and that production from waterfloods could be controlled without waste. The Commission, however, recognized that a constant injection rate was beneficial and so we provided for allowables which would not fluctuate with the normal unit allowable. The allowables established were based on a ten year average of normal unit allowables.

Because operators of previously authorized projects had already purchased equipment designed for capacity production, we exempted such existing projects from allowable limitations. We also made provisions for the establishment of buffer zones between old and new floods where it could be shown at a hearing that correlative rights might suffer. We further concluded that the allowable provisions of our waterflood rule should not apply to a legitimate expansion of an existing project. In determining what constitutes a legitimate expansion, we consider whether or not the acreage is contiguous, whether the ownership is common, whether efforts at unitizing were underway when the flood was started and whether the equipment had already been designed.

The applicant in the Newmont case first applied for a legitimate expansion of a pilot flood which was authorized before the institution of our rule which limits waterflood allowables. Mr. Nutter heard the case and recommended a buffer zone to be established between the pilot flood and the proposed expansion area and that the new area be subjected to the rules which limit production. The Commission entered an order in line with the examiner's recommendations after reviewing the matter in your office.

Now, the applicant says that after several weeks study, that to comply with our order would result in considerable waste and proposes to offer evidence based upon the operation of the pilot

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

flood, as to how and why such waste will occur.

There are serious questions, and they may be raised at the hearing, as to why this case should be heard in view of the fact that the Commission has already determined that waterflood production can be controlled. I think that the answer is that:

1. The applicant proposes to present evidence that he claims is peculiar to his situation, and

2. The Commission should continue its policy of allowing any applicant a full opportunity to show why he thinks he has a valid reason for exception to any rule when there is a chance that waste is involved.

LAW OFFICES

MAIN OFFICE OCC LOSEE AND STEWART

A. J. LOSEE
EDWARD B. STEWART

CARPER BUILDING - P. O. DRAWER 239
ARTESIA, NEW MEXICO

1962 MAR 22 AM 8:19

21 March 1962

Mr. Richard Morris, Attorney
New Mexico Oil Conservation Commission
Land Office Building
P. O. Box 871
Santa Fe, New Mexico

2520

Re: Oil Conservation Commission Case No. ~~2473~~
Newmont Oil Company, Applicant

Dear Mr. Morris:

Enclosed herewith you will please find triplicate copies of an Application for a Modification or Amendment of Oil Conservation Commission Order R-2178 duly entered in Case No. 2473. As stated to you on the telephone, I will furnish, in triplicate, Exhibits 1 and 2 to this Application in the next few days.

As a precautionary measure and in order to be assured that you will receive this Application by March 22, we are sending by bus to Santa Fe under separate cover, an additional copy of this Application. We have requested the bus company to call you upon arrival.

On behalf of the Applicant, Newmont Oil Company, I request that this matter be set for hearing before an examiner on April 10, 1962.

Thank you in advance for your consideration of this request.

Very truly yours,

A. J. Losee

AJL/bk
Enclosures

Docket Mailed 3-30-62

BEFORE THE OIL CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF NEWMONT OIL COMPANY FOR A MODIFICATION OR AMENDMENT OF ORDER NO. R-2178 OF THE OIL CONSERVATION COMMISSION PROVIDING FOR THE EXPANSION BY NEWMONT OIL COMPANY OF ITS LOCO HILLS WATERFLOOD PROJECT, EDDY COUNTY, NEW MEXICO.	:	Case No. ~~2473~~ 2520

APPLICATION

COMES NEWMONT OIL COMPANY by its attorneys, Losee and Stewart, and respectfully state:

1. That on January 30, 1962, the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission" entered its Order No. 2178 providing for the expansion by Newmont Oil Company of its Loco Hills waterflood project, Eddy County, New Mexico, and reserving jurisdiction of this cause for the entry of such further orders as the Commission may deem necessary.

2. The Commission has approved the West Loco Hills Grayburg No. 4 Sand Unit and Applicant is the proposed unit operator thereof.

3. That a plat showing the location of the presently proposed injection wells and the location of all other wells and the names of the lessees within a radius of two miles from said presently proposed wells was

heretofore filed with the Commission as Exhibit 1 to the original Application in this case and reference is here made to the same.

4. Applicant presently proposes to commence injection of water in the following described injection wells:

Ballard B No. 1, SE/4 NW/4 Section 1, Township 18 South, Range 29 East,

Dixon-Yates Federal No. 2, SE/4 SE/4 Section 1, Township 18 South, Range 29 East,

Newmont-Canfield No. 1-A, NW/4 NW/4 Section 7, Township 18 South, Range 30 East, N.M.P.M.

There are no logs of the presently proposed injection wells available to this Applicant.

5. That a description of the presently proposed injection well casing program was heretofore filed with the Commission as Exhibit 2 to the original Application in this case and reference is here made to the same.

6. That it is proposed to inject water at the rate of approximately 1000 barrels per well per day into the West Loco Hills Grayburg No. 4 Sand, which is shown on the gamma ray neutron log of the Newmont-Ballard Well No. B-6 located in the SW/4 NE/4 Section 1, Township 18 South, Range 29 East, Eddy County, New Mexico, as lying between 2760 and 2792 feet below the surface.

7. The water for this project is to be obtained by purchase from Yucca Water Company.

8. That triplicate copies of Exhibits 1 and 2 to the original application in this case, in which there has been no change, will again be filed by this Applicant prior to the date of hearing.

9. That approval of a modification or amendment to Order R-2178 authorizing an exception to Rule 701-E2 defining the project area of the West Loco Hills Grayburg Sand Unit as comprising all of the proration units within said unit area (which have not heretofore been authorized by this Commission to operate at unrestricted rates of production) that have producing wells completed on them in the same formation, without regard to whether or not the proration units are directly or diagonally offset by injection wells; and assigning to such project area the maximum allowable under Rule 701-E3, to be produced from any well or wells within the unit area, will prevent waste and protect correlative rights.

10. That in the alternative, the approval of a special allowable for the West Loco Hills Grayburg Sand Unit Area (except that portion which has heretofore been authorized by this Commission to operate at unrestricted rates of production) equal to the maximum allowable under Rule 701-E3, to be produced from any well or wells in the project area, will prevent waste and protect correlative rights.

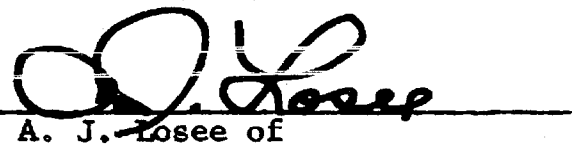
WHEREFORE, Applicant prays the orders of the Commission as follows:

(a) That this matter be set for hearing before an examiner and due notice be given thereof as required by law;

(b) That Commission Order R-2178 be modified or amended to provide for either (i) an exception to Rule 701-E2 as above requested, or (ii) a special allowable for the West Loco Hills Grayburg Sand Unit Area under the authority of Rule 701-E3 as above requested, and

(c) For such other relief as may be just in the premises.

NEWMONT OIL COMPANY

By 

A. J. Losee of
LOSEE AND STEWART
Attorneys at Law
P. O. Box 239
Artesia, New Mexico.

J. CLEO THOMPSON, SR. & JAMES CLEO THOMPSON, JR.
OIL PRODUCERS
12TH FLOOR KIRBY BUILDING
DALLAS 1, TEXAS

April 6, 1962

New Mexico Oil & Gas Conservation Commission
Box 871
Santa Fe, New Mexico

Case 2520

Re: West Loco Hills Water Flood Unit - Eddy County, New Mexico

Attention: Mr. A. L. Porter

Gentlemen:

It is our understanding that on the 10th of April, 1962, you are to give consideration to the application of the West Loco Hills Unit to amend the Order of the Commission, as previously rendered by your Order R-2178, and being one of the unit owners, we would like to submit to you our views regarding the Application, since we will be unable to have a representative at the Hearing.

You are, therefore, respectfully requested to make this letter a part of your record.

It is our feeling: (a) That the evidence as submitted establishes the fact that the Reservoir proposed to be water flooded is in the same field, and the producing horizon is identical with the area which is presently being flooded to the East by Newmont Oil Company.

We, therefore, submit:

(1) That the proposed West Loco Hills unit is a natural expansion of the existing water flood of Newmont Oil Company;

(2) The proposed unit being a natural expansion of an existing water flood, it would be inequitable for the expanded area embraced in the proposed unit to receive different treatment to that presently enjoyed by the present existing water flood;

In support of the above conclusions, we respectfully submit that unless the proposed unit is granted the same rights and privileges which are enjoyed by the present water flood unit operators, the unit being in the same field, and the same horizon, and being adjacent properties, that the proposed unit owners would not be permitted to recover their fair share of the oil in place, and would, in our opinion, result in waste because it would not permit a uniform flood which we feel is necessary in order to recover the most possible oil from the area.

In view of our conclusions as herein stated, we respectfully urge that favorable consideration be given to the Application of the West Loco Hills Unit Operators to amend your Order as heretofore granted, giving the new area the same rights and privileges which their neighbors enjoy at the present time.

Very truly yours,

J. Cleo Thompson

J. Cleo Thompson

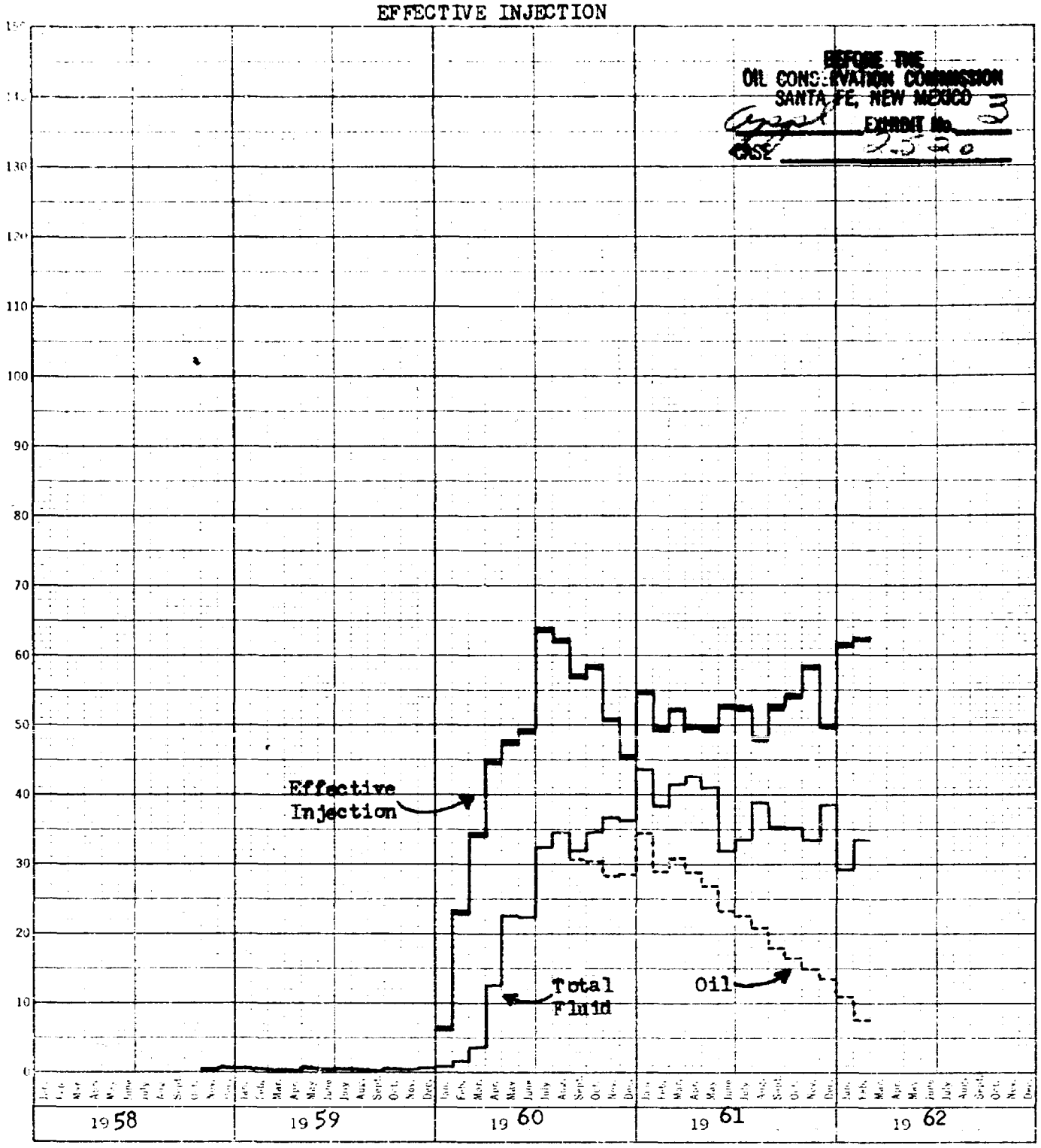
James Cleo Thompson Jr.

James Cleo Thompson, Jr.

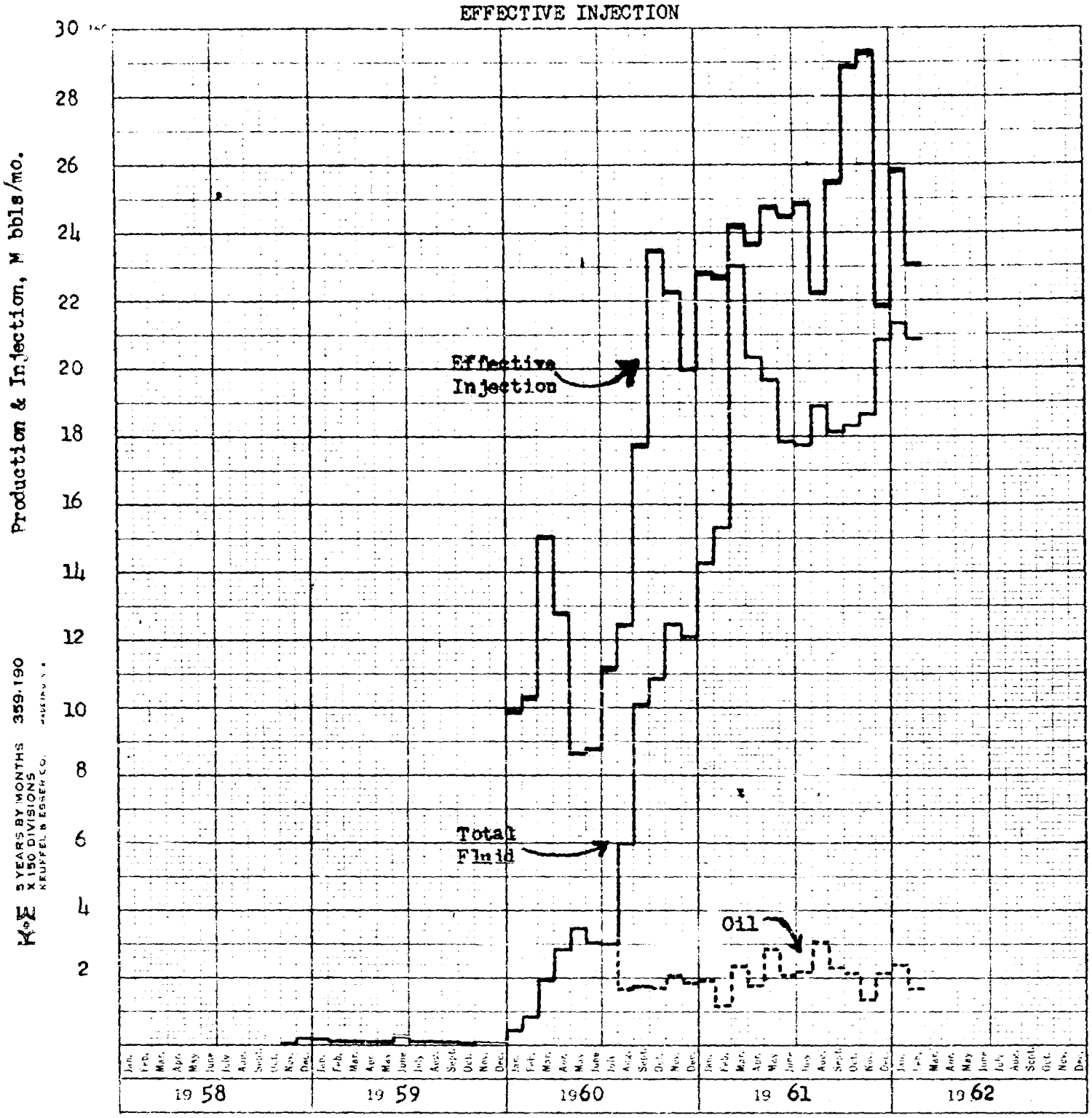
JCT: b . .

NEWMONT OIL COMPANY
LOCO HILLS PROJECT
PILOT AREA
EFFECTIVE INJECTION

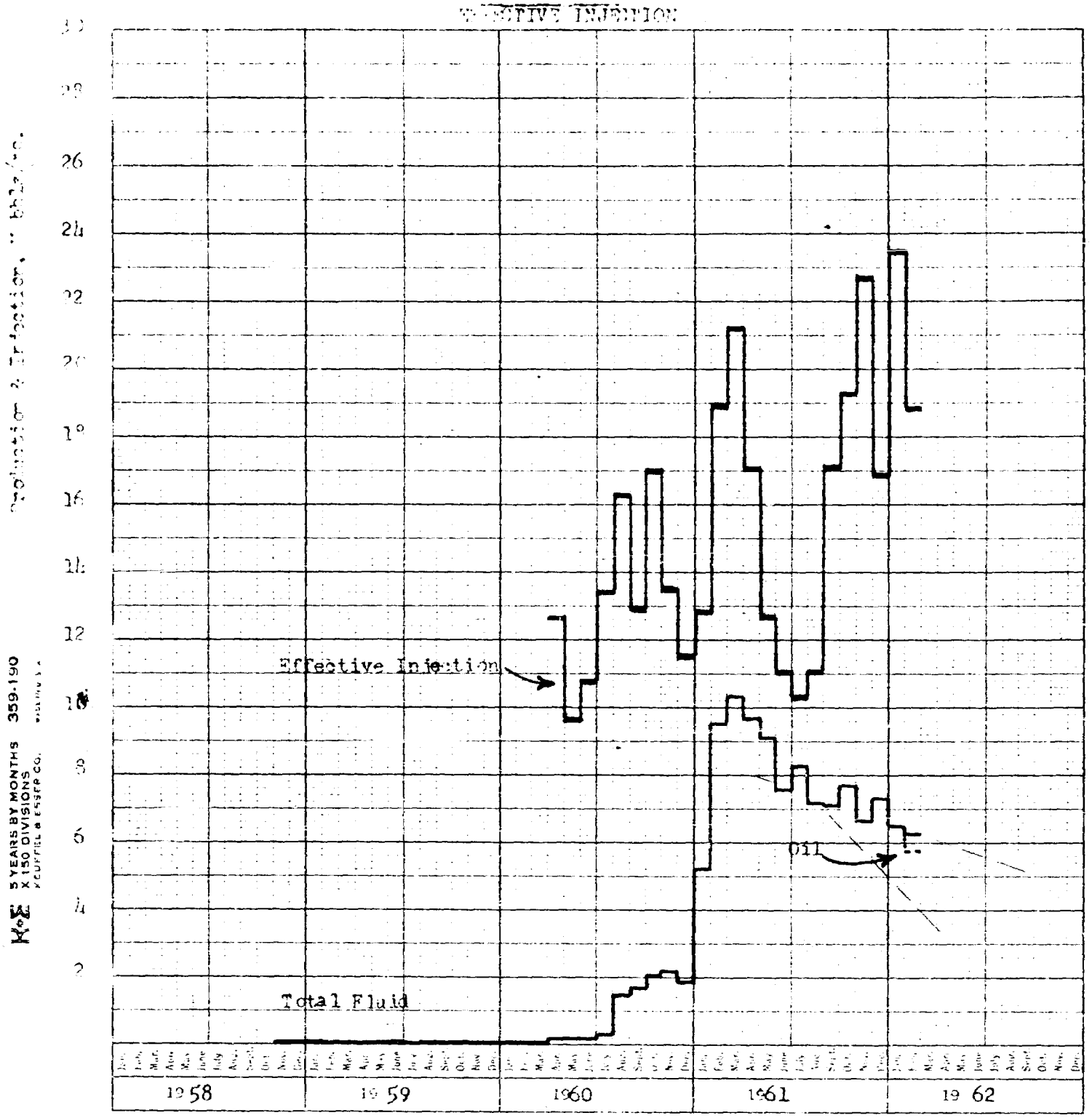
Production & Injection, M bbls/ mo.



NEWMONT OIL COMPANY
BALLARD 1-A
EFFECTIVE INJECTION



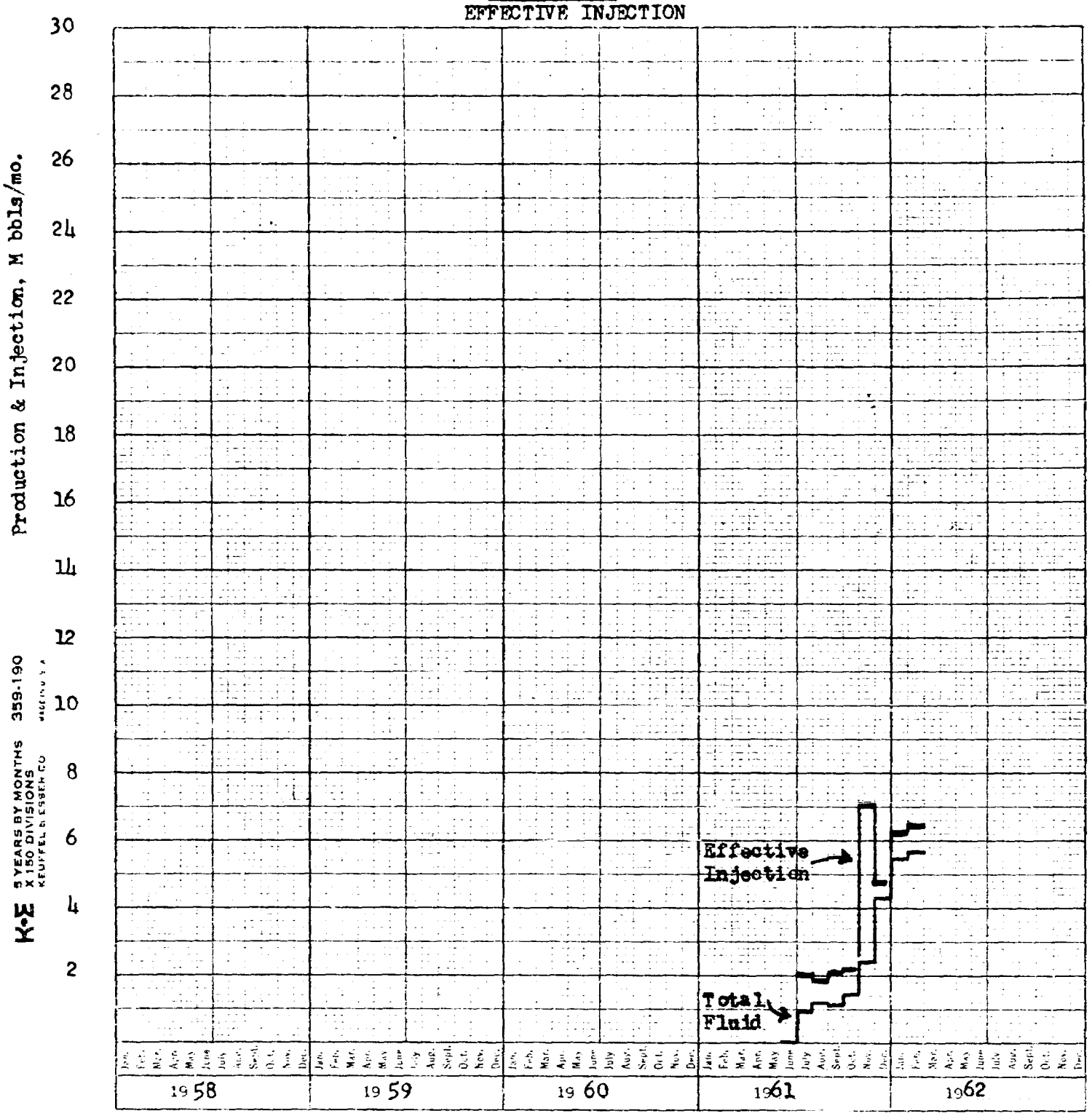
NEWMONT OIL COMPANY
BALLARD 3-A
EFFECTIVE INJECTION



K&E 5 YEARS BY MONTHS
X 150 DIVISIONS
KEUFFEL & ESSER CO.

Reduced Market Limit
119,822 primary recovery still producing
119,165 secondary recovery

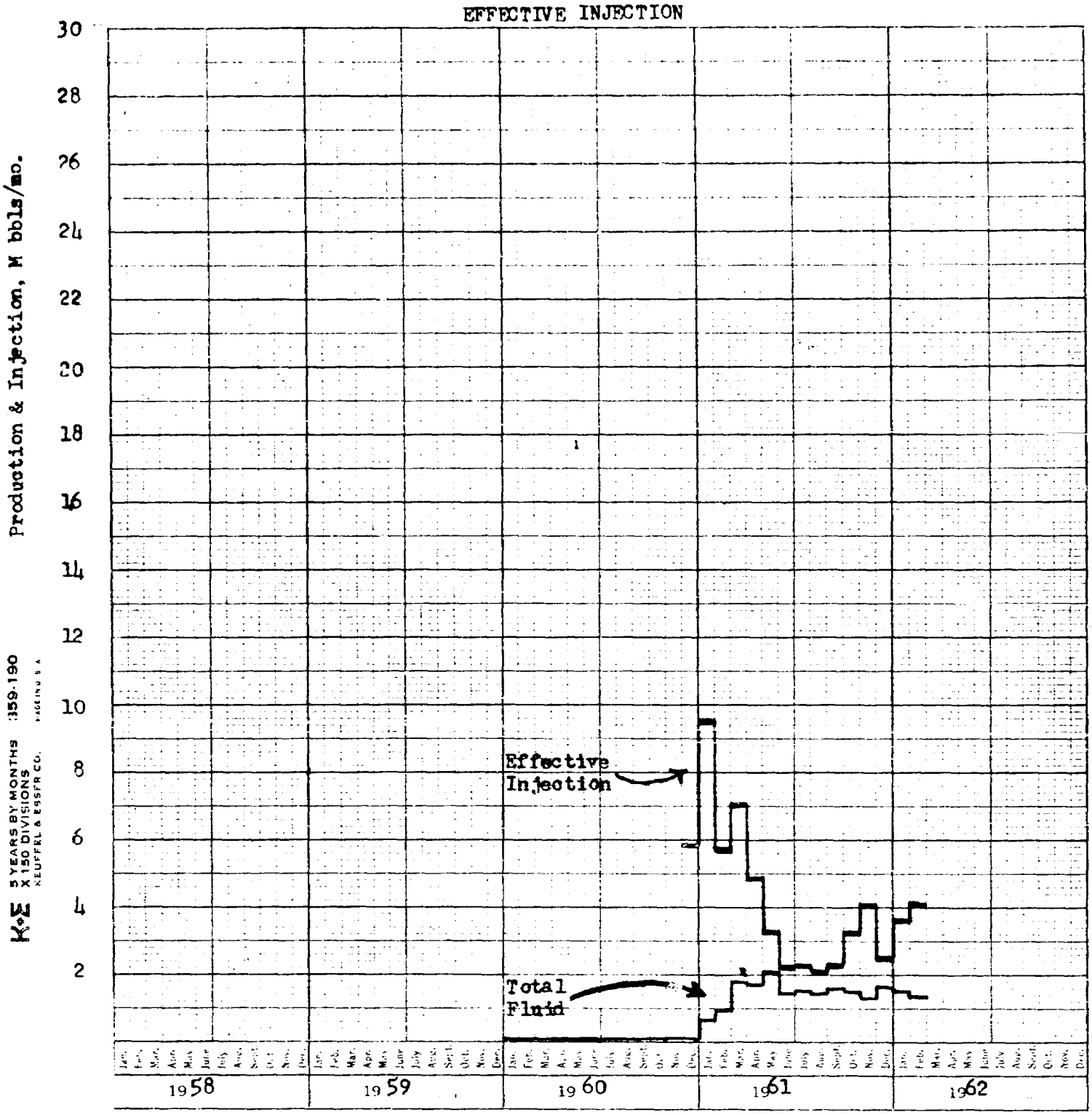
NEWMONT OIL COMPANY
BALLARD A-5
EFFECTIVE INJECTION



K-E 5 YEARS BY MONTHS X 150 DIVISIONS KEUFFEL & ESSER CO

NEWMONT OIL COMPANY
BALLARD B-2

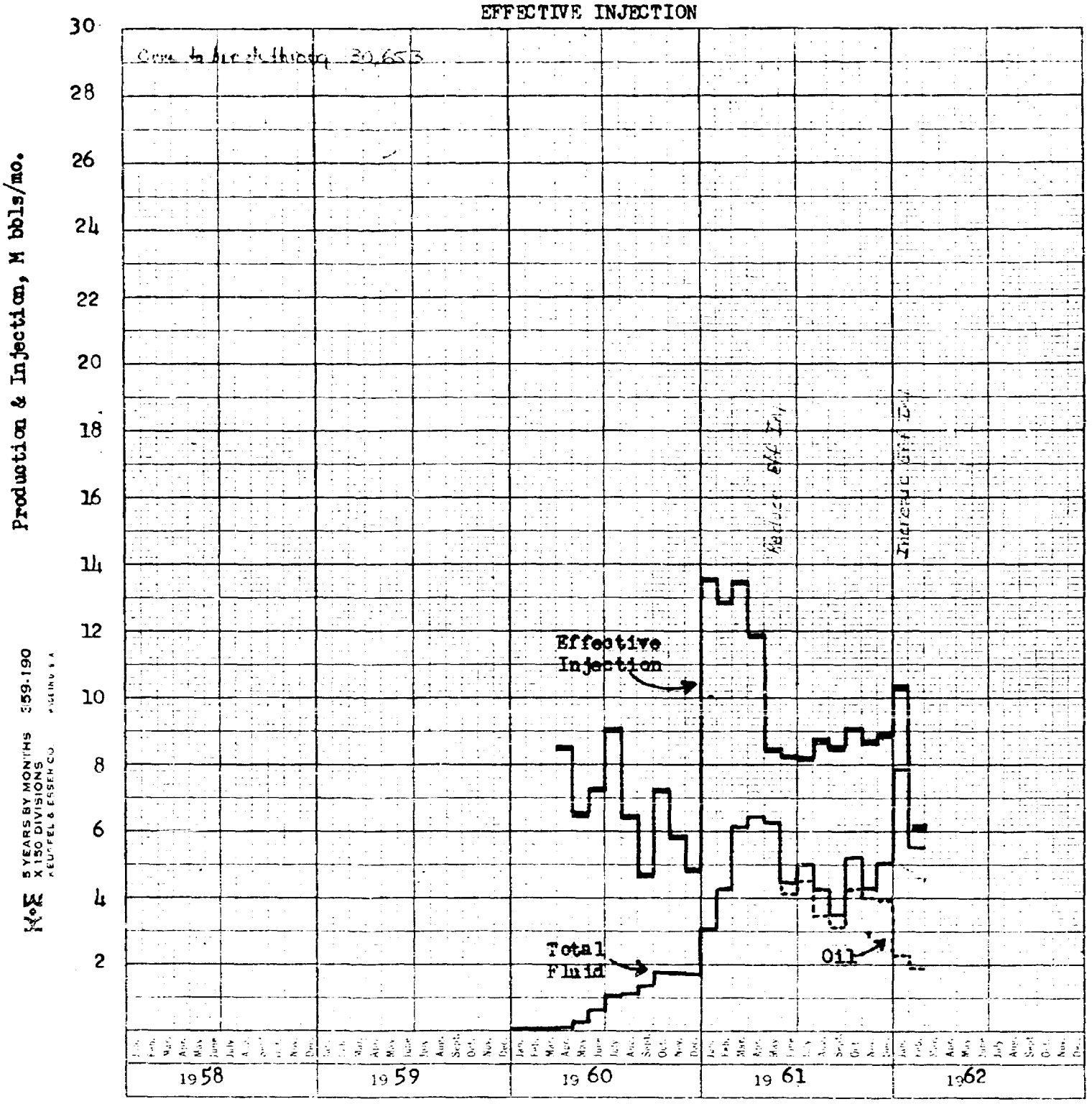
EFFECTIVE INJECTION



NEWMONT OIL COMPANY

BALLARD B-3

EFFECTIVE INJECTION



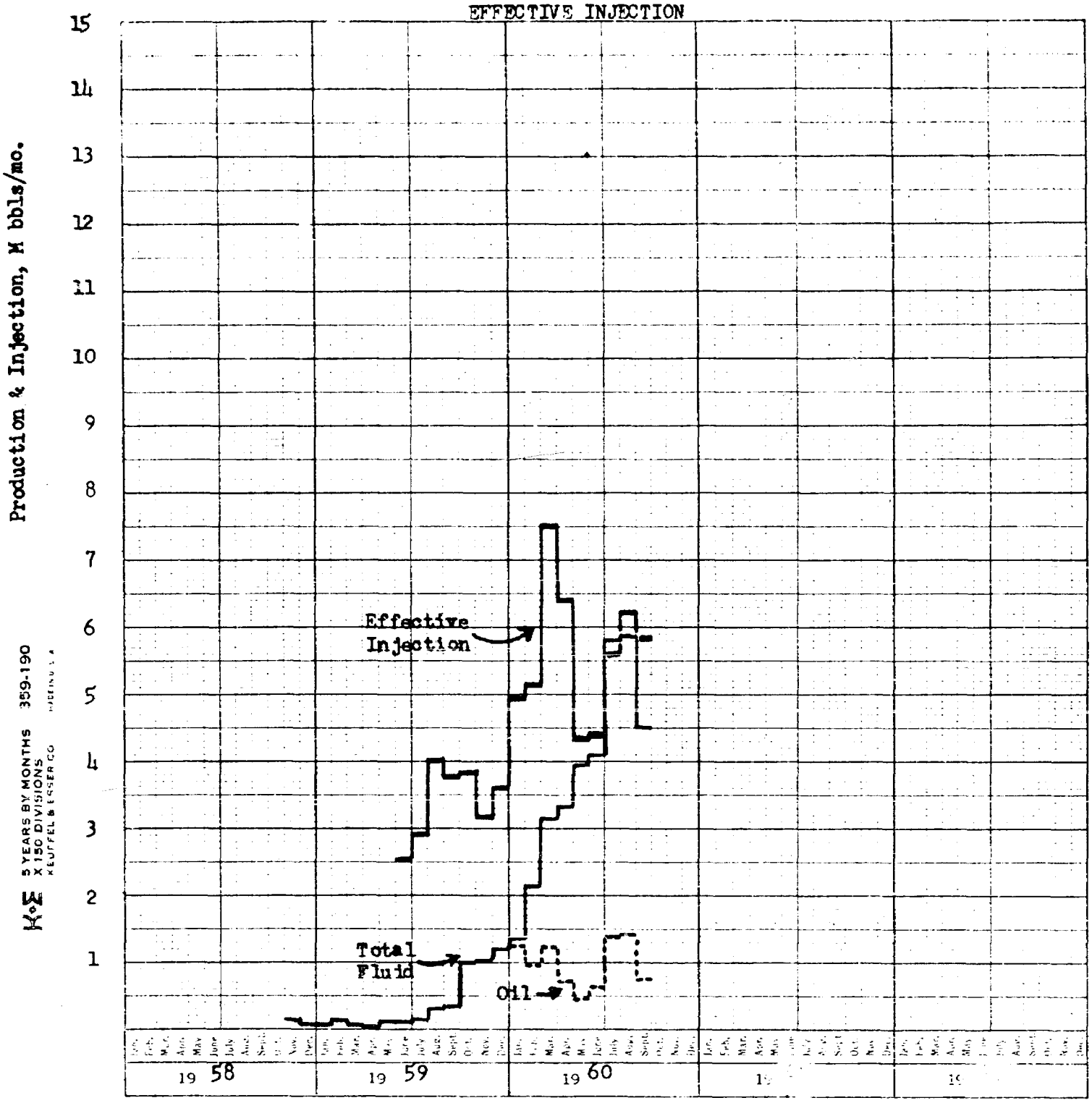
Primary [illegible] / 53.000

Secondary " 68,670

NEWMONT OIL COMPANY

YATES 1

EFFECTIVE INJECTION



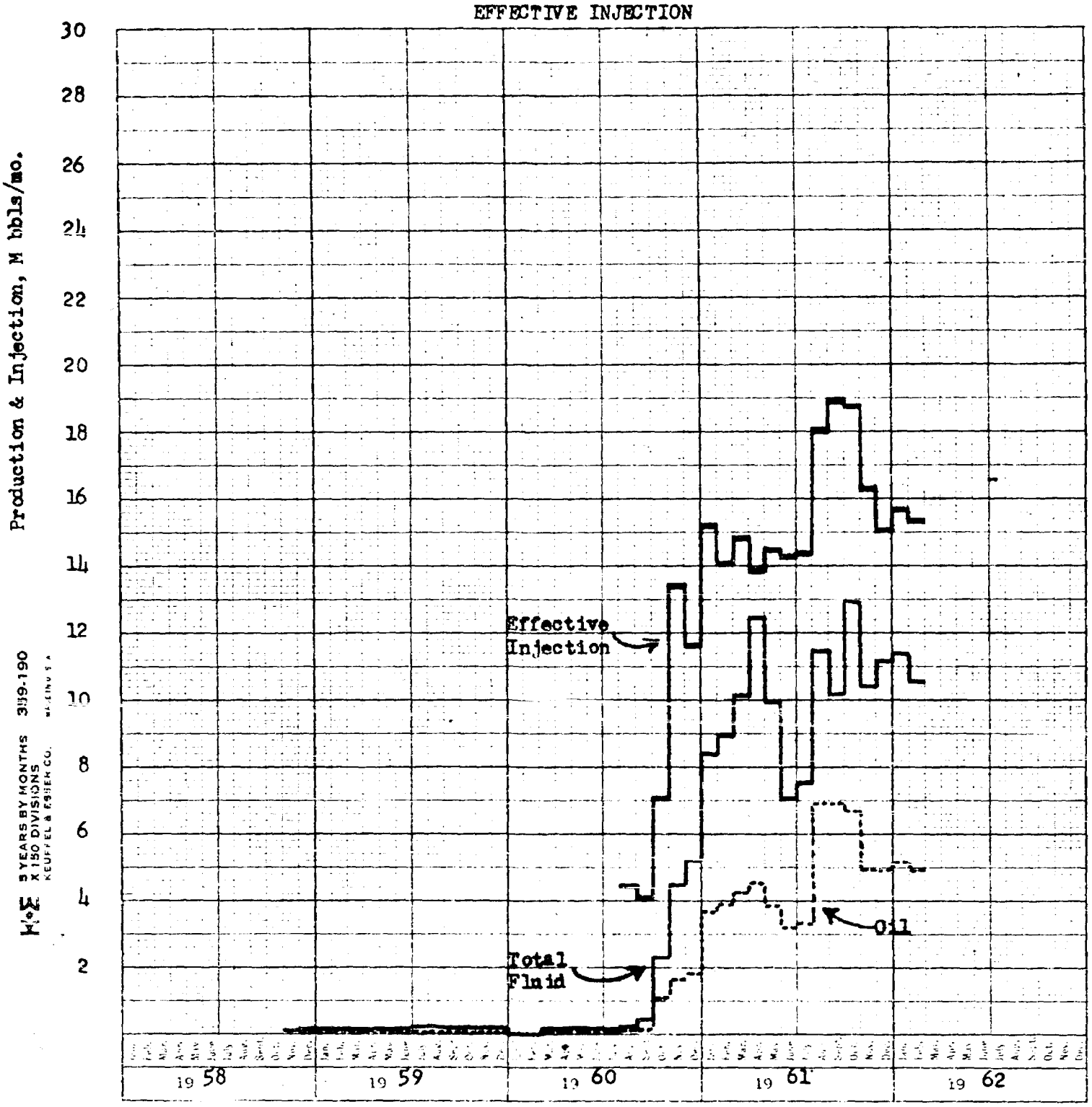
359-190

5 YEARS BY MONTHS
X 150 DIVISIONS
KEUFFEL & ESSER CO

NEWMONT OIL COMPANY

YATES 4

EFFECTIVE INJECTION

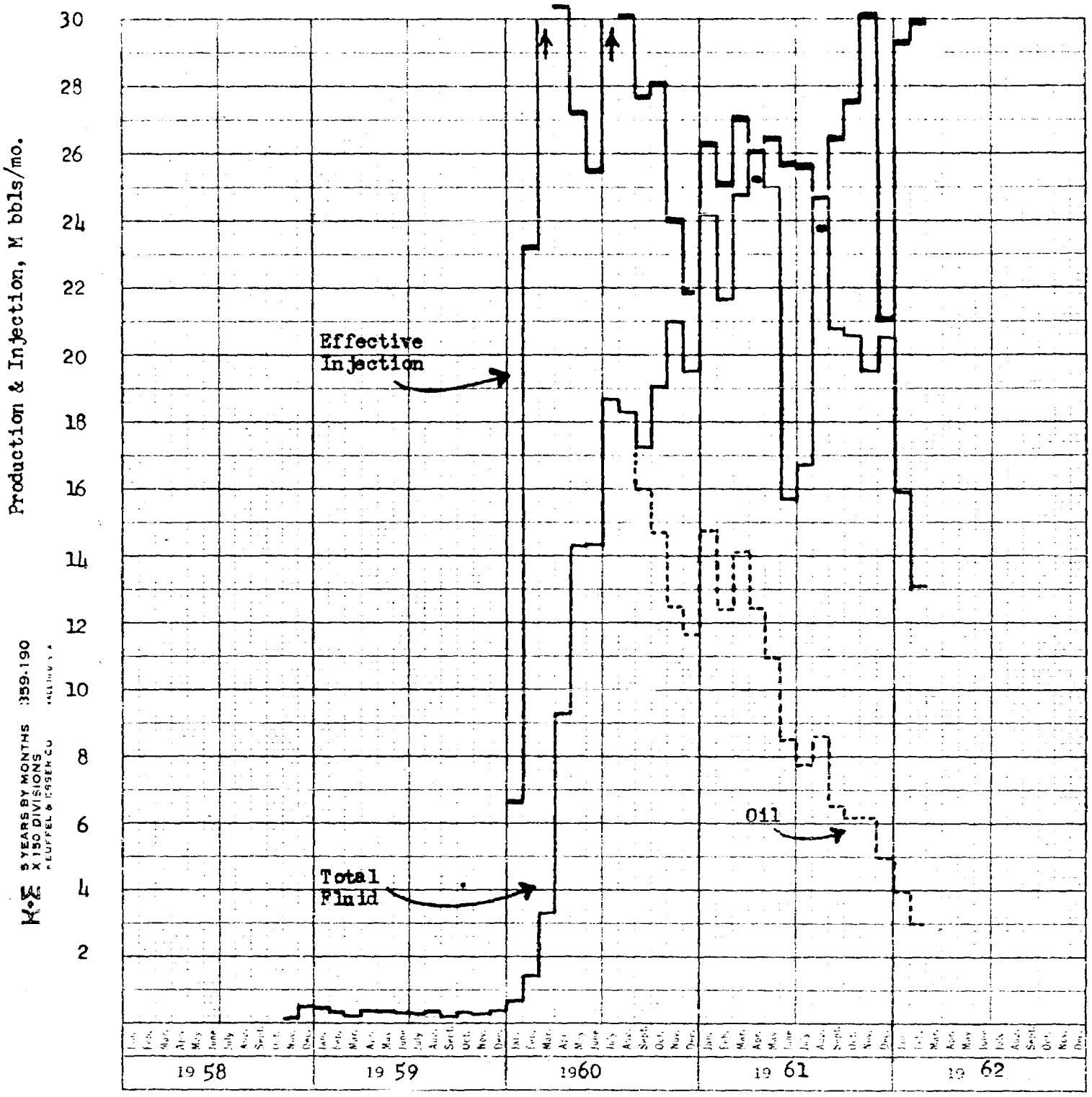


K&E 5 YEARS BY MONTHS X 150 DIVISIONS KEUFFEL & ESSER CO.

NEWMONT OIL COMPANY

YATES 6

EFFECTIVE INJECTION

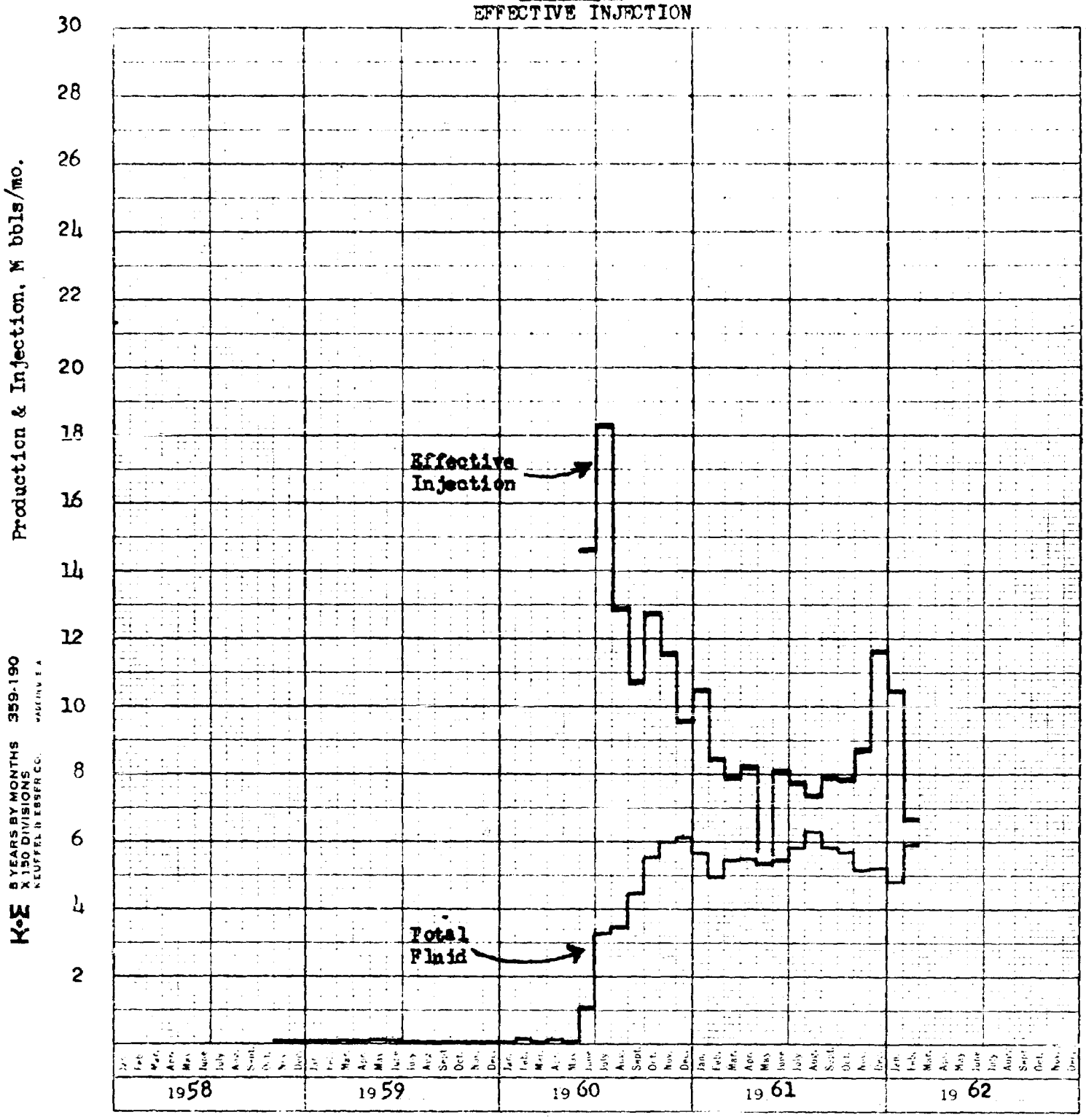


K&E 5 YEARS BY MONTHS X 150 DIVISIONS KEUFFEL & ESSER CO

Primary 137,000

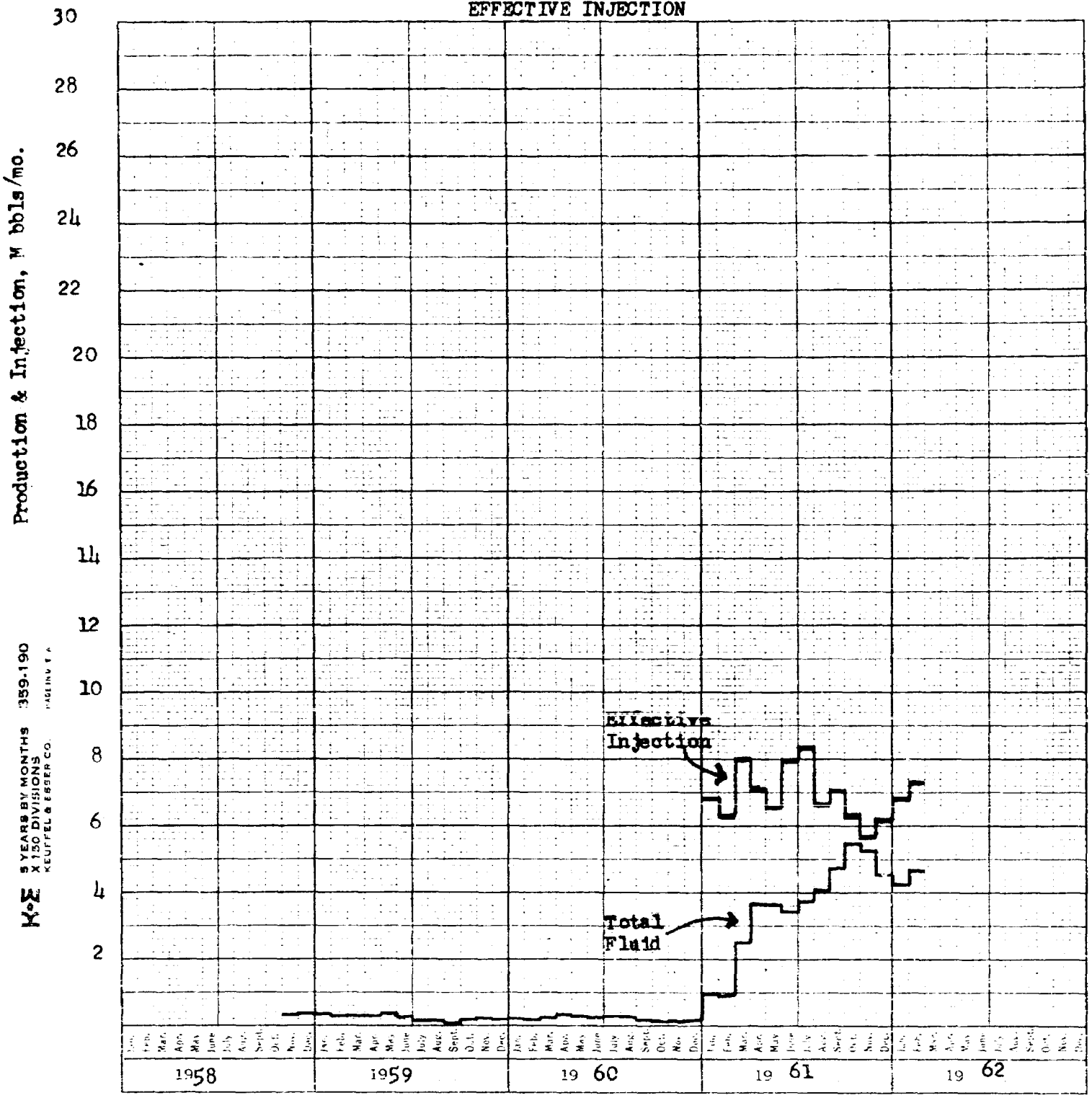
Secondary 260,000

NEWMONT OIL COMPANY
YATES A-1
EFFECTIVE INJECTION



K&E 8 YEARS BY MONTHS 359-190
X 150 DIVISIONS
KEUFFEL & ESSER CO.

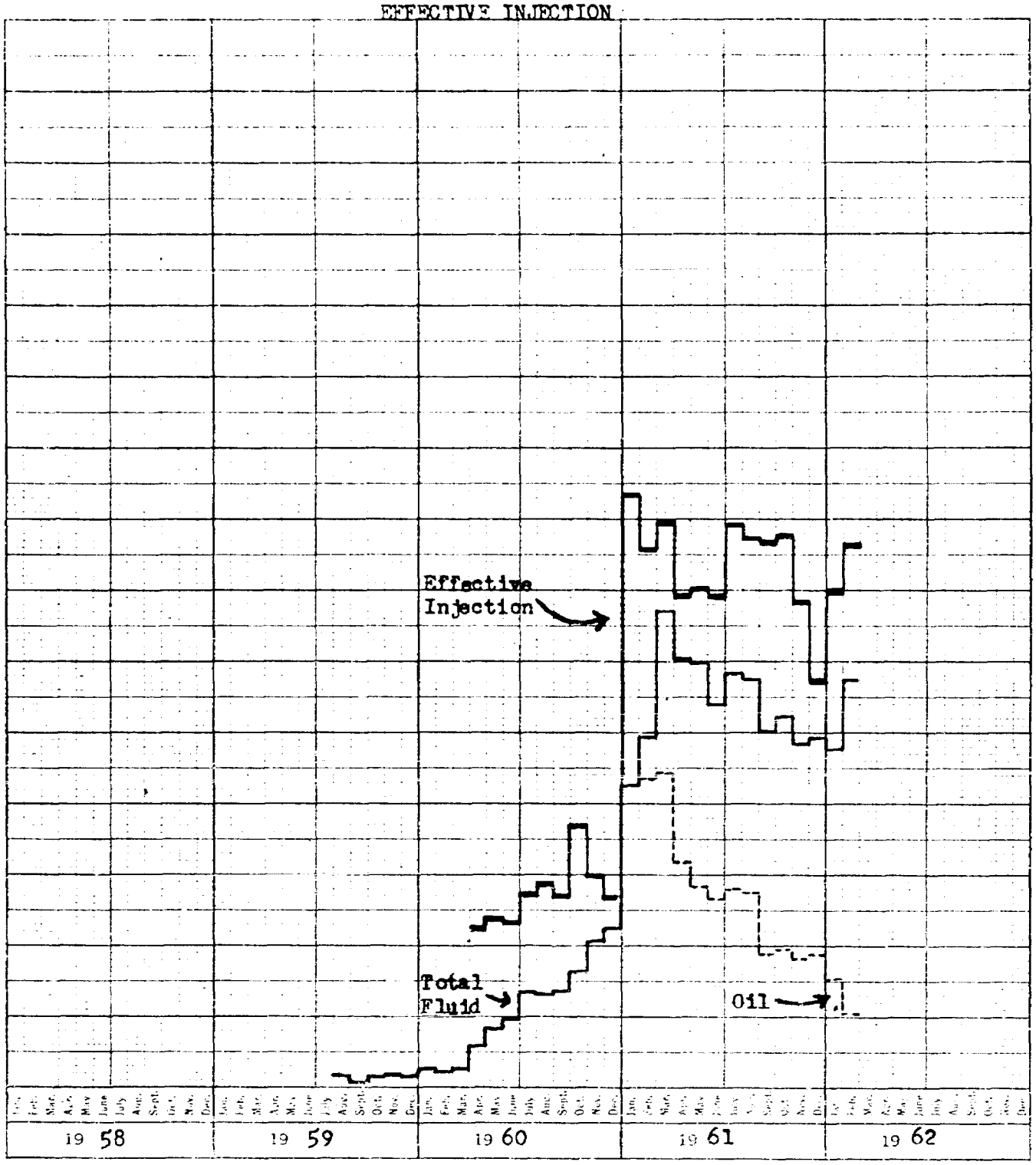
NEWMONT OIL COMPANY
YATES A-3
EFFECTIVE INJECTION



NEWMONT OIL COMPANY

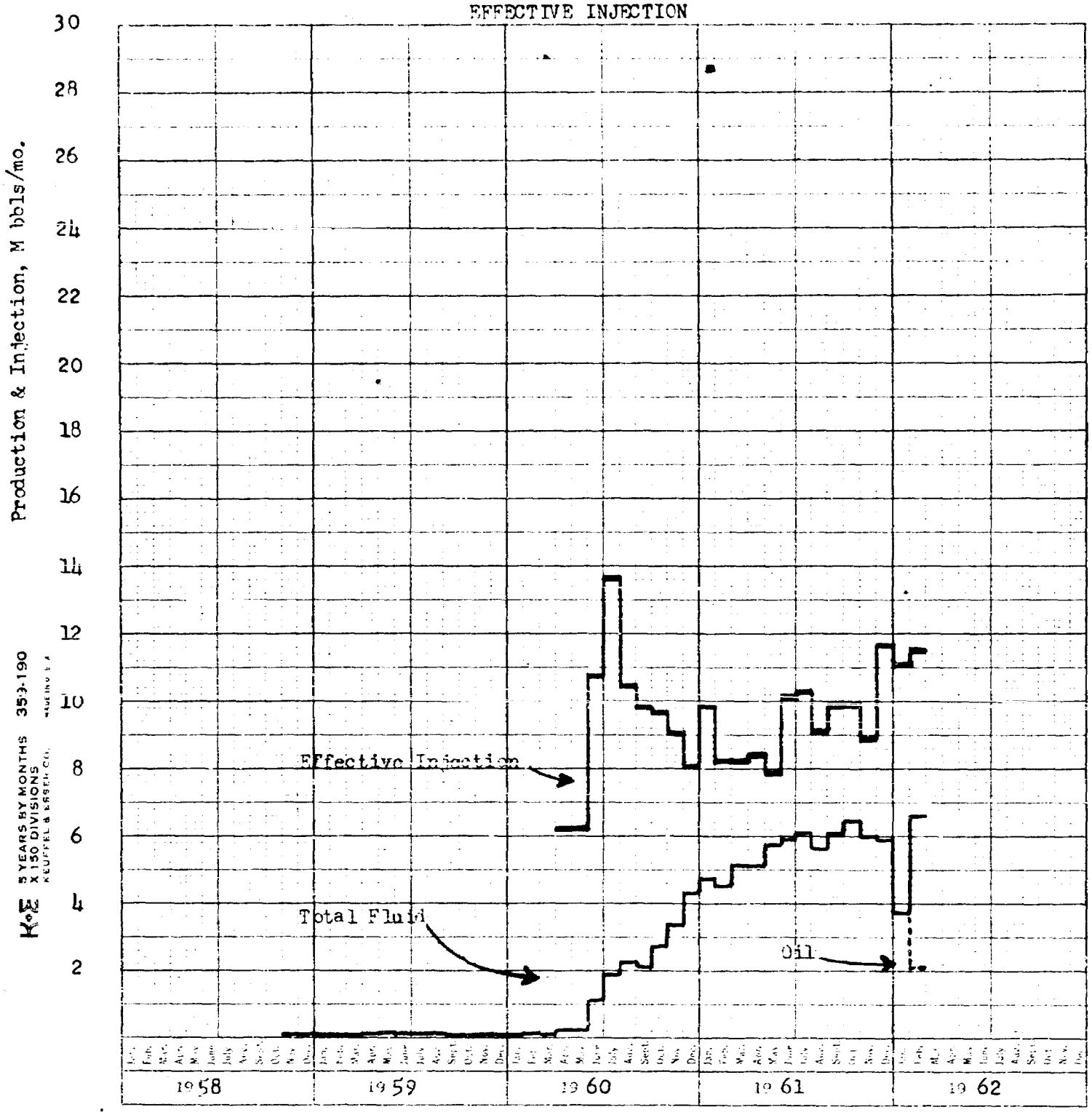
YATES A-6

EFFECTIVE INJECTION



5 YEARS BY MONTHS
X 150 DIVISIONS
KEUFFEL & ESSER CO.
359-190

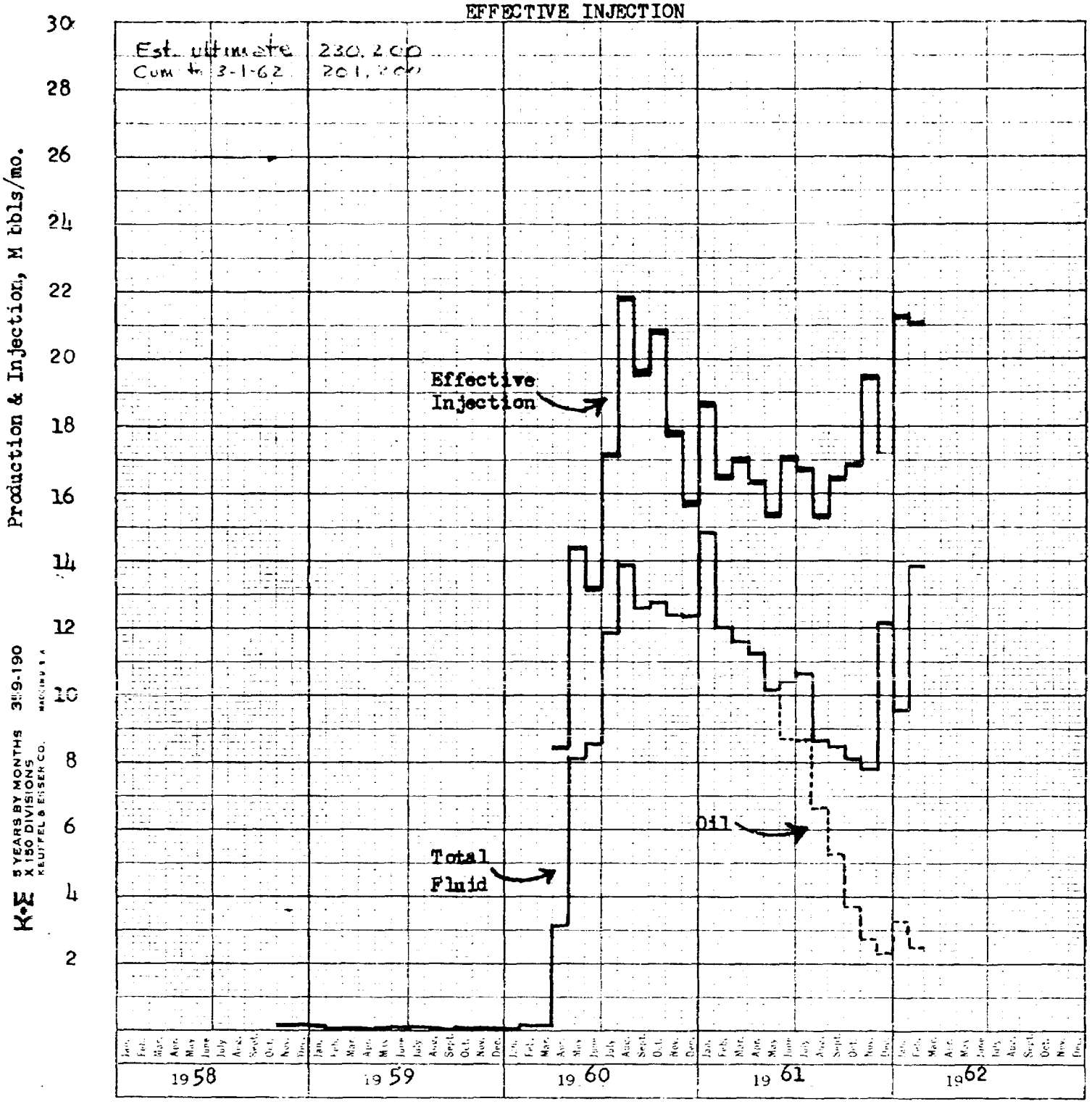
NEWMONT OIL COMPANY
YATES 8-A
EFFECTIVE INJECTION



NEWMONT OIL COMPANY

YATES A-9

EFFECTIVE INJECTION



K·E 5 YEARS BY MONTHS 359-190
X 150 DIVISIONS
KEUFFEL & ESSER CO.

GOVERNOR
EDWIN L. MECHEM
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

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

P. O. BOX 871
SANTA FE

April 27, 1962

Re: CASE NO. 2520
ORDER NO. R-2178-A
APPLICANT:
NEWMONT OIL COMPANY

Mr. A. J. Losee
Losee and Stewart
Carper Building
P. O. Drawer 239
Artesia, New Mexico

Dear Sir:

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

Very truly yours,

A. L. Porter, Jr.
A. L. PORTER, Jr.
Secretary-Director

ir/

Carbon copy of order also sent to:

Hobbs OCC_____
Artesia OCC x
Aztec OCC_____

OTHER Law Library (Supreme Court)

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

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

CASE No. 2520
Order No. R-2178-A

APPLICATION OF NEWMONT OIL COMPANY
FOR AN AMENDMENT OF ORDER NO. R-2178,
EDDY COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on April 10, 1962, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 26th day of April, 1962, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

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

(2) That by Order No. R-2178, entered in Case No. 2473 on January 30, 1962, the Commission authorized Newmont Oil Company to institute a waterflood in the Loco Hills Pool within the West Loco Hills Grayburg No. 4 Sand Unit Area in Eddy County, New Mexico. Said order provided that Rule 701-E of the Commission's Rules and Regulations governed the determination of the project area and of the project allowable, and established a buffer zone within which wells could be produced at unrestricted rates.

(3) That Newmont Oil Company seeks an amendment of said Order No. R-2178 to provide for an exception to Rule 701-E to define the waterflood project area of the West Loco Hills Grayburg No. 4 Sand Unit as comprising all developed proration units in said unit area whether or not the units are offset by injection wells, and to assign to said project area the maximum allowable authorized by Rule 701-E, said allowable to be produced from any well or wells in the unit area. As an alternative, approval is requested of an allowable equal to the maximum allowable authorized by Rule 701-E for all wells in the unit area, to be produced from any well or wells therein.

(4) That in Case No. 1787, Order No. R-1525, by which Rule 701 was promulgated, the Commission determined that reasonable curtailment of production in waterflood projects does not result in a loss of ultimate recovery. Said determination was made only after full consideration of the varying reservoir conditions encountered in the oil pools of New Mexico.

(5) That the applicant in this case failed to prove that the Loco Hills Pool is sufficiently different from other oil pools in New Mexico to justify an exception to Rule 701.

(6) That the applicant failed to prove that waste would be caused or that correlative rights would be violated by operating the subject waterflood project under the provisions of Rule 701 and pursuant to Order No. R-2178.

(7) That the application should be denied.

IT IS THEREFORE ORDERED:

That the application of Newmont Oil Company for an amendment of Order No. R-2178 is hereby denied.

DONE at Santa Fe, New Mexico, on the day and year herein-above designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

EDWIN L. MECHEM, Chairman

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

esr/

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
April 10, 1962

IN THE MATTER OF:

Application of Newmont Oil Company for an amendment of Order No. R-2178, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an amendment of Order R-2178 to provide for an exception to Rule 701-E to define the water-flood project area of the West Loco Hills Grayburg No. 4 Sand Unit located in Townships 17 and 18 South, Ranges 29 and 30 East, Loco Hills Pool, Eddy County, New Mexico, as comprising all developed proration units in said unit area whether or not the units are offset by injection wells, and to assign to said project area the maximum allowable authorized by Rule 701-E, said allowable to be produced from any well or wells within the unit area. As an alternative, applicant requests approval of an allowable equal to the maximum allowable authorized by Rule 701-E for all wells in the West Loco Hills Grayburg No. 4 Sand Unit Area, said allowable to be produced from any well or wells in the unit area.

CASE 2520

BEFORE: A. L. Porter, Jr.,
E. S. "Johnny" Walker

TRANSCRIPT OF HEARING

(Whereupon, Applicant's Exhibits Nos. 1 through 8, including 4A, B, C and D were marked for identification.)

NEW MEXICO OIL CONSERVATION COMMISSION

HEARING

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE APRIL 10, 1962 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
[illegible]	[illegible]	[illegible]
A. J. Losee	Newmont	Artesia
Roger Aston	Franklin, Aston & Fair	Roswell
Grant M. Smith	Franklin Aston & Fair	[illegible]
C. D. Coltharp	Continental Oil Co.	Hobbs
Chas. C. [illegible]	Newmont Oil	Ft Worth
Geo W. Arnold	Fair Oil Co.	Tyler Texas
Jason Kellahin	Kellahin & Fox	Santa Fe
O. B. Champion	Newmont Oil	Ft Worth
Joe D. Ramey	NMOCC	Hobbs
John W. Clark	[illegible] Corp	[illegible], Tex
B. G. [illegible]	[illegible] Corp	—
J. C. [illegible]	—	Artesia N.M.
[illegible] Miller	—	—
R. L. Gray	Fair Oil Co	Tyler, Texas
[illegible]	Newmont Oil Co.	Artesia, N.M.
[illegible]	Cities Service Oil Co	Hobbs, N.M.

I N D E X

I N D E X
(Continued)

MR. PORTER: The hearing will come to order, please. There's only one case on the docket this morning, so I guess we'll take it first. Case No. 2520.

MR. MORRIS: Application of Newmont Oil Company for an amendment of Order No. R-2178, Eddy County, New Mexico.

MR. LOSEE: Mr. Examiner, I assume that's the proper term at this hearing, Mr. Commissioner, A. J. Losee, appearing for Losee & Stewart on behalf of Newmont Oil Company, the applicant in this case.

MR. PORTER: For the record, Mr. Losee, this will not be an Examiner Hearing. It is a Commission Hearing, since two members are present and it was so advertised. I would like to call for other appearances at this time before we get under way with the testimony.

MR. KELLAHIN: Jason Kellahin, Kellahin & Fox, Santa Fe, appearing for Amerada Petroleum Corporation.

MR. BRATTON: Howard Bratton, Hervey, Dow & Hinkle, Roswell, appearing on behalf of Humble Oil & Refining Company.

MR. MORRIS: Richard Morris, appearing for the Commission Staff, and I have a preliminary motion I would like to make.

MR. PORTER: Mr. Morris, we'll call for other appearances first and give you an opportunity to make your motion later. Are there any other appearances, anyone else desire to make an

appearance in the case? Mr. Morris.

MR. MORRIS: If the Commission please, I do not believe it to be the purpose of this hearing to enter into a full-fledged discussion of the pros and cons of restricted water floods inasmuch as that was done at some length at the hearing in Roswell in 1959. But in order that the Commission would have a background in the case file and some evidence to review in making its decision in this particular case with regard to this particular pool, I move that the record of the case in Case 1787 be incorporated into this case.

MR. PORTER: Does anyone desire to comment on counsel's motion for inclusion of the previous record in this case?

MR. LOSEE: If the Commission please, it's the applicant's position in this case, as Mr. Morris has stated, not to contest or attempt to contest the validity or the correctness of Rule 701 which was adopted after the Roswell Hearing. It is our feeling that the problem of applicant in this case is peculiar to this field and to the pay section encountered and being flooded at this time.

We feel that the testimony in the General Hearing on the Order R-701 would be inapplicable to the facts in this case and that applicant should have the opportunity, insofar as any of the witnesses testifying in that other case were concerned, if

their testimony was in regard to this field we feel like we should have the opportunity to examine them on their statements of opinion and accordingly we object to counsel's motion.

MR. PORTER: Anyone else care to make a statement concerning this motion?

MR. BRATTON: If the Commission please, we would support the motion of Mr. Morris. While Mr. Losee says this case pertains to this one pool, the entire problem of restriction of floods and whether that would result in waste or not was presented in that general statewide hearing in which Newmont participated and Amerada and Humble participated, and if the evidence presented there is inapplicable to this particular situation, of course, the Commission would disregard the portions of the evidence therein that are inapplicable.

However, in order not to burden the Commission with another two or three days or four days of hearings, we have not come up again with the same witnesses and evidence on the general proposition of whether floods can be restricted without waste. Insofar as that evidence is applicable and can be considered by the Commission here, we believe it should be available to them. We believe it should be made a part of this record. We would strongly support the motion of Mr. Morris.

MR. PORTER: Mr. Morris, do you have anything further

to say?

MR. MORRIS: No, sir.

MR. PORTER: I thought you were about to say something before Mr. Bratton said it.

The Commission will rule that the record in Case 1787 will be made a part of the record in this case today. Mr. Losee, are you ready to go forward with your testimony?

MR. LOSEE: Yes, sir.

MR. PORTER: Will you have all your witnesses stand and be sworn at the same time if you have more than one?

MR. LOSEE: Yes.

(Witnesses sworn.)

MR. LOSEE: I have a statement I would like to make, Mr. Porter.

MR. PORTER: All right, sir.

MR. LOSEE: By way of clarification of applicant's position in this hearing, we request the Commission to amend its Order 2178 entered on January 30 of this year by two alternative prayers, the first of which requests an exception to Rule 701, which would define the project area as being the producing proration units in the West Loco Hills Unit Area, previously approved by this Commission, which have not heretofore enjoyed unrestricted allowables, and those proration units to be con-

sidered without regard to whether or not they are offset by active injection wells and for a transfer of allowables between wells; or, secondly, in the alternative under the authority of Rule 701-E-3, request the assignment of a special allowable for the West Loco Hills Unit Area except that portion which has heretofore enjoyed unrestricted allowables equal to the maximum allowable under the rule to be produced from any well in the unit area.

The second alternative is based on the provision in the order that special allowables may be assigned in limited instances where it is necessary to protect correlative rights. The end result under either of the prayers of the applicant, as we intend, would be the same. That is to say, the order would authorize an allowable of 42 barrels per day times the number of producing proration units in the unit area not heretofore enjoying unrestricted allowable, plus an allowance of one-third of 42 for each additional well on any producing proration unit.

We believe our testimony will show that unless an order similar to this is received, that correlative rights in the field will be injured and harmed, and that unless the field is flooded in a manner in which it is proposed, waste will occur. We also request, although I think probably it is a part of this record, the testimony at the January 4th hearing in this same case be

considered by the Commission. As I understand, Mr. Porter is nodding his head, it would be part of it?

MR. MORRIS: If the Commission please, I don't believe the parties that have entered an appearance today were parties to the case heard by the Commission on January 4th, and for that reason I would oppose Mr. Losee's motion to incorporate the record in that case.

MR. LOSEE: Mr. Porter, I apologize for having Mr. Morris' copy of the transcript which he has been kind enough to loan me, but I believe Mr. Bratton appeared on behalf of Humble in the original hearing, and I believe Mr. Kellahin appeared on behalf of Amerada.

MR. MORRIS: I stand corrected. I withdraw my opposition.

MR. PORTER: The record in the case from which the Order 2178 came out of, the record in Case 2473 will be made a part of the record in this case. Mr. Losee, you may proceed with your first witness.

GRANT M. SMITH

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q Would you state your name, residence and occupation, Mr. Smith?

A Grant M. Smith. I am a petroleum geologist for Franklin, Aston & Fair at Roswell, New Mexico.

Q You have not previously testified before this Commission?

A No, sir.

Q Would you state your education, your college education and degrees?

A I have a Bachelor of Science degree in Geology and also a Master of Science degree in Geology from Brigham Young University.

Q Are you a member of any engineering societies?

A I am a member of the American Association of Petroleum Geologists and member of Sigma Gamma Epsilon.

Q How long have you been employed as a petroleum geologist or worked in that field?

A Since 1951.

Q Independently or for companies, and if so, what companies?

A I worked with Stanolind Oil & Gas Company and with Atlantic Refining Company. I am now with Franklin, Aston & Fair of Roswell, New Mexico.

MR. LOSEE: Are Mr. Smith's qualifications acceptable, Mr. Commissioner?

MR. PORTER: Yes, sir, they are.

Q (By Mr. Losee) I will refer you to the board and what has been marked Applicant's Exhibit 1 and ask you if you will state what that is and explain it to the Commission, please.

A This is a water flood response map constructed to show the response of the various wells in this water flood to the injection of water. I have shown the area acquired by Newmont Oil Company from Franklin, Aston & Fair outlined in yellow. The area outlined in red is the proposed unit. The contour lines, beginning with the blue one, is the water flood response as of the first of January, 1960; the dark green contour is the water flood response as of January 1st, 1961; the orange line is the water flood response as of January 1st, 1962.

Q What is the purpose of those lines in connection with this case?

A It is contour line connecting wells that are responding to water flood, showing increased production in oil.

Q What interest does Franklin, Aston & Fair have in the area which you are mentioning?

A We have the interest that we retained from Newmont Oil Company.

Q Would you point that out with your pointer and describe it?

A It includes the Southwest portion, Southwest Quarter of Section 32 with the exception of the Southeast of the Southwest.

Q Excluded is that area outlined in yellow on the map?

A Yes.

Q Did Franklin, Aston & Fair retain a production payment out of all that interest outlined in yellow?

A Yes, sir.

Q Are any wells offsetting your acreage responding to this flood at this time?

A Yes, sir. We have wells on the General American acreage in the south part of Section 31, 17 South, 30 East; also in the Southeast Quarter of Section 36, 17 South, 29 East, and we are now showing an increased production in the Yates well in the Southeast Quarter-Southeast Quarter, Section 1, 17 South and 29 East.

On this map I have shown the response of some wells, the month before they responded to water flood and the month following response to water flood. For example, the Yates 6, a well in Section 6, 18, 30, in the Southeast, in the Southwest of the Northeast Quarter, in February of '60 it produced 429 barrels of oil, and in April of '60 it produced 1,092 barrels of oil.

I have followed that, put these figures by a few of the key wells in the area to show the basis of the flood response as shown here. Then, on the last contour, the orange line, I have shown the production from the various wells as of December, 1961. I would like to point out that at that time the Dixon Yates Well No. 2 in the Southeast, Southeast of Section 1 had not responded. Mr. Yates has informed us as of this time that in March the well increased from one barrel of oil a day to 30 barrels per day, indicating that in March the flood front had reached this point.

Also in December the General American Well No. 12 and 3 in the Southeast of the Southwest of 31, 17 South, 30 East produced 2,179 barrels of oil. The No. 2 Well in the Southwest, Southwest of the same section produced 1,952 barrels of oil.

The Ambassador well in the Southwest of the Southeast Quarter, same section, in December produced 1,318 barrels of oil. These are taken from the oil and gas conservation production records.

Q From your testimony and this exhibit, can you reach any conclusion as to whether or not oil underlying Franklin, Aston & Fair's production payment acreage is moving across your lease line onto other lines?

A Well, I certainly believe it has, because there has been no injection in the General American and Ambassador acreage to

cause such a response in their wells.

Q Has there been any injection backup, backup injection on the West Loco Hills Unit Area to the west of your acreage?

A No, sir, not to my knowledge.

Q Under the existing order in this case, R-2178, part of your acreage in yellow, which is at the Southeast corner of your map, and which has not yet been placed under water flood, was included within the unit area and subjected to the participation factors proposed in this unit. Based upon the allowable established in the prior order in this case, that is R-2178, can you recommend to your company that it commit its production payment interest to the terms of this unit agreement?

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

Q For what reason, Mr. Smith?

A Well, the main reason is time of pay-out and overriding royalties and so forth.

Q Actually, your production payment interest now enjoying unrestricted allowable that hasn't yet been flooded would be encumbered by a restricted allowable on the westerly portion of the unit, is that correct?

A Yes, I believe it would be.

Q Is it for that reason that you cannot recommend to your

company that they join this unit?

A Yes, sir.

MR. LOSEE: I think that's all, Mr. Smith.

MR. PORTER: Does anyone have a question of Mr. Smith? Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Smith, how much did you say these wells up here in Section 31 were producing again, please?

A Some of these wells, the General American No. 2 Well, I have 1,952 for December production.

Q That's the little violet colored figure?

A That's the figure that's shown in violet.

Q The No. 12 and 3?

A No.12 and 3 wells combined is 2,179, but I have no way of showing which well or whether both of them produced that, from the record.

Q And Ambassador's No. 1 in the Southwest, Southeast?

A Produced 1,318.

Q What about this other well, the Newmont well?

A Newmont's well, that is part of theirs.

Q I see.

A Pardon me.

Q The other well, the 8,599, that's a Newmont well?

A Right.

Q Has General American started any water into the ground in the water project that was authorized them?

A It's my understanding that they have not at the present time.

Q Have they received an allowable of 1952 barrels for that No. 2 Well?

A I don't know what they have on that.

Q You don't suppose that the 1952 barrels would be in excess of the normal unit allowable for this pool for the month, would you?

A I'm not sure on that. I believe, was it our hearing last July where they received a maximum allowable?

Q They received a maximum allowable, presumably, which would be contingent on the instigation of a water flood project, but to your knowledge they haven't started any water into the ground?

A That is my understanding.

Q Which was the area, which you defined as Franklin, Aston & Fair having retained a production payment interest in, which you could not recommend be included in the unit?

A That is primarily in the Canfield Lease, I believe, in Section 9 of 18 South, 30 East, and extending probably on down

into Section 18.

Q Section 7, possibly, rather than 9, Mr. Smith?

A 7 is correct.

Q That would be the acreage that is outlined in yellow, is that correct?

A Yes, sir.

Q In stating the reason that you couldn't make this recommendation, I believe you said that the reason why is that it enjoys an unrestricted allowable at this time, but would have a restricted allowable if it were included in the unit?

A That's right.

Q You are presuming that as the water flood advanced to the south this area would receive an unrestricted allowable?

A It's my understanding it would.

Q You are also assuming that under the assignment of a project allowable in the unit area, as provided in the original order by Order R No. 2178 in Case 2473, you are also assuming that these wells would not be permitted to produce at the rate at which they were capable of in the unit?

A No, sir. You mean in the over all unit?

Q Yes, sir.

A That's right.

Q You are overlooking the fact that this order provides that allowables may be transferred to wells which could produce

the allowable.

A In the entire area to the west?

Q I am talking about in the water flood project area, Mr. Smith. The order provides that the project would be governed by the allowable provisions of Rule 701-E, but doesn't Rule 701-E allow transfer of allowables among the wells within a project area?

A Well, I am not exactly familiar with that. It was my understanding that that probably would not be the case in an over-all unit.

Q If you are not completely familiar with it, Mr. Smith, you wouldn't be in a position, then, to be able to say for sure whether these wells would be produced at a restricted rate or what rate they would be produced?

A It is my understanding that they would receive the same treatment that the pilot flood and the flood so far has received.

Q I'm talking about if they were in the unit, they would receive the transfer allowable if they were in the unit, would they not?

A Well, I presume --

Q As a matter of fact, some of those wells would be included in the buffer zone that was authorized by the Commission which would have capacity allowables, wouldn't they?

A They could be, but I have some question as to whether a buffer zone would be really accurate protection. If you wait, I feel if you wait until a well responds before it is put into injection, that by that time you have probably moved a lot of oil.

Q You are not acquainted with the testimony in previous cases which have been incorporated in the record of this case to date, in which proponents of capacity allowables have stated that in their opinion no waste nor injury to any water flood in any manner would result if response of a well to water injection were noted and a period of up to thirty days elapsed prior to the time any backup wells were put on?

A Well, I'm not entirely unaware of that, but I would say that in this case we have already suffered drainage and, for instance, if the No. 2 Well on the General American lease up there now goes into injection of water, that there's already been considerable oil moved on through there that we will not recover.

Q Well, the Commission authorized an injection program for that area up in Section 31 quite some time ago?

A Yes, sir.

Q But some of the area which you said you couldn't recommend be committed to the unit is included in the buffer zone with capacity allowables under the provisions of Order R-2178, correct?

A Correct.

Q Then the remainder of the wells would be eligible for transfer of allowable under Rule 701-E, correct?

A Correct.

MR. NUTTER: Thank you.

MR. PORTER: Does anyone else have a question?

MR. LOSEE: Yes.

MR. PORTER: Mr. Losee.

REDIRECT EXAMINATION

BY MR. LOSEE:

Q Mr. Smith, have you seen evidence which will be introduced in this case indicating to you that under the existing order in this case, R-2178, that wells on the west portion of the field which would be included in the project area, when they're offset by injection, could not be flooded with maximum efficiency and that oil would otherwise be lost in that area?

A Wells in the west part of the area?

Q Yes.

A I have seen some of that evidence, yes, sir.

Q Is it not for that reason that you cannot recommend to your company --

A That is one of the reasons, yes.

Q Did you prepare this Exhibit 1, or was it prepared

under your direction?

A I prepared the information and the rough work on it and I had the draftsman do the fancy work.

MR. LOSEE: The applicant will offer Exhibit 1 in evidence.

MR. PORTER: Any objection to the admission of the exhibit? Applicant's Exhibit No. 1 will be admitted to the record. If no further questions --

MR. KELLAHIN: Mr. Porter --

MR. PORTER: Mr. Kellahin.

MR. KELLAHIN: Could I ask a couple of questions, please?

MR. PORTER: Surely.

RECROSS EXAMINATION

BY MR. KELLAHIN:

Q Mr. Smith, I can't see your map and I am not quite clear where the General American and Ambassador wells are located in reference to the present flood project. Could you point them out to me?

A This is General American's well in the Southeast, Southeast of 36, 17 South, 29 East. This is in Section 31, 17 South, 30 East. This quarter section is General American, and the West Half of the Southeast Quarter is Ambassador.

Q In other words, they are all to the north of the

present project area?

A Yes, sir.

Q Do you have any acreage in that area north of those wells?

A No, sir.

Q You don't propose to include any of that portion in your flood project, is that correct, north of the present project?

A Well, that was supposed to be a backup project.

Q By Ambassador?

A By Ambassador and General American.

Q As I understood your testimony, and correct me if I'm wrong please, it's your position that oil is being swept across lease lines to General American's well, is that right?

A That's right.

Q What effect would the granting of this order have to protect those since you already have capacity allowables on the offsetting wells?

A I'm not sure that I understand your question.

Q You have capacity allowables in the project area now, do you not?

A That's right.

Q What effect would the granting of the order you now seek have to protect this drainage that you are talking about?

A Well, it would stop any more oil from moving, but we wouldn't get back what has been moved.

Q How would it stop it?

A By pressure from the opposite side.

Q Where is the pressure from the opposite side coming from?

A From the injection wells when they go in here.

Q Those are not your wells? A No.

Q You are not applying for injection wells?

A All I'm talking about, all our oil has been moved off of here from these leases and we are not protected.

Q That has nothing to do with the present application.

A I am showing that we have suffered drainage due to lack of lease line cooperation.

Q Lack of lease line cooperation does not enter into this application, does it?

A Well, it will to the certain extent that we are starting to move on these leases over here and the leases down here.

Q But it has nothing to do with the area north of it in this application?

A I guess not.

Q I guess not.

MR. PORTER: Any further questions? The witness may be excused.

(Witness excused.)

MR. PORTER: Call your next witness, Mr. Losee.

CHARLES C. LANGDON

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

DIRECT EXAMINATION

BY MR. LOSEE:

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

A My name is Charles C. Langdon, Fort Worth, Texas. I'm Vice President of Newmont Oil Company.

Q How long have you been with Newmont Oil Company?

A Since 1955.

Q Would you generally outline the formation of this West Loco Hills Unit Area?

A Yes, I'll be glad to. In 1958, Newmont acquired from Franklin, Aston, & Fair and others, about 2,000 acres, a little more, in the extreme eastern edge of the Loco Hills fill. This acreage is shown on Exhibit 1 in yellow. In October, on October 25, 1958, upon application to the Commission, Newmont, under Order 1267, received an order from this Commission to institute its pilot water flood.

Immediately thereafter it did institute its pilot water flood, and in early 1959 we started getting some response from our

producing wells. By late 1959, I beg your pardon, we started getting our first response. Early in 1960, it was apparent to Newmont, as well as to the rest of the operators in the balance of the Loco Hill fill, that Newmont would have a successful flood.

Obviously these people had been watching with great interest the results of Newmont's flood, because if it were successful, of course, they felt that inasmuch as the same formation was involved throughout the field, that they likewise would probably be able to conduct a successful flood.

When it did become apparent to Newmont that it had a successful flood in operation, we started contacting the people to the north and to the west line of our project area to determine what their plans might be by way of either giving us backup or by establishing projects of their own. In each case the people had unique problems of their own;in the north General American felt that they needed to work out patterns and agreements with Ambassador and the Ralph Fair interests, to the west of our project area the people involved felt that the most efficient way to go about developing the balance of the field would be by establishing a unit.

As a result, we have been delayed to some extent in getting the backup that our engineers felt was necessary in order to maintain a balance between Newmont's producing wells and their

injection wells.

In June of 1960 a meeting of all the operators in the western portion of the Loco Hill fill was called in Artesia to discuss procedures and plans for developing the balance of the acreage in the fill. At this meeting it was determined that perhaps the first step should be to have a feasibility engineering report prepared, and this report was prepared. I understand that it was prepared at that time without all of the information which Newmont had as a result of actual on-the-ground experience in the field. It was not until May, about a year later, that another meeting of the operators was called to discuss this feasibility report.

At that time no definitive action was taken by the operators, the matter was left somewhat hanging in the air. Each of the operators were to go back and to study the report and to come up with some idea as to what the best approach to put this portion of the West Loco Hills lying to the west of our project under development.

Newmont came up with a plan which they discussed with some of the major operators in this undeveloped area as well as with the local office of the United States Geological Survey in Roswell, and Newmont's plan was tentatively approved by the United States Geological Survey in Roswell as well as the major

operators in the area.

In November of 1961, about a year and a half after our first meeting concerning the area was held, and at this meeting Newmont discussed its proposed plan with all of the operators then present. About 90% of the operators in the undeveloped area of the Loco Hills fill were represented in this meeting. The plan that Newmont submitted at this meeting was approved in principle by most all of the operators then present, and Newmont was named at this meeting, operator for the unit which Newmont proposed in its plan.

Newmont then proceeded to have prepared a unit agreement and a unit operating agreement which embraced the plan which Newmont had presented. At this moment the unit agreement is before the United States Geological Survey in Roswell for approval, and I understand that the agreement is just about in form for approval in Roswell.

The unit agreement has been submitted to the office of the Land Commission of the State of New Mexico, however, no formal approval has at this time been requested. Newmont at this time does not contemplate seeking formal approval of the Commission of the General Land Office in New Mexico, nor does it contemplate seeking final approval of the United States Geological Survey in Washington until such time as the Commission issues its final

order as a result of this hearing. That is the present status of our efforts to put a unit together.

Q Mr. Langdon, was your original water flood project authorized by an order of this Commission entered prior to 701, Rule 701?

A Yes, it was. It was issued on October 25, 1958.

Q Does Newmont assume that this original project had capacity allowable for all of its acreage?

A The order as such does not in so many words state that we get capacity allowable. However, since we have been in operation the Commission has in each case where we have put on additional wells, allowed us to produce those wells at capacity, and we have no reason to assume that as we progress across our present project area that the Commission will change its method of treating that project.

Q Does Newmont have any concern with respect to the acreage that it proposes to contribute to this unit, yielding the same volumes of secondary oil by unit operation as it would under continued operation under the present Newmont order?

A Well, Newmont, in respect to the acreage which was in its original project, is in somewhat of a unique position. We're more or less forced into the position of walking a tight-rope, so-to-speak, because on the one hand, Franklin, Aston &

Fair and their associates are watching us carefully, and properly so, to see that we protect the lease lines in order that their production payments will be properly protected. On the other hand, our engineers are convinced that unless we are allowed to continue to develop this area in the same manner in which our pilot area has been conducted, that is by unrestricted rates of injection, that we might suffer reservoir damage.

So we have to, in each case, determine whether to cut back our injection rates or whether to go forward with them with the possibility of pushing oil across the lease lines, and then, as a result, getting in trouble with our royalty owenrs and our production payment owners.

We don't feel, that is, our engineers have advised me that they do not feel that unless they are allowed to continue the project in the manner in which it has been developed that they will be able to have the ultimate recovery of secondary oil.

Q In connection with your negotiations with General American and Ambassador on the north, did you enter into any lease line agreements?

A Yes. It was about July a year ago that we first arrived at the pattern of producing wells in relation to injection wells, was determined between Newmont, Ambassador and General American. This pattern was definitely agreed upon, it was not until, oh,

perhaps sixty days ago that we finally signed the final agreement placing that pattern into effect. It is my understanding that since Ambassador, General American and the Fair interests received the order from the Commission that they have gone forward in installing their plant facilities and their lines to give them a water supply and that they are at this moment just about ready to begin injection of water in their wells.

Q Do you know what was the reason for this delay in commencing this lease line cooperation with General American and Ambassador?

A I can't give you any initial reason why they delayed. I do understand that when they first saw the Commission approval for their project area for secondary recovery operations, that they were unhappy with the first order that was issued, and that they came back to seek either a new order or an amended order, which I understand they did receive, and I understand that under such order they feel that they can maintain a flood project that will give them maximum recovery for secondary oil.

Q Did Newmont do all it could on its behalf to assist and cooperate with General American and Ambassador in this lease line agreement and in their request for capacity allowables?

A Newmont did. Newmont had innumerable conferences with all of the parties involved in the situation and in the acreage

here to the north, because Newmont owed a definite obligation to its production payment owners and to the royalty owners inside the confines of the Newmont project. We didn't meet with much success by way of getting the backup that we wanted timely. We did at all times meet with a cooperative attitude, which didn't serve us too well; at the time they had their hearing we did show up and support their application.

Q Do you have anything else that you would like to state with reference to this application of Newmont?

A No, except to urge the Commission to grant us an order under one of our alternatives.

MR. LOSEE: I think that's all.

MR. PORTER: Anyone have a question of Mr. Langdon? Mr. Morris.

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Langdon, to clarify exactly what Newmont is seeking in this application, it might be rather difficult from a reading of the notice given in the case as to just what is being sought. Is it true that under either alternatives or prayer of Newmont in this case, what really is being sought is capacity allowables for the production of water flood oil in the entire unit area?

A Mr. Morris, I'll say this, that if we had capacity

allowable for the entire project area and were permitted to go in and develop the whole area simultaneously, then you would have capacity allowable for the whole area. Such is not our intention. We feel that if we stage the development of the area under the order which we seek that we will never produce on a daily basis more than we would produce if we were granted free transfer of allowables from each of the wells located in the whole unit, and we feel that is somewhat, well, certainly a great departure from capacity allowable in the whole field.

Q But it would be your intention to produce the wells that are actually going to be your major water flood oil-producing wells at a capacity rate?

A It is our intention, yes, as we progress in our development of the flood by stages to produce those wells that are then on production at capacity, else our engineers are fearful that we will have reservoir damage and loss in ultimate recovery of secondary oil.

Q Have you made any determination of what capacity will amount to in barrels per day for the initial stages of this project?

A Mr. Morris, I would appreciate it if you would hold that question for one of our subsequent witnesses, because I don't have the information at hand and it will be available to

you, however.

Q All right, sir. Will a subsequent witness also be able to testify concerning a comparison between the allowables that you would have under Rule 701 and the allowables that you would need to produce your project at the rates that you desire to?

A That testimony will be available.

MR. MORRIS: Thank you.

MR. PORTER: Anyone else have a question of this witness?

MR. BRATTON: I don't think I'll ever have an opportunity to ask Mr. Langdon a question under oath again.

BY MR. BRATTON:

Q Mr. Langdon, are you an engineer, sir?

A No, sir.

MR. BRATTON: Thank you.

MR. PORTER: Any further questions? Mr. Kellahin, you are a little slow this morning.

BY MR. KELLAHIN:

Q Mr. Langdon, you testified as having some difficulty in regard to your lease line situation with Franklin, Aston & Fair, and that's to the southeast generally, isn't it?

A If I said that, it was not my intention. I said that, I meant to say that we felt that we had a problem along lease

lines in protecting the reservoir and at the same time protect the over-riding royalties and the production payments owned by Franklin, Aston & Fair and others.

Q How have you resolved that difficulty?

A We are seeking to resolve it in this hearing.

Q What are you doing now, though?

A We are slowing down the expansion of our flood.

Q Have you restricted your injection rates?

A We have to some extent, and very reluctantly so, because our engineers are convinced that by slowing down our injection rates that they're destroying or damaging our underground horizon.

MR. KELLAHIN: Thank you.

MR. PORTER: Anyone else have a question? Mr. Nutter.

BY MR. NUTTER:

Q Mr. Langdon, mentioning that the operators to the north of your flood had not as yet put water into the ground or initiated their water flood operations, in explaining why, you mentioned one of the reasons was that they had received an order from the Commission which evidently they weren't too happy with.

A That was my impression from having discussed the matter with them.

Q And you went on further to state that it was your under-

standing they had come back for another hearing and had received an order that they were happy with?

A That is my understanding, yes, sir.

Q Do you know the date of the order that those three operators received to the north of your flood?

A I know this, Mr. Nutter, that it was received long enough ago that one would expect that they'd have some of the wells on injection today.

Q You didn't mean to infer that the Commission had been lax in its decision?

A No, sir, and if I did, I didn't mean to give such an impression.

Q As a matter of fact, that order was entered last July?

A Certainly.

Q As a matter of fact, if that order were issued last July, that would be sufficient time?

A Yes, sir.

MR. PORTER: If no further questions of this witness, he may be excused.

(Witness excused.)

HERMAN LEDBETTER

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q Would you state your name, residence and occupation?

A Herman Ledbetter, from Artesia, New Mexico, and I'm production superintendent in New Mexico for the Newmont Oil Company.

Q How long have you been employed by Newmont Oil Company in that capacity?

A It will be three years the first of May.

Q Have you previously testified before this Commission?

A I have.

MR. LOSEE: Are his qualifications acceptable?

MR. PORTER: Yes, sir, they are.

Q (By Mr. Losee) Would you give us and the Commission a brief history of the procedures used by Newmont in injection well completions on your pilot project?

A Yes. When we started our pilot water flood in September of 1958, the procedures were to use or convert old producing wells to water injection. These wells, the production equipment was removed and they were cleaned out to total depth and connected to injection. In starting this pilot flood, while we were using a shallow ground water within the project area, the injection rates during this time were limited by the water supply available.

In December, 1959, an adequate water supply was constructed and available and at this time the water injection rates were brought up to what was considered the maximum without lifting the overburden.

Q Mr. Ledbetter, in connection with your discussion I would refer you to Exhibit 2, which has been marked Applicant's Exhibit 2, and ask you if you'll proceed with your explanation of this water injection water program using this exhibit as a guide.

A Well, this is a graphic history of the injection and the production of oil and production of water. As you will note, as I stated previously, water injection was started in September of 19, or in November, I am sorry, November of 1958. The following thirteen months was injected at a more or less even rate until about the middle of December, 1959, when this adequate water source was available and the water injection was increased.

As you will note, the oil production began increasing shortly thereafter and continued to increase for some time and then leveled off. The water injection increases along this time are large--after the first few months in 1960 were due largely to expanding the flood.

Q Is it this point in December of about 1959, or maybe on your graph it would be November, in which you then had an

adequate water supply to start injecting at the maximum efficient rate?

A Yes, that is the time that we did have this adequate supply. During this period, why it was our policy in operating these leases to, general policy to inject in our injection wells at what we felt was the maximum injection rate.

Q Does this performance curve show that the oil production and the water injection are somewhat parallel?

A Yes. The injection into an area and the production out of an area do have a very parallel arrangement.

Q I will ask you to refer to what has been marked Applicant's Exhibit 3 and ask you if you'll explain what that exhibit portrays.

A These are some curves that have been constructed and labeled "Effective Injection", "Total Fluid Production", and "Oil Production". These curves with the effective injection curves were constructed to show the injection into a producing well area where we have the five spot, why we take, if it was a square five spot we would allocate the injection from these injection wells within this producing well area or into the center producer on a geometrical basis.

During a period in 1961 we did make a slight exception to this operating procedure of injecting into all of these wells

at capacity injection. The two wells involved were Yates A No. 2 along the north line of the project and Ballard B No. 5. This is the location of the Yates A No. 2, and this is the location of the Ballard B No. 5.

Q Why did you vary those injection rates on those two wells?

A These injection rates at that time were curtailed to decrease the possibility of moving oil across the lease lines. After some five or six months of this curtailed injection we noticed, or during this five months we noticed an adverse effect upon the production in the offsetting wells. By this time General American Oil Company and Ambassador Oil Company had received an order to start their flood and had agreed to a cooperative flood along the north line.

At this time, why we raised these injection rates back to what we felt was the maximum. From these curves in some of the offsetting wells I would like to call your attention particularly to some. Ballard 3-A, which is the third page --

Q Could you pinpoint it on the map?

A This offsets one of the restricted wells to the south and west, it offsets the Ballard 5-B to the south and west. This restriction can be seen on this effective injection curve quite readily there during the middle part of 1961. As you'll

note, while the injection was steady or increasing, our oil was increasing; about the point where we decreased our injection, our oil production decreased, which was no surprise, really, but the surprise came when we increased the injection in the latter part of the year, why our oil production continued to decrease in this well. If you'll turn to Ballard B-3 --

Q Would you point it out on the map?

A This well offsets the Ballard B No. 5 to the north and west. In this well you'll note the decrease in the effective injection into this well's producing area and about the same time we get a decrease in the total fluid production. When the effective injection into this area was again increased along at the end of the year, why the total fluid production in this well came back up, but the oil production continued to decline, and in about the same manner as it had before.

Farther over towards the back, west, Yates 8-A, it's about the fourth page from the back, this well offsets the Yates A No. 2 to the south and east. You'll notice at the end of the year where we were increasing our effective injection into this area of this well we were able to raise the total fluids slightly, but the oil is declining quite rapidly here.

Another one I would like to point out is the last one in the last graph in this group of graphs, Yates A-9. This well is

affected by both the Yates A-2 and the Ballard B No. 5. It offsets the Ballard B No. 5 to the south and east and the Yates No. 2 to the south and west. Since this well was affected by both wells, why the effective injection into this area during this curtailment was quite evident from your effective injection curve.

During this time, why the total fluid production continued to decline, and when the injection rates were again restored, we were able to increase the total fluid production, but it had very little effect on our decline in oil production.

Q Mr. Ledbetter, before you leave the Yates A-9 well, it is noted in December of 1961, after your effective injection has been increased, that it did fall off during that one month. Would you explain the reason?

A I believe, if I recall properly, that it --

Q Was that the month in which we had the freeze and your power was handicapped in the field?

A We did have some operating difficulties during that time. I'm sure, as I recall, that that is the answer.

Q You did not intentionally reduce the injection rates?

A No, sir.

Q So that I can understand this exhibit, as I understand it, the first page, you correct me if I'm wrong, the first page of your exhibit is the effective injection on the producing wells

in the Newmont Oil Company project?

A Yes, sir.

Q That each of the following sheets are injection rates and fluid rates as well as oil on each of the producing wells?

A Yes, sir.

Q And that for the purpose of arriving at the effective injection you have allocated to each producing well a proportionate amount of water from the offset injection wells?

A That is right.

Q In your allocation of this proportionate amount of water, did you use generally accepted engineering standards?

A Yes, sir.

Q Can you arrive at any conclusion with respect to the relationship of your injection fluid into the offset wells and to the fluid out of the producing well?

A I come to the conclusion that this curtailed injection rate definitely did affect our production in a way that, at least for the present, that seemed to me to be harmful.

Q Your production of oil has not come back up with the production of fluid from these wells?

A No, sir, it hasn't.

Q I'll refer you to what has been marked Applicant's Exhibit 4 and Exhibits 4A, B, C and D.

A Exhibits 4A, B, C and D are isoflow logs that have been run on wells within the pilot flood area. These logs were run at various times from a period starting in January, 1959, and the last in March, 1960.

Q What is an isoflow log, before you start on this exhibit?

A An isoflow log is a method of determining where the water is leaving the well bore in a water injection well.

Q Would you go over each isoflow log that's shown on Exhibits A, B, C and D in relation to the Exhibit 4 which is the injectivity profile test and is on the board?

A First I'll take the isoflow log taken on the Yates No. 5 dated January 12, 1959. This log is shown as this dotted line on this cross section.

Q Why did you start running these isoflow logs on these wells in your project, Mr. Ledbetter?

A This log was taken in order to determine the best we could the effective sand that we were flooding at that time. This was taken about three months after we had started injection and we were just checking to see where our water was going, to see how much of the sand we were flooding.

Q Was this log taken with regard to establishing whether or not you should or should not have a capacity allowable on your

wells in the area?

A No, sir. There was no question at that time about that.

Q On this January 12, 1959 log on the Yates No. 5, would you just give us your rate of injection?

A This well had an injection pressure at the well head of 350 psi, and injection rate of 473 barrels per day.

Q How many feet of this section in this well did this log indicate you were injecting water into at that pressure?

A Approximately 18 feet.

Q Would you mark that on the exhibit on the blackboard as 18 feet?

A (Witness complies.)

Q Did you take the information for that statement off the supporting well isoflow log?

A Yes.

Q Now, referring to the log made on February 4, 1960 --

A This log was run, as you recall, our water supply became adequate in December and we increased our injection rates at that time, and our injection pressure, and at that time we ran this log just to check and see if they had had any effect upon the parts of the sand that were taking water. This log was run at an injection pressure of 1050 psi, and an injection rate of 1500 barrels per day.

Q How many feet of the section did the log indicate you were injecting water into?

A It indicated an injection over a depth of 48 feet.

Q Would you likewise mark that on the profile on the board?

A Yes.

Q Now, referring to the Ballard B No. 5 well, I note you have shown two logs run on this one on February 19 and one on February the 22nd.

A Yes. After running these two logs, or reviewing the information on the two logs that we had on Yates No. 5, we decided to check additional wells in the area to see if this same effect was present in other wells.

Q What is this effect that you are referring to, Mr. Ledbetter?

A The fact that we were injecting over a larger portion of the sand at these higher pressures and injection rates. On February 19 we ran this isoflow log on the Ballard B No. 5 at a pressure of 1300 pounds and a thousand barrels per day. Then, three days later we ran it on the same well at a pressure of 900 pounds and 500 barrels per day.

Q Why did you wait the three days between the runs of this log?

A We waited in order to be sure that this well, or what we felt was adequate time for this well to reach stable conditions at this lower injection rate.

Q How many feet of the section did you find you were injecting water into under your February 19 survey at the pressures noted on the profile?

A The interval taking water at the 1300 psi pressure is 44 feet.

Q What is the interval at the 900 pound pressure?

A Eight feet.

Q Would you mark those two footages on the profile test, Exhibit 4?

A Yes.

Q Refer now to the Yates A No. 11 and the isoflow log run March 31, 1960, at what pressure was the water injected?

A This well was --

MR. PORTER: What's the number of that well?

A Yates A No. 11.

MR. PORTER: Thank you.

A It's the one shown at the right of this cross section. This well was surveyed at a pressure of 1150 pounds and 550 barrels per day. At this time, why we felt that we had adequate evidence from these two wells we had checked that we didn't run

this one at two different pressures. We just ran it at what our normal injection rate at that time was.

Q How many feet of the section did your log show you injected the water into on this well?

A It was injecting water over an interval of 85 feet.

Q Mr. Ledbetter, did you run any of these tests in anticipation of a proration hearing?

A No, sir.

Q How many feet did you say on this Yates A No. 11?

A Let me check it again, please. 85 feet.

Q Would you mark that on the exhibit on the board?

A Yes.

Q Mr. Ledbetter, can you make a general statement with respect to what effect higher rates of injection had in these tests upon these three wells as far as the amount of the section that water was injected into?

A Yes. It was quite an increase in pay section that was taking water under the higher pressures and injection rates. In some instances quite large increase.

Q I'll refer you now to what has been marked Applicant's Exhibit 5 and ask if you would state what that portrays.

A This is a cross section of wells through the field showing the sand sections and character of the pays through the

field as the best information we have available. You'll note that two of the wells shown in the previous cross section, Ballard B No. 5 and the Yates No. 5, are also included in this cross section.

Q Those were the two wells on the injectivity profile, Exhibit 4?

A Yes.

Q Two of the three. Why did you use these particular wells to make up this cross section?

A We used these wells in order to show that the pay characteristics in these two wells is not different largely from the other wells in the field. This characteristic of having a sandy lime zone and sandy zone separated from the other sandy zones covers an extensive area the best that we can determine.

Q Are these wells on this, what has been marked Exhibit 5, wells upon which you had the best information in your project area?

A Yes, sir. Those are the ones that we have the most complete information in the area.

Q Does this cross section run from north to south through the entire area of your --

A Yes, sir, it runs from the well up in this area down through this way.

Q On this Exhibit 5 in respect to the Yates No. 5 and the Ballard B No. 5, you have also shown the results of these iso-flow logs, is that correct?

A Yes, sir. These show the zones, these tighter zones, sandy and sandy dolomite found in these wells and other wells to be taking water at these higher pressures.

Q Do these wells, and does this cross section, show that the additional area that's taking water is a gray lime that has produced in the Grayburg sand, a gray sand that has produced?

A These zones are reported on the driller's log and, of course, all of this was completed open hole and produced together. Exactly where the oil production came from and how much came out of these zones is really problematical, but it's doubtful that in their primary production that they were able to contribute very much oil due to the completions at that time.

Q Refer to what is shown on this cross section as the Canfield No. 8-A, as that well in which you had a larger amount of information than the other wells in the field, and ask what it portrays to the location of this Loco Hills sand?

A The 8-A well was cored and we do have a permeability plotted on the cross section from the core analysis. You will note that we have a permeable section at the top which is separated by an impermeable section near the top of the sand,

and then below this we have a larger sand section, larger permeable sand section.

Q Is that similar to your available information, is that section similar to the available information on the Yates No. 5?

A Yes, Yates No. 5, from our logs and the information that we have available, shows a sand section that is very similar.

Q From your testimony and the exhibits that you have discussed, that is, 2, 3, 4, 4A, B, C and D, and Exhibit 5, what general conclusion can you draw with respect to the development, secondary development of this West Loco Hills Unit Area?

A From the isoflow surveys that we ran at different pressures, I believe that in order to flood this reservoir effectively that high injection pressures and consequently high injection rates are necessary.

Q Do you think this is true of all fields in which you have had any experience, or is this an exceptional field?

A I feel that this field is an exception to the general reservoir found throughout the country.

Q Do you have any opinion as to whether or not, if this field is not flooded at the maximum rate, it is probable that oil will be lost that might otherwise be recovered?

A I believe that, from these injection profiles, that that would have to be a definite conclusion that oil would be lost and

that it could not be recovered unless the pressures on the injection wells were kept up.

Q Were these exhibits 2 through 5 that you have discussed prepared by you or under your direction or supervision?

A Yes, sir.

MR. LOSEE: At this time we'll offer Applicant's Exhibits 2 through 5.

MR. PORTER: Any objections to the exhibits? The exhibits will be admitted to the record. We'll have a short recess and the witness will be recalled for cross examination.

(Whereupon, a recess was taken.)

MR. PORTER: The hearing will come to order, please. Does anyone have any questions of Mr. Ledbetter?

MR. MORRIS: Yes, sir.

MR. PORTER: Mr. Morris.

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Ledbetter, are your effective injection curves Exhibit No. 3 in this case?

A Yes.

Q If you would refer to your Exhibit No. 3, and refer to the first page of that exhibit where your curve showing the oil production is declining now. You would normally expect for the

oil curve to decline as the life of the project moves on, wouldn't you?

A Yes, sir.

Q So the decline in oil shown there is something to be expected, not something that follows only from a reduction in the rate of injection, is that correct?

A In general that's right.

Q I believe you testified with respect to various individual wells in this Exhibit No. 3 that the reduction in the rate of injection in some way, at least for the immediate present, had a detrimental effect upon the oil production, is that correct?

A Yes, sir, so it seemed.

Q But your exhibits do not show what the effect on the ultimate recovery would be, do they?

A No, sir.

Q So your Exhibit No. 3 neither proves nor disproves that waste would be caused by the restricted injection rates? It's not intended to show ultimate loss, is it?

A I believe that's right.

Q Mr. Ledbetter, are you generally familiar with the testimony in Case 1787 which has been made a part of the record in this case, that was the general water flood case, where we established Rule 701 as a result of the hearing?

A I was present in the audience part of the time.

Q Are you familiar generally with the various theories advanced by the parties in that case, specifically the parties holding to the theory that water injected into formations will imbibe throughout the oil bearing sands and that restricted rates will not cause waste, but rather enhance ultimate recovery of oil?

A Yes, I've read of that theory.

Q Whether you agree with that theory or not, Mr. Ledbetter, you do recognize it as one of the accepted theories in the business of water flooding?

A Well, it is a theory. I'm not sure about the acceptance.

MR. PORTER: In other words, you don't accept it?

A No, sir. Not in this particular field.

Q (By Mr. Morris) Now, Mr. Ledbetter, do you have any evidence to present to the Commission today to the effect that the oil bearing sands in this particular pool will not imbibe water injected at relatively low rates?

A No. We don't have any data to that effect.

Q Your isoflow logs that you have shown to the Commission, they show only where the injected water goes directly. They would not show to what formations water might reach by the process of imbibition?

A That is true to a certain extent. I feel that we have definitely established that there are impermeable layers.

Q Relatively impermeable with respect to the major streaks?

A Well, as common oil field terminology where impermeability is measured by core analysis, and I don't believe that any of the imbibition people say that they will go through these layers or imbibe from across these sections.

Q So, your general conclusion that waste would be caused in this field by restricted injection rates depends largely on what theory you hold to, doesn't it?

A I don't think so. I think that there's no way that you could say that we could imbibe into these zones that are taking water at high pressure through these impermeable zones from this main permeable section. I don't believe there's a possibility of them imbibing through maybe six or seven feet of impermeable dolomite into these other sections.

Q Is there any possibility, Mr. Ledbetter, of injecting into the various sections at different pressures?

A These wells were completed open hole with a casing set approximately 75 to 100 feet above. Now, in this main, this most permeable sand section was shot and it has shot holes that we estimate that might be as large as 20 feet in diameter, and we don't feel there's a mechanically feasible way of doing it.

Q Do you find that these impermeable streaks which you say will prevent the processes of imbibition, do you find these streaks to be continuous throughout the Loco Hills sand area?

A We have a limited amount of data that we can work with, and in our cross section and in our Exhibit No. 5, we feel that this is borne out definitely. These wells, we have the best data available in the field, and, for instance, in Yates No. 5 you'll note that there is a zone of considerable thickness and shows to be a tight sandy dolomite, and then a more sandy zone. Now, this pretty well correlates with this zone found at approximately 2800 in the Saunders A No. 1 and the zone shown at the top part of the sand in the Canfield 8-A. We feel that where we do have data there seems to be a continuity over sizable areas in these impermeable zones.

Q Now, the portion of the sand above this impermeable zone, do you have any reason for feeling that it's not taking water at the low pressures, is that shown on your isoflow?

A The isoflow shows that it is not.

Q Do you feel that that is because that particular zone has less porosity or permeability, what reason would you ascribe to that?

A I do not know the reason. I've thought about it considerably. All I know, from all the information that we have,

that it does take at high pressures and it does not at low pressures.

Q Could you tell me a little bit more about the way these isoflow logs are obtained, how you know that water is actually going into one zone and another?

MR. LOSEE: We have a Welex representative here who'll make a detailed explanation of the log, if you would like to wait and let him answer those questions.

MR. MORRIS: Be glad to. I believe that's all. Thank you.

MR. PORTER: Anyone else have a question? Mr. Nutter.

BY MR. NUTTER:

Q Mr. Ledbetter, referring to your Exhibit No. 3, the third sheet there, the Ballard No. 3-A well --

A Yes.

Q -- you stated that you had to restrict the water injection into the offsetting water injection well from approximately March of 1961 until August or September, correct?

A Yes, sir. That was the general.

Q Then when an ample supply of injection water became available, you increased the injection rate in the offsetting wells, correct?

A No, sir. This was done, we had ample water at that time.

Q But you did increase the injection rate as shown here on the Ballard 3-A?

A Yes, sir.

Q But that the oil production from the Ballard 3-A failed to respond to this increased injection rate?

A Yes, sir.

Q What was the primary recovery from the Ballard 3-A well, Mr. Ledbetter?

A I don't have that information with me today.

Q Would you have any approximate value for the primary recovery on the well?

A I think it would be under the order of 75,000 barrels.

Q What has been the secondary recovery from this well?

A Excuse me just a minute, and I'll give you that information. I find this primary here is 119,822 barrels.

Q What's the secondary to date?

A At the end of February it was 119,165 barrels.

Q In February the well produced between five and six thousand barrels?

A Yes, sir.

Q And is still producing?

A Yes, sir, it's still producing.

Q So, actually this well has done fairly well as far as

secondary recovery is concerned, having recovered its primary production to date and still producing at the rate of better than 5,000 barrels a month, wouldn't you say?

A Yes, sir. But the injection wells surrounding this well also had primary recoveries which we'll have to get somewhere too, we feel.

Q If you recover an amount of oil, a secondary recovery equal to the amount of oil produced on primary recovery, you consider that you have a fairly successful water flood, don't you?

A In general that is a very true statement.

Q Does the production decline curve for the second half of 1960 all through 1961 and the first part of 1962 reflect anything other than a normal production decline curve for a well in a water flood project?

A It would seem normal without considering the injection around this, but normally we have a definite relationship to the injection around the well to the fluid produced out of the well.

Q If anything, Mr. Ledbetter, the decline since March of 1961 has been flatter than normally reflected in many water flood producing wells, has it not?

A Yes, just looking at an average production decline curve for an average water flood, you would make that statement.

Q Now, referring to your Ballard B-3, which is the third

or fourth sheet after that one in the Exhibit No. 3, here again you have an injection rate which was decreased approximately March of 1961, and has more or less been stabilized or possibly slightly increased the second half of 1961, is that correct?

A Yes, sir.

Q This is another of those wells which you mentioned had declined in oil production and had not responded to the increased water injection?

A Yes, sir.

Q How much oil has this well produced on secondary recovery?

A 68,670 barrels to the end of February.

Q On how many sides does this well have injection?

A On two sides.

Q So it's had a response of 68,000 from injection on only two sides?

A Yes, sir.

Q What was its primary recovery, Mr. Ledbetter?

A 153,000 barrels, approximately.

Q So it's done fairly well considering the fact that it isn't surrounded by injection wells, hasn't it, having produced a third of its primary recovery?

A Yes, sir. It hasn't done as well as some wells we had

by a considerable extent.

Q Is the decline curve here more than you would expect on a water flood well?

A It is to this extent, normally we don't expect quite as quick a break in this area where we're, this water-oil ratio changed quite abruptly, you'll note, about the time we increased the injection. We would expect the oil to maintain a declining percent of the total fluid that would be a little more regular there.

Q This well undoubtedly would have had a higher maximum producing rate had it had water injection on more sides than it actually has, wouldn't it?

A Yes.

Q And it would have produced more oil prior to the time that the water breakthrough occurred initially?

A Yes, sir.

Q Now, referring to the Yates No. 4 well, which is several pages further, in this case water injection took an overall decrease from January of 1961 until about July of 1961, is that correct?

A Yes, sir.

Q And oil production hit a peak in April of 1961 and declined to a low in June of 1961, correct?

A Yes, it declined.

Q Then when water injection was increased the oil production also increased, is that correct?

A Yes.

Q So at least in all cases it is not always true that wells fail to respond when injection rates in offsetting wells are increased, would that be a fair statement to make?

A Yes, sir, I believe it would.

Q Mr. Ledbetter, these wells are all open hole completions, is that correct?

A All of the original completions were, yes, sir.

Q Now, assuming that these isoflow diagrams are correct, and they show a certain amount of water going into various sands there and the water injection rate to be far from uniform into the entire gross interval which is open to the well bore, would that indicate the possibility of a need for selective injection?

A Well, I feel we're getting a higher uniform coverage under these profiles that show, that were run at the higher injection pressures.

Q Now, referring to the Yates well in which you have two profiles, one for one rate, the other for another rate, neither one of these profiles shows uniform injection into the gross section that's open in the well bore, though, does it?

A No, sir.

Q And there are some lenses or sands or bodies in that open hole interval which are more susceptible to water injection at any rate of injection?

A Yes, sir. There is, we feel, non pay sections open in the open hole section as well as pay sections too. In fact, a considerable amount of this top portion of this, oh, maybe 50 or 75 feet of this open hole at the top is impermeable dolomite and not considered possible pay section.

Q Would this be so impermeable that it wouldn't take water regardless of the injection pressure?

A We have not found any water going into any zones that we didn't think were pay sections or where we thought we could recover oil.

Q In other words, you feel if it's permeable enough to take water, it's permeable enough to produce oil?

A Yes, along with the evidence that we have that there was shows of oil and indications of oil in these zones in the original drilling.

Q But you don't have any logs or anything, or cores, which would indicate the saturation in these tight dolomites?

A No, sir, we don't have other than, I don't even believe we have saturations on the Yates or the Canfield 8-A, I don't believe we do have.

Q Do you have any evidence that, assuming that you were injecting at the rate of 1500 barrels a day or five or a thousand barrels a day, or whatever it was, I believe on the Yates No. 5, the second isoflow was run at 1500 barrels a day, correct?

A Yes, sir.

Q Assuming that you were injecting at the rate of 1500 barrels a day into that well, do you have any evidence that would indicate that the water going into those tight sands would sweep those sands and produce oil from them prior to the time that the more permeable sands had had a complete sweep and the wells were making 100% water and had to be abandoned?

A Yes, to a certain extent we do have. It's kind of in a back conclusion that we had to draw from this standpoint, in that we originally looked at this thing and we were looking at this section, this better part of the pay section, and in individual wells we have recovered a great deal more oil than we thought we should on the basis of this one pay section. From that we attribute this additional oil to these other sections, and come to a conclusion that we are flooding it from that basic.

Q Now, referring to your isoflow on No. 5 at the rate of 1500 barrels a day from the interval 2782 to 2789, you have a percent of input running from 20 to 50%, correct?

A Just a minute. This is the Yates No. 5?

Q Yes, sir, this is the isoflow that was run February 4.

A .2782 to the point.

Q Yes, that would be the second station there on that top.

A Yes, sir, down to the point.

Q 2785 which would be the fifth station there. You have a water receptivity running from 20% to 50% of the total?

A Yes, sir.

Q So that would make 30%, correct?

A Yes, sir.

Q Then, from the 6th station at 2804 to the 8th station at 2807, you have a water receptivity running from 60% to 80%?

A Yes, sir.

Q So, three feet there, taking 20% of the water, correct?

A Yes.

Q And in the other interval seven feet are taking 30% of the water, correct?

A Which --

Q Well, the interval from the second station to the fifth station where you run from 20% to 60%, that would be an interval taking 30% of the water which covers seven feet, or is it less than that, five feet, three feet?

A Seven, isn't it, Mr. Nutter?

Q It's from 2782 to 2789, I believe. Seven feet, and takes

30% of the water there?

A Yes, sir.

Q So you have ten feet of pay taking 50% of the water at a maximum injection rate of 1500 barrels per day. Now, in the face of this, do you think that you are getting efficient sweep through these other less permeable sands? Does it stand to reason that these sands are going to be swept, that you are going to be making a high percentage of water at the producing well prior to the time the water has entered and swept through the other sands that are less permeable?

A Well, that, I don't know, that isn't what happened.

Q Is this water going to go through this permeable sand?

A Yes, it will go through.

Q It's going to reach the producing well, isn't it?

A Yes, sir.

Q And you may have a high water cut at the producing well by the time the water has penetrated a hundred feet out or 50 feet out into the tight sand, is that correct?

A I don't know. I would like to say that like I said, that that isn't what happened. We do have a very good performance surrounding this input well.

Q From your producing wells?

A Yes, sir.

Q Now, did you run an iso production survey to find out what sands were producing the oil in your producing wells?

A No, sir. I don't know of a method which I can run and find that information.

Q In other words, there's no measure to know how effective this sweep is through these tight sands even at this high rate of injection?

A None other than from the performance history of the flood that I know of.

Q And the performance history would indicate that at least you swept the porous permeable sections of the well?

A At least, I would say that happens to be the minimum.

MR. NUTTER: I believe that's all, thank you.

MR. PORTER: Anyone else have a question?

MR. BRATTON: Yes.

MR. PORTER: Mr. Bratton.

BY MR. BRATTON:

Q Mr. Ledbetter, do you know how many orders have been entered for water flood projects in southeast New Mexico under the provision of Rule 701--

A No, sir.

Q -- since the hearing three years ago?

A I do not personally know.

Q Mr. Ledbetter, do I understand you to say that this pool is different for some reason from other pools in southeast New Mexico in the Permian Basin?

A What I did say was, this is different from any pool in my experience. Now, I do not have this data on other pools in southeastern New Mexico, but in general, this is definitely different from anything that I found in my experience.

Q Is it different from the other pools which have gone under water flood under Rule 701-E, the current rule? Do you know whether it is different from those?

A I do not have the data on those pools to say.

Q Do you know of a reservoir where the pay section is homogenous, of equal permeability?

A Not 100%, but there are some that are considerably more homogenous than this one, I would say.

Q Is it a fair statement, Mr. Ledbetter, that in practically every oil pool you are going to have different stringers of different permeabilities throughout the pay section, is that not correct?

A To some extent, yes. I mean to more extent, more in some and less in others.

Q That's right, but you are going to have variations in permeabilities in your stringers throughout your pay section in

almost every pool, in every pool, I'll say?

A Yes, sir, that I know of.

Q So, in that respect what makes this pool any different from other pools in southeast New Mexico, Mr. Ledbetter?

A The fact that it seems to be sensitive to the pressure and injection rate there, with that and the amount of sand that takes water.

Q That would be equally true in every other pool with different ranges of permeabilities in different stringers, wouldn't it?

A I do not know that to be a fact.

Q So you cannot say, then, from your experience, that this pool is different in that respect from the other pools in southeast New Mexico, and particularly the other pools which have obtained water flood orders under Rule 701-E, you cannot say that this pool is different from those in that respect?

A No, in that I don't have this data on them.

MR. BRATTON: I think that's all.

MR. PORTER: Anyone else have a question?

MR. LOSEE: Yes, sir.

MR. PORTER: Mr. Losee.

REDIRECT EXAMINATION

BY MR. LOSEE:

Q Back to the question that Mr. Morris first asked you with respect to your Exhibit 3, Mr. Ledbetter, in which on direct examination you had testified as to the first page of the exhibit, that there was a direct relation to the water injected as to the fluid recovered from the producing wells, and that continued until you slacked off on your injection rates and during that period your fluid out fell until you started back injecting in your water with higher injection rates, and your oil continued on a down-cline. Your answer to Mr. Morris indicated that there was a question in your mind as to whether that was a normal decline or whether in your opinion that was something that was caused by reason of the fact that you had reduced your injection rates in the offset wells.

A I definitely think that this can be attributed to these reduced injection rates. I believe I feel that Mr. Morris' question was, is this an average looking decline which is not necessarily anything, it has a general shape of an average decline, there's no reason to believe that this is the decline that we will expect. In fact, it is different from what we would have expected.

Q Do you have some wells in this field that are shown on this exhibit, or calculated in it, which have reached higher peak rates, considerably higher than other wells shown on the exhibit?

A Yes.

Q From that, could you conclude that at least as to those wells that have not reached a similar peak rate of production, the fact that their production is still off, that it is in part, at least, attributed to the reduced injectivity rate?

A Yes, sir.

Q I believe that Mr. Nutter directed a question to you regarding the straight comparison of primary recoveries to secondary recoveries on one of the wells in which the comparison was made, that it was one to one on the well in question, and I think 122,000 to 119, is that a correct comparison, or should you also consider one injection well where you are on this type of flood pattern in your recovery rate?

A Yes, sir. You will have, in a normal five spot pattern, you will have one injection well to each producer, which also had primary recovery.

Q So that actually, if you are comparing the primary to the secondary on an acreage basis out of the producing well, you would have to recover twice as much oil as you had done on primary out of the producing well or sum equal to the injection well recoveries and the producing well recoveries to get one to one?

A Yes.

Q Have you had any wells in this field or in your project that have recovered more than their primary recoveries?

A Yes, sir.

Q With reference to the Yates 6, do you have the figures on what it was on primary and what you have so far recovered on secondary?

A Yes, Yates No. 6 produced approximately 132,000 barrels of primary production;until the end of February this well had produced 260,000 barrels of secondary.

Q Do you consider that this field, insofar as Newmont has developed it, is an exceptional water flood field by way of recoveries that you have obtained?

A Yes, sir, it's definitely above average.

Q Has the recovery been better than you had originally estimated it to be at the time you acquired this property?

A Yes, sir.

Q Would it be a fair statement that one of the reasons for the larger recoveries that you have obtained is that you are flooding a section of the pay upon which primary oil was probably not recovered?

A Yes, sir. I feel that the amount of primary oil recovered from these tighter sections was probably negligible, and that it appears that we are definitely recovering oil from

these due to secondary operations.

Q At the time of the completion of these wells there was no completion practiced by way of fracturing the formation, was there?

A No, sir, these wells were drilled in the late 40's,-- the discovery was drilled in 1939 and most of the wells were drilled in the early 40's.

Q Referring to the question of the selectivity of the injection with water into this section down here, would it be possible to selectively inject the water into this section?

A No, sir.

Q Would it be practicable?

A It would be impossible in these wells, because of the size of the shot hole. We don't have any way of mechanically completing these wells where we could control the injection.

Q Actually your isoflow logs show in the well, particularly that Mr. Nutter queried you on, show that the water is going into the section which is more permeable, and that to that extent you are obtaining selective injection of the water?

A Yes, sir. We are at the increased pressures and injection rates getting far better distribution of this water than we did at the lower pressures, and that we are, we feel, covering the sand as well as possible and as mechanically possible in

these wells.

MR. LOSEE: I think that's all.

MR. PORTER: Any further questions? Mr. Nutter.

RECROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Ledbetter, I failed to ask you this a while ago, I'm sorry, you stated that in your opinion this high injection was necessary because this particular flood is an exception. Have you ever advocated low injection rates on any flood that wasn't an exception in a situation like this?

A No, sir, but I feel that my opinion was based on the evidence we found in these injection profiles, that substantiates the fact that we should inject at these higher pressures.

Q You are acquainted with water flooding operations generally in southeast New Mexico, aren't you, Mr. Ledbetter?

A To a small extent, yes, sir.

Q Are any water flood operations being conducted to your knowledge in any pays other than the typical limestones, dolomites and sand stringers which you find in limestones and dolomites in these Permian age formations in southeast New Mexico?

A No, sir.

Q Do you know of any flood that has been conducted in other than those types of sands or pays?

A No, sir, I don't. Of course, I haven't studied anybody's floods except our own, Mr. Nutter. I just am really not well qualified to answer that.

Q But, being generally familiar with water flooding operations in southeast New Mexico, you don't have any floods in anything other than the Permian type formations such as we have referred to?

A No, sir.

Q And this is one of those type of formations, for all practical purposes, without considering it as an exception at this time?

A Yes, sir.

Q And you have a dolomite here that has sand stringers in it, is that right?

A Yes, sir, I'd say that.

Q Does Newmont operate any water flood in southeast New Mexico which is governed by the allowable provisions of 701-E?

A No, sir.

Q So you haven't had any actual experience operating a flood under those rules to date?

A No, sir.

Q You mentioned that No. 6 Yates had produced 260,000 barrels secondary versus 132,000 barrels primary. You also

mentioned that in a normal five spot operation you would have 80 acres of acreage dedicated to each producing well. Would you say that No. 6 well is included in what you would call a normal five spot pattern?

A No, sir, we don't really have any of those.

Q As a matter of fact, if we just take an overall look at the water injection pattern for the existing flood plus the proposed flood in the unit, it ranges from triangular shape to parallelograms and rectangles and just about every other pattern between injection wells, doesn't it?

A Yes, sir, there's quite varied patterns.

Q Due to the drilling pattern that was used here, it's impossible to achieve a normal five spot injection?

A Yes, sir, without drilling a great number of new wells.

Q Yes, sir. In your opinion, Mr. Ledbetter, would the time when one of these isoflow logs were run on a well have any effect on the effect of water injection as depicted by the isoflow? In other words, if it was in a state of maximum fillup, would possibly a 1500 barrel rate give a different effect than a 500 barrel rate, whereas if you were just starting water into the ground into a depleted reservoir with a lot of open porosity which wasn't filled, I don't know if I'm making my question clear, but would the state of fillup have any effect on the isoflow log

when it was run for two different rates?

A There definitely could be that possibility, though I feel that the isoflows, particularly the one that we ran in the Ballard 5 which was about three days apart and the state of fillup hadn't changed a great deal during those three days, that it did seem to have the same effect even though this one on the Yates 5 was run almost a year apart. It showed primarily the same situation.

Q Well, now, did you state that these wells on initial completion had been shot?

A Just this best part of the sand section was shot generally.

Q Do you envision a cavity down in there or a large opening around the area where the well was shot?

A Yes, sir. I have several reasons to believe it is very large.

Q Do you think that the size of the cavity or the shape of the cavity would have any effect on the isoflow log when it was run?

A There's a possibility that there may be at low, real low injection rates in this main shot hole, that it might not give, it's not quite as easy to determine the interface, but I feel that we can definitely conclude about the portions that are going

into the shot hole and the portions above are true and correct.

Q When the isoflow stations are picked, it might become important as to whether one was in a cavity, to make a comparison with that station as to one that is not in a cavity. Perhaps these are the questions that the Welex man should answer.

A Maybe he can answer them better. One thing is that the station is not picked laterally in the well bore, it was picked on percentage of injection above and below the interface and not as a point vertically in the well.

Q As a matter of fact, each station covers a certain vertical distance?

A Well, it could, or it could, it's a percentage affair, they change the injection above and below the interface torsions. He can explain, I think, better than I can.

Q Okay. I believe that's all, Mr. Ledbetter, thank you.

MR. PORTER: Mr. Kellahin.

BY MR. KELLAHIN:

Q May I ask just one question, please? You testified on redirect that it is not now possible to selectively inject these wells, as I understand, because of the size of the shot hole. Does that answer pertain to the wells presently being used for injection?

A Yes, sir, very largely so. Practically all injection

wells are converted.

Q Your answer would not necessarily apply to wells in the expanded area which might later be useful as injection wells?

A Yes, it would.

Q Are they all completed the same way?

A Those are going to be conversion of producers to injection too.

Q Are all those wells completed in the same manner?

A Yes, sir, very similar.

Q Have you studied the completions of the wells in the expanded area as proposed?

A Yes, sir, I've had an occasion to look at a number of them.

MR. KELLAHIN: Thank you.

MR. PORTER: Does anyone else have a question? The witness may be excused.

(Witness excused.)

MR. PORTER: The hearing will recess until 1:15.

AFTERNOON SESSION

MR. PORTER: The hearing will come to order, please. Mr. Losee, call your next witness. I believe he has already been sworn.

B. G. HARRISON

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

DIRECT EXAMINATION

BY MR. LOSEE:

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

A I'm B. G. Harrison. I live in Breckenridge, Texas. I am employed by Graridge Corporation as manager of secondary recovery.

Q How long have you been with Graridge Corporation?

A Approximately four years.

Q Have you previously testified before this Commission?

A Yes, sir, I have.

MR. LOSEE: Are his qualifications acceptable?

MR. PORTER: His qualifications are acceptable, yes.

Q (By Mr. Losee) Is Graridge a working interest owner of any acreage in this West Loco Hills Unit Area?

A Yes, sir, they are.

Q Are you, in your capacity with Graridge, familiar with the use of isoflow logs?

A Yes, sir. We use them frequently in our operations.

Q During the year 1961, approximately how many isoflow

logs did you run upon your wells?

A During a period of time of twelve months we ran 157 injectivity profiles.

Q What was the approximate cost to your company for running these profiles?

A These profiles, in total, cost approximately $36,000.00.

Q Based upon the information you obtained from these profiles, did your company spend any money?

A Yes, somewhere in the order of $225,000.00 was spent in well workovers based on information obtained through these surveys.

Q Does your company feel that these surveys are a valuable tool of the water flood industry?

A Yes. We feel that it is a very good tool in determining the areas in which water is being injected into a well bore. We thought so much of this development that we actually have two men licensed to handle radioactive materials, and we have equipment to run this type of survey.

Q For what reasons does Graridge run this type of survey?

A We have two primary reasons for running the survey. We have now set a policy whereby we run an injectivity profile on a well something in the order of thirty to sixty days after it's placed on injection. This is primarily for the purpose of

locating any trouble zones that we might have in these well bores as well as determining how much effective reservoir we have being affected by injection.

Q Have you had an opportunity to examine the logs that have heretofore been introduced in this case as Exhibits 4 A, B, C and D which were run upon the three wells shown on the injectivity profile test, Exhibit 4?

A Yes, I have. I examined those logs.

Q Do you concur in the interpretation placed on those logs by Mr. Ledbetter, who previously testified?

A Yes, I do.

Q Do you concur in his general statement he made that at lesser pressures a lesser portion of the section was being injected into?

A Yes. It's rather apparent from examination of the logs that at the lower rate, in the order of 500 barrels a day, and consequently the lower pressure, that much less overall section was affected in the wells than was at the higher rate and subsequent higher pressure.

Q Assuming for the purpose of your answer to this question that the cross section on the board, which is Exhibit 5, correctly portrays the Loco Hills pay throughout this unit area, in the event the injection rate into these wells is not at

maximum efficiency, is it possible or probable that oil may be lost in flooding this field?

A Yes, it would be my opinion, and I would conclude from examining these profiles and the cross section that less effective reservoir volume would be swept at the lower injection rates, thus we could expect less ultimate recovery.

MR. LOSEE: I think that's all.

MR. PORTER: Any questions of this witness? Mr. Morris.

CROSS EXAMINATION

BY MR. MORRIS:

Q Mr. Harrison, in your experience with the isoflow equipment, have you run into situations where logs were being taken on open hole completions?

A Yes, they're taken quite frequently.

Q Do you find that the results in the case of open hole completions are as reliable as results taken on a cased hole?

A Yes. The technique, as applied, which the Welex people will explain thoroughly to you, is so designed that it takes care of all these variable hole problems. That is the reason it is a good tool and the best tool that we know of today for checking injectivity profiles.

Q The isoflow log, though, is not a direct measure of permeability, is it?

A No, you could not say that.

Q It has some relationship to permeability?

A Yes. You would normally think that the more permeable zone would exhibit the better characteristics to take water. This is a generally accepted concept.

MR. MORRIS: That's all, thank you.

MR. PORTER: Does anyone else have a question? Mr. Nutter.

BY MR. NUTTER:

Q Mr. Harrison, would you agree with me an isoflow log shows that the injection is going to a certain section? Would it necessarily indicate the efficiency of the injection into any of those particular pays within a gross interval, or the efficiency of the sweep through that pay?

A It would be difficult to project that into actual efficiency, but we do use those in calculating our water flood reserves at times, and now the reservoir volume we expect to sweep.

Q Did you state that your company has run 157 isoflow surveys?

A I usedthe term injectivity profiles. A number of these were something other than an isoflow survey.

Q An isoflow, I suppose, is a patented trademark of the Welex Corporation?

A Yes, that's right.

Q An injectivity profile would be an isoflow with Welex and maybe some other name with another company?

A Yes, however, there are other methods, other accepted methods used in the industry to define definite problems. I did not intend to imply that all the surveys we ran were isoflow, although 75% of them were.

Q In the reality of the injectivity tests that you ran, did you attempt to isolate any sand and put the water in any particular sand?

A Yes, we did.

Q Sometimes this may be an indication of selectivity injection, in other words?

A In the particular cases that I'm thinking about, Mr. Nutter, the zones which we were trying to case off were actually thief zones and not pay. We were not casing these off for the purpose of selective injection into separate oil zones.

Q Have you examined the isoflow logs which Mr. Ledbetter submitted here today?

A Yes, I have.

Q Now, referring to Exhibit No. 4-B, if you have one of those handy there, this is the Yates No. 5 on the first injectivity test. I'll give him that copy. Now, Mr. Harrison, on this

particular log, this is Exhibit 4-B, it indicates that you have approximately 25% of the water going into a sand at 2803. Would you consider this to be a thief zone?

A I don't feel like I could answer that question without having a log on the well. I believe it's possibly indicated as pay. I think there's a witness to testify to that. If it is pay section I would not consider it to be a thief zone.

Q It has no vertical depth, however, does it?

A No, it does not.

Q The three stations indicated there are at one vertical point?

A That is correct. Assuming this to be pay, then, you would have 25% going into a one foot zone of pay.

Q You could also have 25% going into a crack, possibly, couldn't you, Mr. Harrison?

A That could be concluded.

MR. NUTTER: I believe that's all, thank you.

MR. PORTER: Anyone else have a question of Mr. Harrison? The witness may be excused.

(Witness excused.)

MR. PORTER: Call your next witness, Mr. Losee.

LLOYD B. PUTMAN

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

follows:

DIRECT EXAMINATION

BY MR. LOSEE:

Q Would you state your name, residence and occupation?

A I'm Lloyd B. Putman and I live in Midland. My occupation presently is sales manager for the West Texas Division of Welex Corporation.

MR. PORTER: Is that Putnam?

A Putman.

MR. PORTER: Putman. Thank you.

Q (By Mr. Losee) What schools of higher learning have you attended and what degrees have you obtained?

A I attended Louisiana State University and obtained a BS in mechanical engineering.

Q That was in 1949? A Correct.

Q How long have you been employed by Welex?

A Thirteen years.

Q In what capacities?

A In various capacities, beginning with an engineer trainee through all the various phases of our services which we perform, engineer, operator on trucks, field engineer, manager and sales manager.

Q Have you attended any technical schools having to do

with logging services?

A Yes, I have attended quite a number of them.

Q Does your company have a patent and are they the licensee of an isoflow log survey?

A At present we're operators of that license, right.

Q How long have you been operators of that license?

A I don't know exactly, because I've only been acquainted with it for the past five years. My company merged with the Halliburton Company and had the service and we took it over at that time.

Q Has this isoflow log become an established tool in the water flood industry?

A I would have to say yes, because we have run several thousand of them.

Q Would you explain how this tool operates, and by use of a diagram, if you have one there?

A I would like to pin this up. Anticipating this, I prepared this at noon. First of all, this process is a patented name. It was designed primarily to measure the location and quantity of fluids entering subsurface formations, primarily in the use of water flood whereas a prerequisite to using this process it's necessary to have certain conditions of the well.

First of all, of course, you must have casing and tubing, the pay section as I've outlined here must be completely open,

either perforated or open hole, and the tubing must be set on the bottom. You must have a source of supply of water, as I've indicated here, and what we do is take the input source of water, run it through a system of valves in which we separate it into two strings, incidentally I'll point out that the tubing in this case set in this well is sealed off from the casing annulus, and we pump water into both sections through the tubing through the annulus. We divide this water source through two meters, as I've indicated here, and to begin the survey we pump a small amount through one meter, which normally is the one going to the tubing, and the remainder we select out, approximately ten percent, go through the tubing first as a first station, ninety percent through the annulus.

At a point beyond this meter we inject a radioactive isotope which enables us to measure where all the fluid goes. We pump down the tubing and annulus and at some time as soon as equilibrium is established, it takes some time, ten or twenty minutes, we find that this physical occurrence takes place, as the fluid comes out of the tubing it enters thusly, goes up, it comes down the annulus, it goes this way.

The formation takes fluid, I will assume that all of it does in this case for illustration, the fluid will go out in the formation this way (indicating). Now, because we're pumping only

a small amount of liquid through the tubing, we find at first that somewhere, say here, a radioactive interface will take place. Let me color that in.

This area I'm cross hatching has radioactive material in it. When it comes out the tubing it will seek a level dependent upon the permeability of the formation and the amount of liquid that's being taken this way.

Now, with the use of a gamma ray probe we can locate this interface knowing that ten percent of the liquid is going down the tubing, ninety percent is going down the annulus, we know that when we locate this point that ten percent of the fluid leaving the bore hole is leaving below this point. Accordingly, we take separate stations, we increase the rate through this tubing to say twenty percent--this is not a fixed number, by the way, we can take any increment, and eighty percent through the annulus. When we do this we find normally that this interface will rise to a point here, perhaps cross hatch, and then we can say that below this point ten percent of the formation or ten percent of the fluid is being taken by the formation below here. At this point twenty percent of the injected water is going into the formation below this point.

We progress upward until we use up all the water, injecting nearly all of it in the tubing. I think it's an established

principle that when equilibrium is reached in the pumping operations, that this interface does exist, and this is the principle on which this service is founded.

Q Mr. Putman, have you examined the Exhibit 4 right next to yours which is the injectivity profile tests run upon the three wells in this project?

A Yes, sir, I have.

Q Do you have an opinion as to what this profile and the logs upon which it is made indicate?

A Based on the surveys we ran on these wells, it points out rather conclusively that at higher injection pressures, which is accompanied by higher injection rate, that more of the formation accepts fluid, in some cases it's pretty substantial.

MR. LOSEE: I think that's all, Mr. Putman.

MR. PORTER: Anyone have a question? Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Putman, first of all I would like to say I have no quarrel with the efficiency of the isoflow log at all. I just would like to understand precisely how it works. If you didn't add the isotope to the water, what would the gamma ray count be on the water itself?

A Well, the water has no gamma count. We would be measur-

ing simply the formation's natural radioactivity.

Q Well, now, in examining this log on this Yates No. 5 well, I don't find that any of the stations exactly fall back to a zero gamma ray count.. Would that indicate that you have some of the radioactive water all the way up through the tubing?

A Yes, through the tubing. It's a constant background. Perhaps I didn't understand your question. Well, no, I didn't. You said if there was no isotope in there at all, since we are pumping isotope down the tubing is always filled with the isotope in a uniform quantity, and it is a constant background.

Q At what point would you have the break from the background in the tubing to the radioactive water in the annulus outside of the tubing?

A How would I pick that depth?

Q Yes, sir.

A The break is rather sharp, and by sharp, is two or three or sometimes four feet. That's pretty sharp. But since the gamma counter is sensitive beyond that level, we pick it at the first point it breaks to your left, from the extreme right to your left. We pick it at a point in there.

Q I wonder if you would mark the point at which you would pick the break at the various stations on this exhibit by making a red mark where you feel it breaks off the radioactivity in the annulus to the background count in the tubing.

A You can say the width of a pencil line is six inches.

Q In other words, you feel that from -- now what is the lowermost line which I'll indicate on station No. 1 with a red X? Is that the bottom of the hole in this case?

A Well, let's see, I'm not sure. I am not sure, not necessarily. We don't log to the bottom of the hole.

Q Yes. How would you have a radioactive count higher than the bottom of the hole if the radioactive material is coming in from the bottom?

A We have a concentration of it at that point where the interface takes place, plus we have the natural formation radiation is taken into account too.

Q Radioactivity is increasing to the right?

A Yes, increasing to the right.

Q Between the two points that I have marked A and A^1 be the points at which the radioactivity is the natural formation radioactivity?

A No. Right here is the background in our tubing right here.

Q This is tubing? A Yes.

Q This is marked as B?

A There's a much higher radioactive count here--

Q Now, this --

A -- than in the tubing.

Q This is in the cross hatched area in the annulus at the bottom of your exhibit?

A Yes. That's all filled with radioactive material.

Q What causes this increase at point A to the right, is that the interface there between the radioactive water and the non-radioactive water?

A Yes, we have a little higher count right at the interface.

Q Now, as you approach that interface you are approaching non-radioactive water, aren't you, when you are coming up?

A Well, that's right, but we detect that interface even after we come out of it, which is indicated right here.

Q What I'm wondering is what causes the extreme break to the right in the increase in the gamma ray count at point A on station No. 5 on run 2 here. In other words, what causes this to break right here?

A Let me look at the original gamma ray. We're looking at a difference in the basic background of the formation.

Q On your composite picture at the top of the log, the radioactive count or the radioactive trace that's given here is the trace in the formation itself?

A Without any radioactive isotope. A base log we call it.

Q What would this indicate right here, Mr. Putman, where you have an increase of from approximately four or five percent input to approximately thirty percent input, and then a one point, so to speak?

A That indicates that there's a high concentration of liquid leaving the formation at that point, I say leaving at that point, that a higher percentage of liquid that is being pumped.

Q What actual vertical measurement do you have of what that point is? Do you have a crevice or crack that has a thickness of half an inch?

A It could be, we can't detect the difference in that concentration of radioactivity, whether it's in a foot or two feet.

Q I notice in a couple of the other logs you didn't show a hundred percent of the water going into the formation. What happens to the remaining percent of the water?

A Whenever we pump all the liquid through the annulus or tubing we no longer have an isoflow survey. There must be liquid going down direction to establish an interface. After that it becomes what is a conventional survey. So, our limits are between five percent and ninety-five percent.

Q So you never do achieve one hundred percent water injection, so to speak?

A That's right.

MR. NUTTER: Thank you, Mr. Putman.

MR. PORTER: Anyone else have a question of this witness? Mr. Bratton?

BY MR. BRATTON:

Q Mr. Putman, as I take it, the isoflow surveys here reflect that the whole open zone is not receiving water equally, that different portions of it take water, some easier than other portions, is that correct?

A That's correct.

Q Is that not the situation in practically every water flood?

A Where you have multiple zones I would say yes.

Q How many of these have you run in water floods in southeast New Mexico?

A That's difficult to say, but it's hundreds of them.

Q Would this be typical of the situation in other floods in southeast New Mexico?

A Well, I don't know that we've changed the rates of injection.

Q All I'm asking is, in any zone you don't have fifty feet that all accepts water evenly?

A No. Oh, no, I said we don't have formation that uniform in the Permian Basin.

Q And this formation here is just typical of the rest of them in the Permian Basin in that regard?

A In that regard.

Q Some portions of it will accept water more readily than other portions?

A Yes, this is a typical isoflow.

MR. BRATTON: Thank you.

MR. PORTER: Anyone else have a question of the witness? Mr. Losee.

REDIRECT EXAMINATION

BY MR. LOSEE:

Q Mr. Putman, one further question in connection with this large number of surveys that you have run in southeast New Mexico. Would it be general that most of those wells would take the volumes and pressures obtained in the higher of these three runs on these wells?

A No, the average pressures would probably be lower than the second set of runs we made on these wells.

Q In that respect, then, these wells at least differ from the majority of other wells that you have run these surveys on?

A In that respect, yes.

MR. LOSEE: I think that's all.

MR. PORTER: Any further questions?

RECROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Putman, one more question. In your experience in running these logs and supervising the running of them, have you ever noted or detected any difference in which the isoflow log is pictured as a result of maybe complete fillup, or just starting water injection into a formation? Have you noted any difference in the way in which the zone takes the water?

A I have never studied it from that angle.

Q When you run a survey, you don't know whether they have fillup or just starting the project or just what the status is?

A We may know, but it's only

Q It's not part of the necessary data to run the survey?

A No, all we do is say "this is where it leaves now".

MR. NUTTER: Thank you, Mr. Putman.

MR. PORTER: Mr. Losee, did you have a further question?

MR. LOSEE: No, I have no further questions.

MR. PORTER: The witness may be excused. Call your next witness.

(Witness excused.)

MR. LOSEE: At this time, if the Commission please, we have one person representing this hearing who has an appointment. They came for the purpose of not only hearing the testimony, but

making a statement. They have to catch a plane in Albuquerque, but with the Commission's approval, I would like to have Mr. Ray make his statement.

MR. PORTER: That will be permissible.

MR. RAY: I appreciate the leniency of breaking into the hearing at this stage. I am R. L. Ray with Fair Oil Company. We are owners of over-riding royalty interests under the Newmont water flood. We are also owners of leasehold interests and operate seventeen 40's, and will have 14.69% of the proposed unit. Fair Oil Company also operates water floods in Texas, Louisiana and Oklahoma.

Based on our experience in a similar situation with very similar sand conditions in the Glen Pool Field, Creek County, Oklahoma, we are convinced that in the Loco Hills Field, waste will occur unless the flood is expanded in an orderly fashion.

We also are firmly convinced that the restricted injection rates will bypass oil. The West Loco Hills lease owners have agreed and worked out the major points for unitization. With United States Geological Survey approval, and an order from the Commission granting this request, the operators should be in a position to set an effective date for the West Loco Hills Unit, oh, in the neighborhood of ninety days. At any rate, so far as the operators are concerned, things have worked out.

We would like to point out that without such an order there is danger that the proposed unit will fall apart. We could end up with several or a group of more or less cooperative projects with the resulting loss in oil and loss in efficiency.

Fair Oil Company concurs in the application of Newmont, and we urge the approval of their request. Thank you very much.

MR. PORTER: Yes, sir.

MR. NUTTER: I would like to ask Mr. Ray a question, if I could.

MR. RAY: Sure, be glad to.

MR. NUTTER: You were present in the hearing this morning, were you not?

MR. RAY: Yes, I was.

MR. NUTTER: You have heard some discussion about the delay that has been encountered in putting the injection wells on in the north of Newmont's flood. I think Fair Oil was one of the three companies authorized to water flood?

MR. RAY: We were, Mr. Nutter. I'm glad you brought it up. I am terribly embarrassed about this situation. It's something over which we have no control. We have been involved primarily in a dispute, or a problem, of securing an adequate water supply. The personalities and prices of water and a great many other factors have entered into it. It is a shame that

we have not been able to get this worked out sooner, but this is one of the drawbacks to cooperative operation. We are non-operative, we have agreed to it, we were willing to pay our part of the injection expense and are very anxious to see it started.

As I pointed out, we do have an interest along with Franklin, Aston & Fair in the Newmont projects, and it's part of our oil that's being moved as well as theirs. We are apologetic, and yet there's nothing that we can do about it. It's my understanding that water will start in the ground within the next week or ten days. I certainly hope that's true.

MR. NUTTER: Now, Mr. Ray, this loss of oil by one party to another and the purported ultimate loss of recovery, then, which we heard mentioned this morning, is resulting from a conflict of personalities and a disagreement over the price of water?

MR. RAY: That's one of the factors, and also the company, there are a lot of factors involved that I don't know all the details myself. But General American or Ambassador was purchasing the water, General American was putting in the injection plant. They thought they had a contract worked out and they found out that the water was not, the supply was not available. They started negotiating with other water supply companies and found out then that water was available and the contract for the water was not signed until after Christmas.

MR. NUTTER: Who was the contract for the water signed with?

MR. RAY: With Caprock Water Company.

MR. NUTTER: Caprock Water Company?

MR. RAY: Yes, that's my understanding.

MR. NUTTER: Among the plans that Fair Oil Company has for a water flood project in 36 was drilling and equipping an injection well in 36, have you all drilled that well?

MR. RAY: We are not operators in any of those wells. We pay a proportionate part of the wells, but of the three wells, Newmont will drill one, General American will drill two. We are not the operators, although we will pay a portion of it.

MR. NUTTER: One of these wells was to be drilled on Fair's acreage?

MR. RAY: No. Let me see which ones you are talking about. No, this well is to be drilled right here.

MR. NUTTER: That well has been moved over to General American's property?

MR. RAY: Whose map is this? The location is on the plat that we showed you originally was right here and that has been the spot, this spot, and then this one right here (indicating). We do not have control and are not operators, so we could not do anything other than urge the operator to move along, which

we have done consistently.

MR. NUTTER: I see. Thank you.

MR. RAY: I thank you for the opportunity to explain.

MR. PORTER: Call your next witness, Mr. Losee.

S. P. YATES

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q State your name, residence and occupation.

A My name is S. P. Yates. I live in Artesia, New Mexico, and my occupation is, well, I'm an oil man, drilling contractor.

Q You are an oil producer?

A I have my hand in some other businesses.

Q Have you previously testified before this Commission?

A I don't believe I have ever testified. I think I have made some statements in former years, but I don't believe I have testified.

Q What colleges or schools of higher learning have you attended, and what degrees, if any, have you obtained?

A I attended the University of Texas where I received a Bachelor of Science and a Master of Science degree in chemical engineering, and I attended Massachusetts Institute of Technology

one year, working towards a Doctorate, which I did not finish.

Q When did you start in this oil business?

A In 1939, here in Loco Hills, in fact.

Q Is that where you drilled your first well?

A Yes, sir.

Q Are you President of Yates Petroleum Corporation?

A Yes, sir.

Q Is it a working interest owner in this unit area?

A Yes, it is.

Q Are you a partner in Dixon and Yates Oil Company, and is it likewise a working interest owner in this?

A I am and it is.

Q Do you have a portion, are you the owner of a portion of this production payment interest that was previously discussed in Mr. Smith's testimony?

A Yes. Our group owns, the Yates group, that is, owns a ten percent interest in the oil payment on the federal lands under the Franklin, Aston & Fair, and we also have an additional oil payment under this Yates, et. al., I believe he calls it the Yates Lease in this testimony.

Q What portion of the working interest participation do you and the other Yates brothers and the corporation have in this unit area as proposed?

A Our group has roughly forty percent.

Q Did the Yates interests contribute or convey to Newmont part of the original acreage in which they started this flood in the Loco Hills area?

A Yes. We made a deal, we went along with Franklin, Aston & Fair group on our ten percent interest, which we turned over to them for consideration, and an oil payment, and likewise we turned this 160 acres, which would be right in the middle of the proposed flood, to the Newmont group.

We did this, I mean our primary concern for doing this was that we were surrendering a relatively small interest of ours in this field to determine whether a water flood project would be feasible.

Q Based upon the progress that Newmont has made, have you determined that a water flood project is feasible?

A Yes, we certainly have, and we have been working for a couple of years trying to get a water flood started on our own.

Q Have the recoveries in this initial area been equal to or in excess of what you had originally anticipated?

A In the area, particularly on the Yates lease where the flood was started, and the first increase was obtained, I think the recovery has been phenomenal in comparison to what we had anticipated.

Q In that respect, do you think this field is an exceptional field for water flooding?

A Yes, it's been quite good. We think it's been excellent water flood prospect.

Q Why, with your large interest in this unit area, did you agree to, or propose to agree to make Newmont the operator of this project?

A We had discussed with Newmont after the original kick, after we saw that this was going to be a success, about forming a unit to flood the rest of the field. We worked quite some time on this, and I think that maybe Newmont kept hoping that they could make a deal with us on the balance of the leases, but after I think they saw that we weren't going to make a deal, why then we could, we saw that we could work a feasible plan where we could use their skill and their personnel that was already in the field to go ahead and flood the rest of the pool.

Q Do you consider that they have been successful so far in the initial part of the field?

A I think they have been eminently successful.

Q Mr. Yates, I'll refer you to this cross section of the field that's partially covered up by Mr. Putman's graph. I think I'll move that.

A You are talking about the bottom one?

Q Yes, the bottom one, which is the cross section of the Loco Hills pay, and ask you if, based upon your experience as an operator in this field, you would say that that north-south cross section fairly represents the entire Loco Hills Unit Area from east to west.

A I think that cross section is quite typical of the entire field. In fact, the Loco Hills, the zone 4 sand in the Loco Hills Field is a very uniform sand throughout the pool, and it's characterized by what we called, at the time of drilling, a sandy limestone above the main pay section; I believe, in practically every well we drilled in the Loco Hills Pool that a show of oil was encountered some fifteen or twenty feet above the main pay. Of course, back in those days we just kind of noticed it, we didn't think we had anything, and, of course, we drilled on into the main pay and the main pay was quite good. It would fill up, in fact, some wells fill up and flow in maybe eight hours' time, so when you had something like that you wouldn't pay attention to what you would call a small show.

Q Have you subsequently in recent years, since fracking has become an accepted completion method, have you had occasion to make or try to make oil wells out of this similar sand that was disregarded?

A Yes, I think in Eddy County, I think the average well

that's completed now in the Grayburg sand is no better than this sand. I mean you get a small show and you run pipe through it and perforate and frack it and then you make a well.

Q Have you had occasion to examine this Exhibit 4, the injectivity profile test, showing the location of the three wells and the results of this isoflow survey?

A Yes, sir, I have.

Q Have you reached any conclusion as to what would or would not be accomplished by injecting at an efficient rate into those wells?

A It would appear to me, from the profiles, and it's quite interesting to me, that this is proved out in so many wells, I mean if this was just one isolated well I wouldn't put the weight to it that I would if it did not happen in so many of the wells, and it seems to be quite uniform.

I think that by not injecting at this high rate that you are going to complete, almost completely bypass that sand zone, that is the oil in the sand zone, and you will lose it.

Q And it's your opinion, based upon your examination of that, and your experience in the field, that unless it is put in at an efficient rate, that there will be oil loss?

A Yes. I think there's very definite possibility.

Q There was some earlier testimony with respect to the

quality of the production from this field as compared to other fields in Eddy County. Based upon your experience, would you care to render an opinion as to a comparison between this field and other fields in Eddy County?

A Well, this sand is a sand that varies from, oh, in the field proper from ten feet to thirty feet in thickness, and in the main body it has a high permeability. I mean it's, it varies, the highest permeability, I suppose, would be around 300 millidarcy. It is what we could consider a very very good oil pay, oil sand.

Q By reason of these high permeabilities?

A Yes, and high porosities too, by the way.

Q What is its relation, or what comparison would you make to other general fields in this Grayburg pay in Eddy County?

A I would say that this particular pay you can achieve much higher injectivity because of the high permeability without creating a fracture in the pay zone.

Q What about the primary performance of this field in comparison to other Grayburg fields in Eddy County?

A Well, the cumulative production, I'd say the average Grayburg well in Eddy County produces somewhere around fifteen to twenty thousand barrels of oil per well. That's its primary recovery. In these wells the average was somewhere in excess of 100,000 barrels per well, I believe that is the average now.

Now, I really didn't look at the average, but I know it's in the neighborhood of 100,000.

Q Approximately five to one, then, over the average well?

A Yes, that's right.

Q Do you have any other statements you would like to make with respect to this application?

A Well, I've been, ever since I've looked at this isoflow chart, I have been pondering it and wondering if there was some explanation for it. I mean there's some good sound basic engineering basis for it. The thing that it looks like to me, I mean it's more characteristic of, and I cannot say that this happens, because not knowing the exact conditions in the bottom of the hole or the sand characteristics under injectivity at these rates, but it does, this is something that's very characteristic of turbulent flow as against viscous flow.

I think anyone that has run permeability, you realize that all the permeabilities are run at very low rates of flow. In fact, it's very careful to not achieve turbulent flow because it gives a very wrong reading. In fact, you take readings under turbulent flow, why they're just no good as far as the ordinary permeability reading is concerned.

Q Would you elaborate on the difference between the two flows?

A Well, from an engineering viewpoint the pressure and relating pressure drops through the Fanning equation, you know what the characteristic of pressure drops through pipes and through, what we call in chemical engineering, called piked towers, that if you were comparing the velocity, suppose you have the two piked towers, one sitting here and one sitting here of different permeability, and you had it hooked in together, putting the same pressure on it, and you had turbulent flow, that your distribution of flow under viscous flow would be in direct proportion to the permeability. That is if you had permeability of ten in one and one hundred in the other, you would have ten times as much fluid going through the higher permeability as you would in the lower permeability. However, in turbulent flow that relation changes. That relation comes to the point three one power which is less than the cube root.

For instance, if you have, well, suppose you have an eight to one, let's take one that you can get a cube root on easily, but suppose you have eight times the permeability in one tower as in the other, then in viscous flow you would get the distribution, you would get one-ninth or eight times as much in that higher permeability as the lower. But in viscous in a turbulent flow, if you take that to the .31 power, let's take the cube root, it would be two times as much, two to one. In other words, you would

be getting one-third as much fluid through the lower permeability as you would through the higher. Did I lose you?

Q Does that mean that under one flow you would or would not increase the overall sweep efficiency of the sand?

A Well, this would probably just control at the injection point only, because you get out in the formation, I don't think there's any question but what you would have viscous flow, and this is something that I looked through the literature and I don't think any work has been done on it, and I think it's going to have to take some research work to find out if such is the case.

This would be one logical explanation of what could be happening, I mean why you would get this at the higher pressure, why you would suddenly, see this critical break between viscous flow and turbulent flow happens over a very short range. I mean it just happens, either you have turbulent flow or you have viscous flow, that is on sands of uniform thickness. Now, where you have a little different ranges you have smaller particles and bigger particles, there will be a less sharp break between viscous and turbulent flow.

Q Do you think that is a possibility of what is occurring in this field?

A Well, I think it's a possibility of what could be

happening. I don't think any engineer could swear that that's happening, I don't think he could swear that it isn't.

MR. LOSEE: I think that's all.

MR. PORTER: Any questions of Mr. Yates? Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Yates, to get away from the piked tower, if you had a brick laying on a bed of sand out here in the yard and you poured a gallon of oil on that brick, or let's say something even less permeable than a brick, let's say a pretty good piece of rock, and you poured some oil on that, it would only have one force acting on it to cause that oil to penetrate into the sand or into the rock. It would have the weight of gravity or one atmosphere of pressure possibly exerted on it. Would you say that pouring the oil on the rock and allowing the oil to run off the rock and into the sand, where most of it surely would go, would that keep that rock from becoming stained by oil, or would some of that oil actually penetrate into that rock?

A Which rock are you talking about, the brick?

Q We can take a brick or rock, either one.

A You mean if you pour oil on a brick, you mean will it stain it?

Q Yes, even though that brick is laying next to a bed of

sand which would be highly permeable.

A You mean next to it or on top of it?

Q We have a child's sand box here.

A Yes.

Q We have a rock lying there in the sand on the surface of the sand, and we pour the oil on the rock and allow the oil to run off the rock and into the sand which is highly permeable, of course, the sand is. Now, with only one atmosphere of pressure working on this, or only the force of gravity causing the oil to try to penetrate the sand or the rock, would the rock come out of there unstained?

A Oh, you mean the surface of it, or down in the middle?

Q The surface of it.

A Oh, I think it would be stained somewhat.

Q So, even as impermeable as the rock is, in relation to the highly permeable sand next to it, you would still have some penetration of some of that oil into that rock whether it's turbulent flow or viscous flow?

A Well, you wouldn't in the case you are talking about, there's not, it wouldn't even come anywhere close to turbulent flow. You are just pouring something on it. If any flow at all, it's viscous.

Q There is going to be some penetration of the oil into

the rock?

A I would think so, depending on the permeability.

Q Naturally it would depend on the permeability.

A If you had a glazed surface I don't think it would penetrate any.

Q I wasn't taking a glazed rock. But the measure of the oil stain that would be on the surface of the rock necessarily wouldn't be a measure of the depth to which that oil had penetrated into the rock, would it? I mean you would --

A No.

Q I mean you would have to break that rock open to find out how much penetration there had been.

A That's right.

Q Is there any indication as to the effect of the water into the tight zones? Is there any indication there of the effectiveness of the water into the tight zones or only that some of the water is going into that?

A I tell you, you are asking me about the isoflows and I never saw an isoflow chart until about a week ago.

Q The only reason I was asking was because you had said that you concurred more or less in what they demonstrated, and also that you had wondered about them.

A Yes, I'm putting faith in the testimony that's been

given here that the isoflow here is a good tool, and I am assuming, you have heard witness after witness give that testimony, and I'm only just one of the listeners, I kind of believe them.

Q So far, we have no measure as to the effectiveness of the flooding action on these tight sands?

A Well, I think the only thing,like Mr. Ledbetter said, you have kind of an indirect method in that the water flood is working exceedingly well, that the recoveries are very good and quite good, and I, for one, I'd be willing to flood any way, any way that I thought was going to be good, but I hate to take a proven method of doing it, that's working right off, and go throw it out and start on another method. I think this, what we're asking here for, I don't think we're asking for any more oil or any more allowable. We're just asking to do it our way instead of being limited and maybe losing a bunch of oil.

Q Well, as long as you are not asking for any more allowable, that's fine. Thank you.

A Well, in effect, I think that's about, about what I think we are asking for, is that right?

MR. NUTTER: Thank you, Mr. Yates.

MR. PORTER: Mr. Morris. Mr. Yates, just a minute.

A Yes, sir.

BY MR. MORRIS:

Q Mr. Yates, let's get out of the sand box and get back to the Loco Hills Pool. You stated that you believed that oil would be bypassed, and I assume you are referring to the oil in the less permeable sands?

A Yes.

Q How do you believe that any of that oil is going to be produced by the injection of water non-selectively at higher rates?

A I think the fact, I think you go back to the isoflow, that if you don't get water into a formation, how you going to get any oil out.

Q I'm going back to a point that I believe Mr. Nutter made with another witness this morning. If you inject water into this open hole and you have one nice section, it's very permeable and you are injecting at high rates, that very permeable section is going to take more water and you are eventually going to flood out your producing wells faster and probably before you get any oil from the less permeable section, as a result of the higher injection pressures, would you agree with that?

A Well, not if you go back to your isoflow, and you see you are putting a fair percentage of water in there in that other zone.

Q If you are not putting as much in the top zone?

A Well, you don't have as much to push. That thing

doesn't have as much oil as the other zone. At least I don't think it's as thick or has the porosity, but it has maybe 25% of it, or 20% or something like that.

Q You think that some oil, then, would be, say, pushed out at the other end of this less permeable streak, if we can refer to it that way?

A If you put water in on one end it's got to go somewhere. It's got to, I mean it's going to push something ahead of it.

Q You don't feel, then, that an injection at a higher rate would just cause your producing wells to water out that much faster and, of course, produce the oil in the more permeable area that much faster too?

A No, I think the better distribution you get on your sand the less recircling you are going to have to do with your water. If you have it going through a permeable zone and it breaks through, you are going to have to recircle and keep putting it in. In fact, it might get uneconomical to produce.

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

MR. LOSEE: No questions.

BY MR. PORTER:

Q Mr. Yates, reference has been made a number of times to amount of primary recovery and secondary recover, and so forth. How long was this particular area under pressure maintenance?

A Oh, it was under pressure maintenance about fifteen years.

Q That was with gas injection?

A With gas, yes.

MR. PORTER: No further questions of the witness, he may be excused.

(Witness excused.)

MR. PORTER: Call your next witness.

FRANK DARDEN

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

DIRECT EXAMINATION

BY MR. LOSEE:

Q Would you state your name, residence and occupation?

A I am Frank Darden. I live in Fort Worth, Texas. I am manager of operations for Newmont Oil Company.

Q Have you previously testified before this Commission as an expert?

A I have.

MR. LOSEE: Are his qualifications acceptable?

MR. PORTER: Yes, sir.

Q (By Mr. Losee) In connection with this Loco Hills Unit and your existing project, have you had an opportunity to calculate the sweep efficiency based upon these isoflow profiles of the

Ballard B-3 well?

A Yes, I have. The Ballard B-3 well is affected by only one injection well, and that's the Ballard B-5. Now, perhaps I ought to locate these on the map so we can all follow this. The Ballard 5-B well, as you recall, is one of the two wells which Newmont was forced to reduce injection rates in order to try to protect our lease line. So the Ballard 3-B is this producing well to the northwest of the Ballard 5-B injection well.

Before I start this discussion I would like to reiterate one characteristic of this field and of this project, that being that we are faced with a limited amount of detailed reservoir data on this field. So, consequently, we have to use every bit of information we have in trying to determine what's happening in this project. In many wells all we have to indicate what kind of productive sand we have is the driller's log. We found that most field driller's logs are not necessarily accurate, but they usually indicate considerably more sand than is actually net effective pay in a reservoir.

In the Ballard No. 3 well, the driller's log logged Loco Hills sand from 2735 to 2770 feet, and 17 feet of sand was reported as oil sand with free oil in the hole. The Ballard 5-B well, driller's log showed Loco Hills sand from 2752 to 2800, which is 48 feet of gross section with the bottom 23 feet reported as oil

sand with free oil in the hole. Well, in order to come up with what the effective acre feet was that was swept between the Ballard 5-B and the Ballard 3-B, we took the average, we took what they reported as oil sand, only the sand which showed oil in the hole, 17 feet for the Ballard 3-B, 23 feet for the Ballard 5-B. We averaged that and came up with 20 feet of average thickness between those two wells. By measurement of the estimated area between those two wells we assumed that no more than 10.6 acres was swept by a one-way push from Ballard 5-B to 3-B.

So, to get the total volume of reservoir which was affected by the injection well, we multiplied 10.6 acres by the 20 feet of average thickness and came up with 212 acre feet of reservoir volume.

Now, in our original study of the Loco Hills Field, in analysis of the primary we determined that there was 353 barrels of void space per acre foot, the void space being the pore space which was vacated by the production of oil and gas, leaving the connate water, some residual gas saturation and the residual oil saturation. So, the theoretical fillup volume before you had started moving any oil in this 10.6 acres, or this 212 acre feet, would be 353 barrels of void space per acre foot times the 212, you come up with 74,836 barrels, which would be the theoretical volume of water necessary to fill up the theoretical void space.

Well, at the time of response the Ballard 5-B well had injected 289,883 barrels. We assumed that 25%, in the first place we assumed radial flow, we have nothing that would indicate we are not having radial flow around an injection well. We assumed that 25% of the water put in that well was affecting the Ballard 3-B. So, 25% of the total volume injected was 72,470 barrels before we got our first oil response in the Ballard 3-B.

Well, our theoretical void space was 74,836 barrels, and we put in 72,470 barrels of effective injection water before we got response, so we got a sweep efficiency in that volume of 96.8%.

Well, never in the knowledge of any of the engineers with Newmont, or any of my associates that I have discussed this with in the consulting field, have they heard of a water flood that achieves that high percent of effective sweep efficiency. Therefore, something else has happened. We feel that we're doing a pretty fair job of water flooding, but we don't know any big secrets that other water flooders don't know, so we have to assume that there was something else that was happening besides just an increased sweep efficiency.

The normal sweep efficiency ranges from 50 to 60%. On a 60% basis we would have had response in the Ballard 3-B well when we had injected about 45,000 barrels of water. Well, of course, we didn't get response at that time, so we know we've got either

a higher efficiency or else we're flooding considerably more sand.

Well, now, our injectivity profile for the Ballard 5-B, and if you will look at the cross section you will note that shows that approximately 40% of the total water being injected at the high rate is going into an upper sand above the good Loco Hills pay which we had given credit as being the primary pay or the effective pay. Well, so if you take, using this 60% overall efficiency, and assuming that 45,000 barrels went into the good sand, then that leaves 27,000, roughly 27,000 barrels that had to go somewhere else.

Well, our isoflow shows that 40% is going somewhere else, and so, using a 60% overall efficiency, and you take the 27,000 over the total amount that we had injected when we got response, you come out with about 38% of the water which was actually injected into the upper sand.

Now, from this we conclude that we are definitely flooding additional sand. In other words, if all of the water had been going through just what was considered effective pay originally, why we would have gotten our response much faster.

Q In other words, your calculations, based upon averages, percentage averages in the industry, support the earlier statements and the profiles that you are sweeping, putting water in this upper section of sand that was not originally considered as

pay?

A That's correct.

Q Will you please refer to Exhibit 6, which is the primary versus secondary recovery figures. Would you please state to the Commission what this portrays, this exhibit?

A Yes, Exhibit 6 is an analysis of the primary and secondary recovery rises in barrels from the three center producers in the pilot area. We analyzed these three because they are the only wells that have had sufficient history for us to make a realistic projection as to what their ultimate recovery will be. Those wells are the Yates 8-A, the Yates 9-A and the Yates No. 6.

These are the three wells that were affected by the original pilot injection wells. Now, what we did was we took the cumulative primary production from the injection wells surrounding the producers; in this case, we took a quarter of the total primary production from each of these three injectors that affect Yates 6. In this case we took a quarter of the production from these three wells affecting 9-A and about 20% of the production from 5-B, and we made similar assumptions as to how much of this oil was inside this pattern. On that basis the primary production from the Yates No. 6 pattern was 132,000 barrels. The primary production from the Yates 8-A was 113,000 barrels. The primary

production from the Yates 9-A was 176,000 barrels.

Now, right here I would like to point out that because of the limited amount of detailed reservoir information that we have on this field, and this is true in many water floods I think, because they're performed on old fields, it's a salvage operation and, therefore, you don't have modern reservoir data on them. We feel that production performance is the most dependable piece of data which you have on an old field. So, consequently, we may use the other things, we use everything we have but we rest heavily on production performance because we know that has not been distorted, that is something that has been gauged carefully. Therefore, we calculated what the production had been on primary from these three wells and then we looked at what the secondary production to March the 1st of this year had been from those three wells.

The Yates No. 6 has produced 260,000 barrels, which is 1.97 times what we estimate this five spot has produced by primary. The Yates 8-A produced 94,000 barrels, which is .83 times what it had made by primary. Yates 9-A has produced 201,000 barrels, which is 1.14 times what it had produced by primary.

Projecting our production curves on these three wells we come to an ultimate estimated secondary production of the Yates 6 of 284,000 barrels, which is 2.15 times what that pattern made by

primary production. The Yates 8-A will make 140,000 barrels, which is 1.24 times primary. The Yates 9-A will make 250,000 barrels, which is 1.42 times primary.

Now, we're quite proud of all three of these wells. Any time a project produces more than one times primary, why it's, I think it's an exceptional project. However, we couldn't understand why you would have such a big variation between the recoveries of these three on the basis of what they had made by primary or a factor what they had made by primary. So we began to look for some reasons why this had occurred. The only thing that we have been able to determine that was different in the way these three wells were operated in the pilot operation of this field was that Yates 8-A and Yates 9-A had injection rates cut back. Yates 2-A was cut back, which affected both the 8-A and the 9-A.

Now, I will say right here that actually we might not have gotten the same type of recovery factor from the 8-A because it does not have the same type of pattern configuration, but the 9-A, as a matter of fact, should have a better pattern efficiency than the Yates 6 because it also should receive some effect from the 5-B well, which also was cut back in injection rate. So we don't say that that is the only thing that contributed to the lower recovery from the Yates A-9 or the Yates A-8, but we do say that it's significant that they're recovering so much less and we feel

that definitely the cutback in the injection rates in these two wells has adversely affected the ultimate recovery from those two wells. It's all well and good to say that a well recovers better than one times its primary, that's fine. But Newmont and the operators which Newmont are representing in this hearing are not content with one times primary when our experience shows we may get two times primary or one and a half times primary if we flood it in what we consider the most efficient manner.

Q Have you had an opportunity to correlate this production performance with the isoflow results?

A Well, of course, we did that in the case of the Ballard 3-B. Also in our original projections, of course, when you start a pilot or when you start a project you always make estimates as to what kind of recoveries you'll get, and we made estimates on these individual wells so we could tell our Board of Directors what the production was going to be six months from now, and that's a pretty risky thing to do any time, but sometimes you have to.

In all three cases we got response considerably later than we had estimated by theoretical methods, based upon the net sand which we could logically give these five spots; in all three cases we got, first, water production from twice to three times the length of time that we projected we would on a theoretical basis. Well, those things indicated that either one of two things was

happening, we were getting a tremendously better sweep efficiency than we estimated originally or we were flooding considerably more sand, so when we ran the isoflow at considerably higher pressure and we found that we were putting water into more sand than we gave originally credit for, that was our conclusion, that we are simply flooding more sand than was originally credited as being effective oil sand in this Loco Hills Field.

Q I suppose it necessarily follows that you have reached also a conclusion as to what would occur if you are not permitted to flood this field at the maximum efficient rate by way of occurring to the reservoir?

A Well, there's been a lot of testimony of this, there still seems to be some question about what it means, but I simply can't understand how you can flood at a reduced rate through maybe eight feet of sand, or eighteen feet of sand, and expect to ever get oil out of sand up here, which we know is there and which we believe has oil shows and which we show is taking water. If you don't put water in that sand I don't see how in the world you will ever get oil out of it, and by our performance in the pilot area and by the higher recoveries we're getting, we know that we are effectively flooding that sand and we are getting oil out of it, so, consequently, my conclusion is that if we were forced in any five spot in the West Loco Hills Unit to inject at

an artificially restricted rate, that we would be in danger of leaving oil behind simply because we were not putting water into all of the sand which would contribute oil.

Q Mr. Darden, there has been some testimony about the ability to select the areas in which you were going to inject water and the fact that water going into the more permeable lower section, and that it might flood out, or would flood out before the upper pay. Would you care to comment on that?

A Well, all I can say is that we have not had that performance. That's one of the first things you look for in a water flood when you are starting out, to see if you are going to have premature water breakthrough. Just the opposite thing has occurred in our case, instead of having first response, or instead of having first water production when we should have had it theoretically, and instead of having it earlier than we should have had it, we're having it two or three times later than we should have had it, so, in our opinion there's no question but what we are flooding additional sand.

Q Would it be possible or practical and/or economical to go back at a subsequent date if you were forced to restrict your rate and just flood the lower sand and go back at a later date and flood the upper sand?

A Well, the definition of oil reserves is economic oil.

No one gives reserves that you can't produce at a profit. In my opinion the reserves which are left behind, if we cut back, would be uneconomic to go back in to try to recover at a later date.

Q I'll refer you now to Exhibit 7 and ask you to state what that is.

A As soon as I find it I'll answer that. Exhibit 7 is an isocumulative map of the primary production in the Loco Hills Field, and this map was prepared as a basis for establishing the limits of the West Loco Hills Unit. It includes all production that came from zones other than the Loco Hills. We believe that this exhibit is further evidence because of the configuration of the production, the configuration of your map of isocumulative, that we have a continuous reservoir here and that the same things which occur in Newmont's present project will occur in the West Loco Hills Unit.

In other words, it would be foolhardy for us to assume that we're going to have a different set of conditions for operations over here than we have facing us in our original project, because our cross sections, and this isocumulative, all indicate that we do have a common reservoir.

MR. PORTER: Excuse me, just a minute, Mr. Darden, I don't believe you put the color legend in on this exhibit which has been submitted as the official exhibit.

A I will correct that for you. That was an oversight.

MR. PORTER: All right.

MR. MORRIS: Could the Staff see a copy of that exhibit, please?

Q (By Mr. Losee) In connection with your operation of this project and the possible result of being held to Rule 701 on a five spot basis, have you had an opportunity to calculate what might occur with respect to the fluid that's injected in in relation to the fluid that comes out of the formation?

A Well, as I understand it, under Rule 701 each producing well, assuming one producing well for 40-acre unit, would be entitled to 42 barrels plus credit for one injection well or a total of 84 barrels of oil per day. Well, the previously submitted effective injection curves for the pilot area of our project indicate that we in this field have a pretty high percentage of fluids out for fluids in.

In other words, we have an efficient flood here, and just looking at this it's somewhere between, oh, I would say 70 to 80% of the fluids in are returned, so that means we are not losing very much of our water. In fact, it's all working for us. So, transferring this experience over to a five spot where you would have to produce no more than 84 barrels per day, that would mean that we will assume that we had an effective fluids out to fluids

in of 70%; 84 barrels out would mean that in the average injection well surrounding that we could not inject more than 120 barrels per day in.

We haven't even attempted to show what happens at 120 barrels a day because we can't afford to waste oil for even a short period of time to do that, but we know that the condition will be at least as bad as is shown on the isoflows, and it might be considerably worse. So, consequently, as far as we are concerned it would be suicide from an economic standpoint to inject 120 barrels per well per day in a field that's this good, has this good a sand and has this characteristic from our operation and performance.

Q Have you had an opportunity to project the production for the West Loco Hills Unit in relation to the existing Newmont project and portray it on your Exhibit 8?

A I have. This, incidently, is the same projection which we submitted at our previous hearing. The reason it's the same is that we intend, if the Commission should see fit to permit us, to develop this field in such a way, the West Loco Hills Unit in such a way that each individual five spot would be flooded effectively at the maximum efficient rates, and that the total production from the project would be restricted by the rate at which we expanded development.

Based upon our application, the total allowable as we calculate

it would be about 4620 barrels in the prorated portion of this field or of this unit, and our projections indicate that we can hold our total production rate to less than 4400 barrels per day in the project.

Q In the process of holding it, do you mean that you would move from east to west across the project area developing on a five spot pattern without undertaking development of the entire unit?

A That's right. We would stage our development in accordance with the Rule 701, getting administrative approval for each injection well which we put on, and we would restrict the rate of development and it will take a lot of careful doing, but we can do it to restrict our rate of development so that our total production will not exceed an allowable such as we are asking for in this application.

Q How did you arrive at your calculation of 4600 barrels for this unit based upon our application?

A Well, I took all of the 40-acre units west of the township line in this unit. In other words, I excluded--

MR. PORTER: What township line is that?

A It's the township line between 18 South, 29 East and 18 South, 30 East. And the reason I took it west of there is this acreage of Newmont's is in our present project and we consider it

to have a different type of allowable treatment, so I took the total 40-acre units to the west and took the total number of producing injection wells which we expect to ultimately have in the development of this project. We had 107 40-acre tracts, and we had a total, let's see here, 126 extra wells on the 40's; in other words, as I understand Rule 701, you receive credit of one-third of a 40-acre unit, you receive 17 barrels for a, no, 14 barrels or one-third for an extra well on a 40-acre unit, so we will have 4494 barrels from the 40-acre units, giving a total of 4620 barrels.

Q Now, that calculation was based on all the wells that you are referring to being producing for injection wells?

A Yes, that includes both injection wells and producing wells.

MR. PORTER: Let me get this. You had 107 40-acre tracts?

A Yes, sir.

MR. PORTER: And you had how many wells there, 126?

A We had 107 plus 9, we had 116 total wells.

Q (By Mr. Losee) Actually, in that 107, does that include the recompletion of some plugged and abandoned?

A Yes.

Q And drilling of new wells?

A This is our estimated total number of wells we will have based upon our exhibit as our recommended development pattern for this unit.

Q Did you prepare Exhibits 6, 7 and 8 or were they prepared under your supervision and direction?

A Yes.

MR. LOSEE: We'll offer those exhibits in evidence.

MR. PORTER: Without objection the exhibits will be admitted to the record.

Q Does the witness have any other statement he would like to make in respect to this application?

A Well, yes, I do. First, I would like to face the fact that in this hearing Newmont Oil Company is representing fourteen different operators who have property in the West Loco Hills Field. Newmont Oil Company will only own approximately 17.7% of this unit when and if it is formed, so, therefore, we are acting not only in Newmont's behalf, but in the total unit's behalf in this hearing.

One of the reasons why we have worked so hard to form this unit is that we've tried lease line cooperation on our north lease line as a method for protecting correlative rights and we have found that that hasn't worked. Now, maybe it would work on the west side, but we believe in performance better than anything

else and, therefore, we've concluded that a unit is the most sure way of protecting correlative rights throughout the remainder of the field.

Our reductions in rates after fillup in this field have indicated that there is a possibility that waste will occur in that you are not getting the same factor of primary which the wells which were not affected by cutbacks have gotten. So, therefore, we hope we don't have to do that more than absolutely necessary. There has been some discussion of imbibition in this hearing, and I think that even my good friends with the Humble will have to admit that you can't imbibe water through an impermeable limestone stringer; so, therefore, I don't think throwing out time which it would take for imbibition, I don't think that you would recover this oil. I think it would be impossible to recover this oil if it were not swept from the well bore. Unfortunately we have no tools which show us what happens between wells in the reservoir. So the only thing we can go on and the only place we have any control is where we put the water in.

Now, we know at the higher rates we are putting water into all the productive sand. We know at the low rates we are not putting it in all the productive sand. So, as far as we are concerned, that is a fact and that is why we say we'll have waste if we don't inject at maximum efficient rates in each individual

five spot. There's one other thing I would like to say. This is turning into a long statement, but I would like to point out to the Commission that what we're asking for here is an allowable which, as I understand it, if our total unit were developed at one time we would be entitled to with the idea that this proration rule was put in to restrict the impact of total production on the New Mexico market.

Well, now, if we had applied for the whole unit at one time it would be contradictory to what we sincerely believe from an engineering and economical standpoint to flood this field. But we're willing to stage this development so that we'll never exceed what the Commission would determine would be the maximum permissible rate for this unit. So, if the Commission issues an order which will permit the flooding of this proposed unit on one or the other of the alternate prayers of Newmont, and it should be proved that the position taken by the applicant Newmont and the unit is in error, we have not lost any ultimate recovery.

However, if, on the other hand, the Commission issues an order which we believe would possibly cause waste, probably cause waste, and then after five years or six years proof comes forward that that is actually what occurs, that we are wasting oil and we are losing oil, and there's sufficient conclusive proof of that, well, we can't get that oil back then.

So, on balance it would appear that this is the risk which the Commission should not force upon the participants in this West Loco Hills Unit, the possibility that we might have waste, That's all my statement.

MR. LOSEE: No further questions.

MR. PORTER: Mr. Darden, I will ask you to fill in those colors, please, because that's the official exhibit. I have an idea there may be some questions. Right now we are going to take a short recess.

(Whereupon, a recess was taken.)

MR. PORTER: The hearing will come to order, please. Does anyone have any questions of Mr. Darden?

MR. NUTTER: Yes, sir.

MR. PORTER: Mr. Nutter.

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Darden, when you started out your direct testimony in this case, you were referring to the No. 3-B Ballard and the No. 5-B Ballard wells?

A Yes, sir.

Q First of all, in making your calculation as to how much water would be injected into the reservoir prior to the time you had a response in the 3-B, you assumed your injection was going

out from the injection well in a radial manner, is that correct?

A That's correct.

Q Is this a fair assumption to make, Mr. Darden?

A Well, I don't know any other assumption which would be more fair. We have to assume that it's going out in a radial manner unless we find some evidence in the field that we have fractures which cause a directional trend of the water, but in most water floods that I've heard anything about that is an accepted assumption.

Q Now, an inspection of your Exhibit No. 7, which is an isoproduction map, indicates that you have quite a marked variation between offsetting wells and the amount of primary production that some of the wells have had. As a matter of fact, you have used a color code here and I see some offsets that run the gamut of maybe four or five color bands in between 40-acre offset wells. Would this indicate a difference in porosity and permeability between those two wells, assuming they were initially completed at about the same time, and they are in a similar state of depletion at this time?

A With those assumptions I think you could say that the cumulative primary production is related to the permeability and the porosity of the individual well.

Q Wouldn't the porosity and permeability, say, going in one direction from a well, an injection well, if you were going

towards the well, say north from an injection well, and you went towards another producing well which had a high primary recovery as indicated by the isoproduction map, and you went south from that well to a well that has a low initial primary recovery, wouldn't that indicate that the well to the north probably had more permeability and porosity than the well to the south?

A It would probably indicate it had more good sand.

Q Well, good sand is related to permeability and porosity, isn't it?

A Not necessarily. I mean if you assume that you have got average conditions in a field, why then certainly you can't ignore the thickness of the pay as contributing to additional oil recovery you see.

Q Well, take into account not only the permeability and porosity but then the thickness of the pay also. Then we have an indication of what's good sand, correct?

A Well, we did that to the best of our ability, yes.

Q When you have such a marked differential in the primary history of offsetting wells, would this indicate that you could use radial flow as a criterion by which you are judging which direction the water is going when you inject into a well?

A Well, I frankly don't know any other method to use. If you have one we would welcome it, because we don't know

any other assumption to make except that the water goes out in a radial pattern.

Q But the very fact that you have this marked differential in primary producing history between offsetting wells running the gamut of four or five bands of color on your Exhibit No. 7 would indicate that possibly radial flow would be an ineffective means of determining which way the water is going, correct?

A No, I don't think so.

Q Are you going --

A Really, I don't think that has any particular bearing on it.

Q Now, we defined the primary production as being a function of the porosity, the permeability and the sand thickness?

A That's right, and the stage of depletion.

Q And the stage of depletion?

A That's right.

Q If you have got an injection well and you go one direction towards the well that has had a large primary producing life, that would indicate that that well probably had a combination of a good section and good porosity and probably good permeability, wouldn't it?

A Yes, I'd think so.

Q If you go in the other direction towards a well that

has a small primary life or small primary production in its history, this would indicate that this well has either low permeability, low porosity or a small net pay?

A Well, in order to analyze that with any definition, you would have to have detailed porosity and permeability data on each well, and you would have to analyze the production of each well, and I really don't think that there's any oil field that I know of where you can do that just to tell you exactly what pattern that water takes going to a well.

I'll say this, when you do have a channel where you get water production very shortly in an offset producer, then you have got a pretty valid assumption that more water is going in that direction, because you have a high permeability streak, but we have not had that in this field.

Q But as you stated, you have no way of knowing which way the water is going from the injection well?

A No, except that when you get response you know that your dry wall sour water is moving in that direction, and that's been one of the encouraging signs in this field that we have gotten response throughout the whole area, not just on an isolated producer over here or over there.

Q But for an individual injection well the water may go more in one direction than another, as reflected by your statement--

A I think it's possible. I wouldn't have any way of knowing or any way of guessing.

Q You have to assume that the water is going in all directions equally to make a radial flow calculation valid, though, don't you?

A Yes.

Q In making your calculation, you assumed that you had 10.6 acres being swept by the No. 5-B in the direction of the No. 3-B?

A That's right.

Q What was the actual basis for calculating the 10.6 acres?

A Engineering judgment.

Q I see.

A You can't just take a slide rule and work all this stuff out, you have to take what seems reasonable. We know that it didn't flood just one foot straight across there, and we are allocating 25% of the water, so we just made in our best judgment a path that was swept by this one injection well to the one producer.

Q Did you draw an elliptical shaped pattern across there and then calculate the area within that?

A Yes.

Q What was the 353 barrels of void space based on, did you have any cores on which to determine the actual porosity?

A Yes, we have ten cores in the field. We had flood pots run on one core and we based that on the reservoir data which was available which indicated we had recovered about 145 barrels per acre foot by primary. Now, this again, we have to talk about primary acre feet, which was our engineering estimate of the thickness at the time that we started.

Q 145 barrels of primary per acre foot?

A Yes, 25% water saturation.

Q You calculated that you had 212 acre feet in this elliptical shaped pattern?

A That's correct.

Q You based your 212 acre feet on the driller's log which showed 20 feet of pay had a free oil saturation, is that correct?

A Well, Ballard 3-B, the driller's log showed total Loco Hills sand of 35 feet, but it only logged as oil pay the bottom 17 feet which had free oil in the hole. The Ballard 5-B logged 48 feet of total sand and they logged as oil sand the bottom 23 feet because it had free oil in the hole.

So, therefore, we took the 23 feet and the 17 feet and averaged them and came up with the average thickness of 20.

Q You stated that your computation which resulted in a

sweep efficiency of 96.8% indicated something is wrong, so you must have more pay than the 20 feet of net pay you originally used, was that your testimony?

A That's right.

Q Have you determined how much net pay you've got?

A Well, as a matter of fact, we rely on these injectivity profiles, is an indication of how much pay we have.

Q Did you run an injectivity profile on the No. 3?

A You can't run one on a producing well.

Q You ran one on the No. 5-B?

A Yes, we have presented evidence here we ran at two rates on the Ballard B-5.

Q How much pay do you think you have as a result of the injectivity profile?

A Well, we can look at it and count it up. Now, to determine actual pay, there again, you get into a case of engineering judgment, but we use the gamma ray as a guide and our sample logs as a guide as to where sand was. From our correlations and our cross sections we knew that there were lime stringers that didn't have permeability, so you can pretty well assume, for instance, let's take the first four stations there showed water was going, that's down to 5% of the water from there, from 2752 or 51, I guess it is, to 2760, which is nine feet. You

had what we call a uniform pattern there of this injectivity profile, and since it correlates with sand, why we assume that is pay that's taking water. We had 10% of the water going from 2760 to 2778.

Now, it's pretty difficult to say precisely how much pay you've got there unless you assume that the same amount of water is going into each foot of pay, and we know because of variations of permeability that you don't have that, it's hard to be definitive on this thing as to exactly how much secondary pay you've got, but particularly in a case like that where you are sweeping 29 feet there with 10% of the water.

We know that one or two feet are probably taking all of that, but you just have to make a guess as to how many actual feet within that zone are taking it. We suspect that most of it is going, based upon the gamma ray log, that most of it is going below 2770, so on that basis I'd say maybe we're taking that 10% over eight or nine feet in that interval, you see.

Q From the 70 to the 80?

A Yes, that's right. Because from the gamma ray it looked like we probably wouldn't be taking it above there, and then from 2779 down to 28--down to 2795, well, there's another 16 feet which is being taken in a uniform manner, and then we've got another 10% which is being taken below that point, so we don't know

how many feet are taking it there, but there may be five, may be four, may be two, it's pretty hard to say.

Q Do you have any idea which of the intervals on this log is the 23 feet that the driller's log shows as being oil sand?

A Yes, I would say this interval from about 2780 on the gamma ray to, or 2779 to probably 2801. I don't know whether that adds up to 23 feet or not, but that looks like from the gamma ray what the pay would be. Of course, that's where 60% of our water is going.

Q So the water that you are putting in in the upper section is indicative of the pay which the driller included on his log?

A That's correct.

Q Do you have any means of determining how much pay you have in this well in primary and secondary pay? I think you already answered that, didn't you? That you have no actual way of knowing?

A No, we have nothing that we haven't already described.

Q Have you any means at all at your disposal of determining how much pay you have in the No. 3-B well?

A Well, we had the driller's --

Q Evidently the 17 feet must be wrong, so do you have a correct figure?

A No. We have a driller's log which showed a total sand of 35 feet. We figure the 17 feet because of this isoflow is too low. We could probably run a gamma ray log and have a better estimate of how much net pay there is. In other words, this sand above probably can be picked by the gamma ray, and in that respect we might be able to make an estimate of it, but I don't have it right now. We could probably run a gamma ray log and get an estimate of that in view of what has happened in this isoflow.

Q How much water had been injected into the No. 5-B prior to the time that a response occurred in the No. 3-B?

A 72,470 barrels.

Q Is this reflected by the --

A No, excuse me, that is one-quarter of the water injected into that well. The total water that had been injected was 289,883 barrels.

Q Now, Mr. Ledbetter's Exhibit No. 3 shows effective injection into these various wells that offset the producing wells?

A Yes, sir.

Q Ballard B-3 is the sixth page in that book, Mr. Darden.

A All right.

Q Where would you say initial response has occurred here?

A Well, initial response occurred in May of 1960. We have not plotted effective injection prior to response. As you will

notice from all of these curves, that we're talking about an effective injection once we've had response in these wells, and we do that because we need to see the comparison between what the producing well in that five spot does in relation to what the injection rate is in that well. This is a dynamic process, and until you get response in your producer you have nothing to compare with. You are just injecting your water.

Q So this isn't first injection depicted here?

A No, sir.

Q This is first injection on response?

A No, that's right. First injection was, well, it was in the original pilot and that was in, it seems like November of '58, I believe.

Q I see.

A The first water that we put in the ground.

Q Now, in preparing Exhibit No. 6 you have shown primary production from the area, cumulative secondary, and estimated ultimate, and then you compared these three wells. Did you take into consideration any effective pay or the thickness of the sand?

A No, and that's the whole purpose in this exhibit, because of the questionable value of the data or the little amount of data that we have, I thought we ought to look at it from another standpoint strictly on what it had done by primary.

That eliminates any acre feet calculation.

Q This measures the well on what it has produced and not the condition of the sand in the reservoir?

A That's true. But in our previous testimony and in all of our discussion about this West Loco Hills Unit, all of the operators in the unit have agreed that because of the limited amount of reservoir data that cumulative primary is the most reasonable factor to base secondary on, and that's what our participation factor is.

Q Isn't it a fact that a gas injection program was in operation here for a considerable length of time?

A I'm not certain how long. Of course, we studied that before we ever came into the Loco Hills Field. We could not find any evidence that it had ever helped production.

Q But in making these comparisons here, you didn't consider the proximity of any of these three wells to any gas injection wells or their response to gas injection--

A No.

Q -- on an individual basis?

A No, but, of course, that would have been by primary production and that would have served to leave less oil behind and we would have gotten a lower factor of primary by water flood.

Q A lower comparative factor of ultimate with primary?

A Yes.

Q What is the source of water that you'll use for this water flood, Mr. Darden?

A Yucca Water Company.

Q What is your estimated volume per day that you are going to need for the water flood project to be carried out in accordance with your expected recovery program here as depicted on Exhibit 8?

A Now, are you speaking of volume of water or volume of oil?

Q Volume of water.

A Volume of injection water?

Q Yes, sir. A To achieve this?

Q Yes.

A Well, we estimate that at peak demand we may be injecting as much as 20,000 barrels a day, between 20 and 25,000 barrels over the whole project.

Q This peak demand, I presume you will be using some recircled water?

A Yes.

Q What is your expected peak as far as new water is concerned?

A Oh, I think around 20,000 barrels a day of makeup water.

We might, it might not fall quite that high. There again, it depends on how fast you get produced water in sufficient quantities to gather and inject.

Q Well, 20,000 barrels maximum injection, or 20,000 make-up water?

A 25,000 maximum and maybe 20,000 at one period. Now, that's the maximum purchased water that we'll have.

MR. NUTTER: I believe that's all.

MR. PORTER: Do you have any questions, Mr. Morris?

MR. MORRIS: Just one or two.

BY MR. MORRIS:

Q Mr. Darden, I believe we're all agreed that the waste of oil in this upper sand stringer is what's basically at issue in this hearing, is that right?

A Well, not completely. Our isoflows show that at the low rate you can't even flood all of the good sand.

Q Would you agree that the waste of the oil in this upper stringer is one of the issues in contention?

A Yes.

Q Can you make any estimate as to how much oil you expect to recover at high injection rates from this upper sand stringer, or is that an impossible task?

A Well, you are really reaching out into the sky for it,

because, in the first place, all our testimony indicates that this upper stringer did not contribute too much to primary. However, it is exposed in all of the wells, so we don't really know how much it produced. We also don't know very much about what the residual saturation is in that sand for that reason. So we don't know how much oil per foot of that sand is going to be flooded, say, opposed to how much of the good Loco Hills sand.

Q You can't give us any data with particularity concerning the permeability or the porosity or the residual oil saturation in this upper sand?

A Well, now, in our cross section here we show a core analysis which was run on the Canfield 8-A, and if you will see at the top of the cross section there is a calibration of the permeability in millidarcies. We can run down here and in this upper section, it's kind of hard --

Q Would it be possible to give me a very general but average figure for the upper sand in permeability or porosity?

A I don't know if I have the actual core analysis here or not. Do we have that? I could furnish that to you, or we will furnish copies of this core analysis, complete core analysis if you would like. One thing I might say in regard to that is that we originally estimated, now this to give you some factor of what we might be leaving behind, and I don't know whether this is

representative of more than just one well or not, but in the original pilot, theoretical calculations which utilized the Sudder-Calhoun method of permeability variation indicated that we would get about 158,000 barrels out of the Yates 6 five spot. We now expect to get 284,000. Now, I would not say that that's any hard and fast factor that you could use as to what we're going to leave behind. I certainly wouldn't want the Commission to think I was inferring that either.

Q Mr. Darden, the question has been asked of other witnesses whether the permeable streaks and impermeable streaks in this particular reservoir are any different or are so peculiar compared to other reservoirs as to justify a particular exception in this case.

A Well, I don't think we have ever contended that the permeability variation was the reason for the exception in itself. Certainly anybody that's worked in the oil fields knows that every oil field has individual characteristics. I don't know of any two oil fields in the world that are identical.

Q Every field is peculiar to itself, you can say?

A Yes. But the reason that we think this field is exceptional for this area, for New Mexico, for water floods in general, is that our performance to date where we have been able to flood at the maximum efficient rate has indicated an exceptional

recovery of oil as a factor of the primary recovery. Also this field in its primary production was considerably better than most of the Grayburg sand fields that I know anything about in southeastern New Mexico. Also, because of that fact, and because the sand is better and there's more of it, we can put more water in the ground and we have to put more water in the ground in order to flood it effectively.

Now, where you have maybe a five foot sand that you had to shoot or frack in order to get production, you are not faced with this problem of whether you can put 1500 barrels a day in it or whether you can put 150 barrels a day in it. You just put all you can possibly put in it and maybe that is 150 barrels a day.

Q It's true, isn't it, that Newmont Oil Company has been against restricted rates of injection in production of water flood projects from the very beginning of water flood operations in New Mexico?

A I don't know what you base that on. We attended the proration hearing and followed it and we supported the water flooder's position on it because in our opinion they were more experienced than we were and we were going to try to make money in the same business they were in. But we have not since that order came in, we have never attacked the order as far as I know.

Q Newmont --

A We don't intend to here either.

Q Newmont was against the restricted rates of Rule 701, though, from the very beginning, wasn't it?

A Well, we haven't had to worry about it. I mean we have not taken a position on that because we happened to have all of our projects started before it came in.

Q You have never attempted to live with the rule, have you?

A Well, you don't intentionally look for problems. We have no projects that are prorated, that's not saying we might not take some projects that will be prorated.

Q You have no projects being operated under Rule 701 at this time?

A That's correct.

MR. MORRIS: Thank you.

MR. PORTER: Any further questions? The witness may be excused.

(Witness excused.)

MR. LOSEE: That is the applicant's case, if the Commission please.

MR. PORTER: Did you offer the last two exhibits?

MR. LOSEE: I think I asked Mr. Darden if he prepared them and we offered the last three, really, 6, 7 and 8.

MR. PORTER: Does anyone else have testimony to

present in this case? Anybody have any statements to make? Mr. Aston.

MR. ASTON: Roger Aston, Franklin, Aston & Fair, Inc. In order to answer Bud's question, he knows I am not an engineer, I'm just the guy that pays the bill. I think this gives some end result, because it all has to go through the bank account to scour out. I represent both production payments and royalty interest. I had testimony put on by our corporation regarding the failure on the north line to get protection of correlative rights. This is the compounding of many problems, and I think the Commission will recall that our organization put on testimony in support of General American and Ambassador's request for capacity allowable in July.

I might also say that we took strong issue with General American and Ambassador over the delays that have occurred up there. We feel that this has rendered a disservice to all the interest holders in the area of the initial flood. We feel that the unit seems to offer the most immediate protection to correlative rights.

Now, we have to look at this selfishly, of course, as it affects our interest, so we have to measure it by that yardstick of value. One of the things, of course, in this unit that affects our viewpoint considerably is the fact that in the order

authorizing the unit they removed some 800 acres, less 160 acres, which were classified as buffer and given capacity allowable from the acreage that was originally under the initial project as authorized to Newmont. This leaves 640 acres, which is impacted and thrown under 701, which to at least our interpretation of the rule as passed by the Commission, was a capacity flood.

We can't help but feel that having sat through all the various hearings relative to the control of these units on proration basis, we can't help but feel that market impact was the prime place that the testimony was lodged, and we were concerned by the impact this would have on market, and this was measured on waste.

We feel that on one hand we have definite indications of potential waste, on the other hand we can control the unit production in such a way as to minimize waste and to minimize market impact. On the general basis that we are most desirous and determined to see that our correlative righs are protected on the west line of all our initial property under the initial flood, we intend to support the unit.

MR. PORTER: Mr. Bratton.

MR. BRATTON: If the Commission please, I didn't understand that some acreage had been taken out of the original authorized project area and put into this area. I did not know

that until now. I cannot understand fully the ramifications of that. However, insofar as correlative rights are concerned, it seems to me you have only one issue and that is between the original authorized area, or as I believe Mr. Kellahin called it last time, the tail that's now wagging the dog insofar as that authorized area and this tremendous unit, certainly a buffer zone of capacity allowable can be set up that will protect the correlative rights between those two areas. That seems to me just something that certainly can be adjusted, and I don't see the impact of correlative rights on this hearing.

Now, insofar as the basic proposition, as I stated this morning in support of Mr. Morris' application, we did not propose to burden the Commission anew with some three days or five or six or eight, I don't know what the total number of days that have gone into these flood hearings prior to Rule 701 were. However, as a result of these hearings, the evidence of which is incorporated in this case, the Commission found that the evidence presented in this case, including the records in Cases Nos. 1324 and 1294, which records were incorporated by reference into the record of this case, preponderates in favor of the engineering viewpoint that reasonable curtailment of production in water flood projects does not result in a loss of ultimate oil recovery.

Insofar as this application today is an attack on that basic

finding, I think that the sum of this evidence and the sum of the evidence that was presented in those previous cases would lead the Commission to the same conclusion it reached at that time. Essentially, nothing new has been presented here today that I have heard. It's substantially the same type and trend of testimony that was presented before on behalf of those advocating capacity allowables.

Since Rule 701 was enacted, I am not sure of the exact count, but I believe there have been approximately 15 projects approved by the Commission for Permian reservoirs, incorporating restrictions therein. If the Commission were at this point to abandon its finding that there can be reasonable curtailment of production in water flood projects, I believe, and I sincerely believe it would be making a mistake if it were to abandon that finding. I think it would open up Pandora's box, and we would be right back where we were before, and I do not believe that that would be for the best interest of the industry generally in New Mexico.

I recognize fully that Newmont is apprehensive about operating under restrictions, they have never operated under the restriction of Rule 701 or any restriction of production in New Mexico. However, any number of other operators who advocated capacity allowable at that previous hearing have now instituted

projects recognizing that there can be reasonable curtailment of production without loss of ultimate recovery. We sincerely urge this Commission not to abandon that finding.

MR. PORTER: Mr. Kellahin.

MR. KELLAHIN: If the Commission please, Amerada Petroleum Corporation, as a matter of principle, supports the Commission's order in restricting production from water flood projects as provided by Rule 701-E. This case originally came before the Commission as a legitimate or logical expansion of a legitimate flood with their request for capacity allowables. It's now back before the Commission with a request for, in effect, what amounts to capacity allowables. On that basis perhaps it might be objectionable, it might have been subject to objection as a rehearing in the original case.

Amerada has never taken the position that this Commission is without jurisdiction to hear a case predicated upon waste, and certainly would not like to see the Commission take a position of that kind, and, therefore, of course, we made no objection to this hearing.

As Mr. Bratton pointed out, the only question involving correlative rights apparently lies between the original zone and the expanded area. That area to the north where they're concerned over oil being swept across lease lines, admittedly has nothing

projects recognizing that there can be reasonable curtailment of production without loss of ultimate recovery. We sincerely urge this Commission not to abandon that finding.

MR. PORTER: Mr. Kellahin.

MR. KELLAHIN: If the Commission please, Amerada Petroleum Corporation, as a matter of principle, supports the Commission's order in restricting production from water flood projects as provided by Rule 701-E. This case originally came before the Commission as a legitimate or logical expansion of a legitimate flood with their request for capacity allowables. It's now back before the Commission with a request for, in effect, what amounts to capacity allowables. On that basis perhaps it might be objectionable, it might have been subject to objection as a rehearing in the original case.

Amerada has never taken the position that this Commission is without jurisdiction to hear a case predicated upon waste, and certainly would not like to see the Commission take a position of that kind, and, therefore, of course, we made no objection to this hearing.

As Mr. Bratton pointed out, the only question involving correlative rights apparently lies between the original zone and the expanded area. That area to the north where they're concerned over oil being swept across lease lines, admittedly has nothing

to do with this Commission and the order to be entered by the Commission would have no bearing on it because that's in another project. The Commission, after a hearing in this case, wisely entered an order denying the application, but, as a matter of protection, setting up the proper zone.

I'm not qualified to judge as to the merits of the adequacy of this buffer zone for the protection of correlative rights involved, there's been some testimony which may or may not indicate that the zone should be expanded somewhat in some portions of the area to fully protect correlative rights. However, the only question left which the Commission must decide is the question of waste, and as the statement in behalf of Humble Oil & Refining Company shows, and we agree, the evidence presented here adds nothing new to the record which is before this Commission by the incorporation of the records in these other cases.

The very fact which has been brought out, which is justification for the exception in this case, were presented in those other cases and examined by the Commission, and to change the rule at this stage would, in effect, cause the Commission to abandon its position that there can be reasonable curtailment of water flood projects without resultant waste.

MR. PORTER: Mr. Losee, do you have a statement?

MR. LOSEE: Yes, sir. If the Commission please, I think

as one of our early witnesses pointed out, there was nothing intended by the presentation here today in any of the evidence to attack the validity of Rule 701 as a general rule of conservation by this Commission. However, we felt, and we think our evidence shows, that the Commission or we would be wrong to ignore the possibility of waste occurring in the field. Surely when the Commission adopted the Rule 701 it had a continuing interest in the impact of that rule upon the industry, and by the same token has the continuing right to make exceptions to the general rules, in this case 701, to prevent possible waste.

We think the evidence at this hearing, the only satisfactory evidence at this hearing with respect to this field, which is the issue, shows that it is an exceptional field and that the general Rule 701 should not be applicable. We think that's the first fact that I think the evidence shows.

The second, and probably the most important, is that under the existing order in this case oil may be lost that could otherwise be recovered. The relief we have requested of the Commission in this application would prevent the waste that might occur. It would treat the field as an exception to this Rule 701, and yet still the relief would keep the project within the market impact limitations of Rule 701. We feel and respectfully urge the adoption of the relief requested.

MR. PORTER: Does anyone else have anything to say?

MR. HARRISON: Mr. Porter, I would like to read into the record a statement for Graridge Corporation.

MR. PORTER: Yes, sir.

MR. HARRISON: "Graridge Corporation believes that the analysis presented by testimony in this case is based on sound engineering principles and practices and is supported by field performance. The evidence indicates no adverse effects from high injection rates and pressures in performance of the Newmont project, but does give all indications of increased ultimate recovery from this area. Since performance bears out the contention that high injection rates are good in the recovery of secondary oil from the field, it must be concluded that this is a proven and efficient method of conservation and does, in reality, prevent waste."

"The Graridge Corporation would like to go on record supporting Newmont in this case and urges approval of this Commission."

MR. McGREGOR: I am representing Brenson & Woodhall in the West Loco Hills Unit Area.

MR. PORTER: Would you give us your name, please?

MR. McGREGOR: James McGregor.

MR. PORTER: Representing Brenson and Woodhall?

MR. McGREGOR: Brenson and Woodhall. We have examined

the data presented by Newmont Oil Company at this hearing and are of the opinion that oil will be lost that otherwise might be recovered unless the unit area is flooded at the maximum efficient rates of injection. We, therefore, concur in support of this application of Newmont Oil Company for an exception to Rule 701.

MR. PORTER: Anyone else have a statement they would like to make? Mr. Morris.

MR. MORRIS: If the Commission please, the Commission has received a letter from J. Cleo Thompson, Senior and James Cleo Thompson, Junior, oil producers, Dallas, Texas. They have requested that their letter be made part of the record in this case, and it is offered for that purpose.

MR. PORTER: The letter will be made a part of the record. Do you have any other communication, Mr. Morris?

MR. MORRIS: No, sir, that's all.

MR. PORTER: If no one has anything further to offer in this case, we will take the case under advisement. The hearing is adjourned.

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Court Reporter, do hereby certify that the foregoing and attached transcript of proceedings before the New Mexico Oil Conservation Commission at Santa Fe, New Mexico, is a true and correct record to the best of my knowledge, skill and ability.

IN WITNESS WHEREOF I have affixed my hand and notarial seal this 14th day of April, 1962.

Ada Dearnley
Notary Public-Court Reporter

My commission expires:

June 19, 1963.