CASE 6741: ARCO OIL AND GAS COMPANY FOR AN AMENDMENT TO ORDER NO. R-6054, EDDY COUNTY, NEW MEXICO

Case No.

6941

Application

Transcripts.

Small Exhibits

ETC.

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

BRUCE KING
GOVERNOR

LARRY KEHOE
SECRETARY

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

January 30, 1980

Mr. Conrad E. Coffield
Hinkle, Cox, Eaton, Coffield
& Hensley
Attorneys at Law
Post Office Box 3580
Midland, Texas 79702

Re: CASE NO. 6741
ORDER NO. R-6258

Applicant:

ARCO Oil and Gas Company

Dear Sir:

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

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCD x
Artesia OCD x
Aztec OCD

Other

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

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

CASE NO. 6741
Order No. R-6258

APPLICATION OF ARCO OIL AND GAS
COMPANY FOR AN AMENDMENT TO ORDER
NO. R-6054, EDDY COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on November 28, 1979, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 28th day of January, 1980, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

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

(2) That the applicant, ARCO Oil and Gas Company, seeks the amendment of Order No. R-6054 to amend the findings in said order to make said findings more specific as to the necessity for the drilling of infill wells in the Empire Abo Unit in order to recover additional gas pursuant to the Natural Gas Policy Act of 1978.

(3) That the applicant further seeks to amend said order to make such findings applicable to present and future drilling operations including the drilling of horizontal drainholes.

(4) That Finding No. (13) of Order No. R-6054 should be amended to reflect that the necessity for the drilling of infill wells in applicant's Empire Abo Unit is based upon engineering and geological evidence.

(5) That Order No. (2) of Order No. R-6054 should be amended to reflect that said infill wells are necessary to effectively and efficiently drain both oil and gas reserves which would not otherwise be recovered by the existing well on the appropriate proration unit.

(6) That said Finding No. (13) and said Order No. (2) should each be amended to cover infill wells drilled under the provisions of Orders Nos. R-4549-D and R-6203 (horizontal drainholes).

(7) That these amendments are consistent with the evidence presented in Division Cases Nos. 5177, 6409, 6553, 6720, and 6742.

IT IS THEREFORE ORDERED:

(1) That Finding No. (13) of Division Order No. R-6054 entered July 10, 1979, is hereby amended to read in its entirety as follows:

> "(13) That the Division has recognized, based on engineering and geological evidence, the necessity for the drilling of such additional wells in order to more effectively and efficiently drain the portion of the proration units upon which said wells are located which could not be so drained by the existing well(s) thereon, and, by its Orders Nos. R-4549-B, R-4549-D, R-5906, and R-6203, has approved their being drilled as infill wells."

(2) That Order No. (2) of said Order No. R-6054 is hereby amended to read in its entirety as follows:

> "(2) That such unorthodox producing well locations as have been approved pursuant to said Orders Nos. R-4549-B, R-4549-D, R-5906, or R-6203, as infill producing wells were, and are hereby found, to be necessary to effectively and efficiently drain both oil and gas reserves in the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units.

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

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

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

JOE D. RAMEY
Director

S E A L

fd/

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0201

Jerry L. Tweed
District Engineer

December 17, 1979

Mr. Richard L. Stamets, Examiner
State of New Mexico Energy & Minerals
Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

RE: Case 6741

Dear Mr. Stamets:

As you requested at the New Mexico Oil Conservation Division hearing of Case 6741 on November 28, 1979 ARCO is submitting proposed wording for the Division Order in the case.

Also, please find attached a tabulation of all Empire Abo Unit infill wells spudded since February 19, 1977 along with their respective expected incremental oil and gas reserves and cummulative oil recoveries through October 31, 1979. The oil reserves were allocated based on each well's structural position, spacing, time of drilling and performance to date. The incremental gas reserves were calculated by multiplying each oil reserve, value by 0.180 MCF/BO, the solution gas factor at the Unit's expected abandonment pressure of 100 psi.

This calculation results in the incremental amount of gas that would have been left in solution in the reservoir had the infill wells not been drilled.

As stated in the testimony in Case 6741, we propose that Division Order R-6054 be amended to include reference to the geologic evidence presented and also to explicitly state that incremental gas recovery will result from the drilling and producing of infill wells in the Empire Abo Unit.

One possible way to implement these amendments is to change Finding (13) to include a reference to the geologic evidence and to also modify Order (2) to include a reference to increased recovery of gas.

Following is our proposed wording for these changes:

Finding (13)

That the Division has recognized, based on engineering and geological evidence, the necessity for the drilling of such additional wells in order to more effectively and efficiently drain the portion of the proration units upon which said wells are located which could not be so drained by existing well(s) thereon, and, by its orders nos. R-4549-B and R-5906, has approved their being drilled as infill wells in exception to the applicable well spacing requirements for the Empire Abo Pool.

Order (2)

That such unorthodox producing well locations as have been approved persuant to said order no. R-4549-B or order R-5906 as infill producing wells were, and are hereby found, to be necessary to effectively and efficiently drain both oil and gas reserves in the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units, and that the existing well spacing requirements were waived to permit their approval.

Very truly yours,

J. L. Tweed

J. L. Tweed

RLS:ad

EMPIRE ABO UNIT
INFILL WELL RESERVES

WELL	SPUD DATE	ORIG.EST.OF INC RES'S MBO	ORIG.EST.OF INC RES'S MMCF	CUM TOTAL MBO TO 10/31/79	CURRENT EST. OF INCR. RES'S MBO	CURRENT EST. OF INCR. RES'S MMCF
D-361	3/12/79	29	5.2	19	37	6.7
E-341	5/19/78	52	9.4	53	12	2.2
E-351	5/4/78	52	9.4	66	15	2.7
E-361	4/12/78	52	9.4	154	279	50.2
E-362	3/13/79	29	5.2	66	45	8.1
E-363	1/30/79	29	5.2	80	38	6.8
E-372	7/13/77	100	25.0	255	159	28.6
E-373	3/29/78	52	9.4	181	43	7.7
E-374	1/6/79	29	5.2	88	42	7.6
E-383	12/31/78	29	5.2	64	43	7.7
E-384	1/3/79	29	5.2	57	43	7.7
E-392	3/6/79	29	5.2	31	36	6.5
E-393	3/21/79	39	7.0	30	43	7.7
E-395	3/15/79	29	5.2	15	7	1.3
F-321	6/1/78	197	35.5	117	27	4.9
F-322	7/5/78	48	8.6	87	23	4.1
F-333	8/18/77	100	25.0	271	193	34.7
F-334	5/10/79	29	5.2	16	32	5.8
F-335	1/27/79	29	5.2	68	38	6.8
F-336	5/4/79	29	5.2	19	38	6.8
F-341	7/27/77	100	25.0	269	191	34.4
F-342	3/31/79	29	5.2	63	45	8.1
F-343	4/18/79	29	5.2	34	43	7.7
F-352	10/15/78	48	8.6	133	161	29.0
F-353	9/29/78	48	8.6	121	149	26.8
F-354	3/16/79	29	5.2	82	45	8.1
F-362	10/31/78	48	8.6	111	161	29.0
F-363	4/5/79	29	5.2	51	45	8.1
F-364	6/9/79	29	5.2	18	41	7.4
F-372	6/1/77	100	25.0	143	150	27.0
F-373	2/26/79	29	5.2	48	42	7.6
F-374	1/10/79	39	7.0	94	52	9.4
F-375	1/10/79	29	5.2	71	42	7.6

Empire Abo Unit
Infill Well Reserves

WELL	SPUD DATE	ORIG.EST.OF INC RES'S MBO	ORIG.EST.OF INC RES'S MMCF	CUM TOTAL MBO TO 10/31/79	CURRENT EST.OF INCR. RES'S MBO	CURRENT EST.OF INCR. RES'S MMCF
F-376	1/26/79	29	5.2	58	35	6.3
F-381	6/22/77	100	25.0	167	159	28.6
F-382	1/24/79	39	7.0	52	50	9.0
F-383	2/9/79	39	7.0	38	48	8.6
F-391	6/25/79	39	7.0	5	47	8.5
G-291	4/21/79	39	7.0	20	8	1.4
G-313	7/20/78	39	7.0	20	7	1.3
G-314	4/3/79	39	7.0	44	45	8.1
G-315	3/16/79	29	5.2	35	35	6.3
G-322	6/17/78	197	35.5	97	359	64.6
G-323	3/12/78	48	8.6	130	32	5.8
G-324	3/1/79	29	5.2	35	12	2.2
G-332	3/12/78	48	8.6	51	11	2.0
G-333	9/8/78	48	8.6	84	161	29.0
G-334	2/12/79	29	5.2	49	41	7.4
G-343	11/16/78	48	8.6	68	331	59.6
G-351	5/13/77	100	25.0	283	199	35.8
G-352	4/21/79	39	7.0	45	53	9.5
G-353	5/6/79	39	7.0	26	49	8.8
G-361	2/12/79	39	7.0	86	50	9.0
H-281	8/24/78	48	8.6	37	54	9.7
H-292	4/5/77	100	25.0	145	110	19.8
H-293	3/16/77	100	25.0	176	40	7.2
H-294	10/30/78	39	7.0	29	8	1.4
H-295	10/14/78	39	7.0	64	78	14.0
H-301	4/15/78	48	8.6	55	80	14.4
H-302	8/7/78	39	7.0	28	6	1.1
H-303	11/17/78	48	8.6	14	4	.7
H-311	4/26/77	100	25.0	172	39	7.0
H-312	8/22/78	48	8.6	46	10	1.8
H-321	2/22/78	197	35.5	105	399	71.8
H-322	3/28/78	48	8.6	8	93	16.7
H-331	2/23/78	48	8.6	69	16	2.9

Empire Abo Unit
Infill Well Reserves

WELL	SPUD DATE	ORIG.EST.OF INCR RES'S MBO	ORIG.EST.OF INCR RES'S MMCF	CUM TOTAL MBO 10/31/79	CURRENT EST. OF INCR RES'S MBO	CURRENT EST. OF INCR RES'S MMCF
H-341	6/7/79	39	7.0	24	17	3.1
I-251	12/22/78	48	8.6	15	3	.5
I-261	12/3/78	48	8.6	22	65	11.7
I-272	6/9/78	197	35.5	41	11	2.0
I-273	5/24/78	48	8.6	38	9	1.6
I-281	2/27/77	100	25.0	130	31	5.6
I-282	5/4/78	48	8.6	32	10	1.8
I-283	9/9/78	48	8.6	16	7	1.3
I-291	9/28/78	197	35.5	42	224	40.3
I-292	5/8/79	39	7.0	17	42	7.6
J-203	9/13/78	39	7.0	32	7	1.3
J-212	12/4/78	52	9.4	48	86	15.5
J-223	4/22/78	48	8.6	0	0	0.0
J-233	5/10/78	48	8.6	83	19	3.4
J-234	8/4/78	39	7.0	37	9	1.6
J-234	5/31/79	29	5.2	6	34	6.1
K-131	2/21/79	29	5.2	29	32	5.8
K-141	4/7/77	100	25.0	299	189	34.0
K-142	7/31/79	63	11.3	0	69	12.4
K-143	4/16/79	29	5.2	31	34	6.1
K-161	6/21/79	29	5.2	4	34	6.1
K-183	6/23/77	100	25.0	151	130	23.4
K-184	6/20/78	39	7.0	37	12	2.2
K-192	5/30/78	39	7.0	79	160	10.8
K-193	9/29/78	39	7.0	18	10	1.8
K-194	10/18/78	48	8.6	25	6	1.1
K-231	7/18/78	197	35.5	91	21	3.8
K-232	6/27/78	48	8.6	0	0	0.0
L-121	4/27/77	100	25.0	192	43	7.7
L-122	4/20/79	29	5.2	18	6	1.1
L-123	4/4/79	29	5.2	1	2	0.4
L-133	3/17/79	29	5.2	13	34	6.1
L-134	1/17/79	29	5.2	31	7	1.3
L-142	12/13/78	39	7.0	42	12	2.2
L-143	11/26/78	48	8.6	25	6	1.1

Empire Abo Unit
Infill Well Reserves

WELL	SPUD DATE	ORIG.EST.OF INCR RES'S MBO	ORIG.EST.OF INCR RES'S MMCF	CUM TOTAL MBO To 10/31/79	CURRENT EST. OF INCR. RES'S MBO	CURRENT EST. OF INCR. RES'S MMCF
L-153	3/17/77	100	25.0	184	41	7.4
L-154	11/7/78	39	7.0	60	14	2.5
L-155	3/30/79	29	5.2	50	12	2.2
L-156	2/1/79	29	5.2	26	9	1.6
L-171	5/22/79	39	7.0	13	43	7.7
M-901	7/17/77	100	25.0	43	10	1.8
M-101	6/5/77	100	25.0	56	13	2.3
M-122	5/17/77	100	25.0	0	0	0.0
M-123	5/8/79	39	7.0	2	1	0.2
M-131	7/10/78	197	35.5	0	0	0.0
M-132	12/18/78	48	8.6	5	1	0.2
M-133	5/23/79	39	7.0	3	4	0.7
M-141	5/21/79	39	7.0	4	2	0.4
M-151	8/1/78	48	8.6	16	134	24.1
M-152	8/23/78	48	8.6	84	19	3.4
M-153	5/6/79	39	7.0	9	2	0.4
N-901	8/4/77	100	25.0	8	103	18.5

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
AZTEC DISTRICT OFFICE

JERRY APODACA
GOVERNOR

NICK FRANKLIN
SECRETARY

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO 87410
(505) 334-6178

January 9, 1980

RECEIVED
JAN 14 1980
OIL CONSERVATION DIVISION
SANTA FE

Mr. Steve Kirby
Miles Production Company
1925 Belt Line Road #525
Carrollton, Texas 75006

Re: Extension of plugging deadline of R-6143

Dear Mr. Kirby:

Your company has had since October to comply with Order R-6143. The area where the well is located is accessible if travel is restricted to the part of the day that the road is frozen. Therefore, this office will grant no further extension to the deadline of February 1, 1980, as set out in R-6143.

If you have any questions, please call.

Yours truly,

Frank T. Chavez
Deputy Inspector

xc: Oil Conservation Division, Santa Fe

FTC:no

BILL

34TH LEGISLATURE - STATE OF NEW MEXICO - SECOND SESSION, 1980

INTRODUCED BY

DISCUSSION DRAFT

AN ACT

MAKING APPROPRIATIONS FOR THE PURPOSE OF ENERGY RESEARCH AND DEVELOPMENT.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF NEW MEXICO:

Section 1. APPROPRIATIONS.--

A. Three million five hundred thousand dollars ($3,500,000) is appropriated from the ~~general~~ severance tax income fund to the energy research and development fund for expenditure in the sixty-ninth and following fiscal years pursuant to the provisions of the Energy Research and Development Act, provided that at least seventy-five percent of the expenditures made from this appropriation shall be expended for the development and demonstration projects having a practical application in New Mexico.

B. In addition to the appropriation made in Subsection A of this section, five hundred thousand dollars ($500,000) is appropriated from the general fund to the energy and minerals department for expenditure in the sixty-ninth and following fiscal years to be disbursed,

underscored material = new
[bracketed material] = deletion

after approval of a solar plan and budget by the secretary of energy and minerals, to the board of regents of New Mexico state university in order to:

(1) develop solar equipment performance standards for solar energy development;

(2) test solar energy heating and cooling systems;

(3) coordinate major solar research development and demonstration efforts within the state;

(4) collect and disseminate information to the citizens and industry in the state concerning solar energy research, development and demonstration and solar energy applications and technologies; and

(5) coordinate the development of federal solar energy programs within the state.

C. Any unencumbered or unexpended balances of the appropriations made in Subsections A and B of this section shall not revert.

GK .44680ms

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
28 November 1979

EXAMINER HEARING

IN THE MATTER OF:

Application of ARCO Oil and Gas Company for amendment to Order No. R-6054, Eddy County, New Mexico. CASE 6741

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel for the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: Conrad Coffield, Esq.
HINKLE LAW FIRM
P. O. BOX 3580
Midland, Texas

SALLY WALTON BOYD
CERTIFIED SHORTHAND REPORTER
1010 Plaza Blanca (505) 471-2462
Santa Fe, New Mexico 87501

I N D E X

RYAN STRAMP

E X H I B I T S

MR. STAMETS: We will call next Case 6741.

MR. PADILLA: Application of ARCO Oil and Gas Company for amendment to Order No. R-6054, Eddy County, New Mexico.

MR. COFFIELD: Conrad Coffield, with the Hinkle Law Firm of Midland, Texas, appearing on behalf of ARCO Oil and Gas Company. I have one witness.

MR. STAMETS: Any other appearances in this case? I'd like to have the witness stand and be sworn.

(Witness sworn.)

RYAN STRAMP

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

DIRECT EXAMINATION

BY MR. COFFIELD:

Q. Mr. Stramp, would you please state your name and address, occupation and employer?

A. Yes, sir. My name is Ryan Stramp, S-T-R-A-M-P and I reside in Midland, Texas, and I work for ARCO Oil and Gas there as a petroleum engineer.

Q. Are you familiar with ARCO's application in this case?

A. Yes, sir, I am.

Q. Have you previously testified before the Division as a petroleum engineer?

A. Yes, sir, I have.

Q. And were your qualifications made a matter of record and accepted by the Division?

A. They were.

MR. COFFIELD: Mr. Examiner, is the witness considered qualified?

MR. STAMETS: Yes, he is.

Q. Mr. Stramp, would you please state your connections with the Empire Abo Unit?

A. I've been assigned to the Empire Abo Unit engineering group within ARCO for approximately the past year and a half, and I've held various positions in that engineering group.

Q. Okay, Mr. Stramp, are you familiar with testimony and with the record which was established before the Oil Conservation Division in Cases numbered 4952, 4953, which were heard on April 25, 1973, as well as Cases numbered 5211, 5212, 5213, heard on April 10, 1974, and Case 6553, with its exhibits, heard on June 13, 1979, as a result of which the Division issued Order No. R-6054, dated July 10, 1979, and also are you familiar with the Order R-6054?

A. Yes, I am.

MR. COFFIELD: If the Examiner please, reference will be made to these cases throughout Mr. Stramp's testimony, and we would respectfully request that administrative notice be taken of matters reflected therein.

MR. STAMETS: It will be.

Q. Mr. Stramp, would you state briefly what ARCO seeks in this application?

A. By amendment of Order No. R-6054, dated July 10th, 1979, ARCO seeks a finding that those same unorthodox producing well locations in the Empire Abo Unit area which were found in Order 6054, order two, to be necessarily to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units, be found to be necessary to effectively and efficiently drain both as to oil and gas the portion of the reservoir covered by the respective existing proration units which could not be so drained by existing wells on the units.

ARCO further seeks the finding by amendment of Order 6054 that the Empire Abo reservoir studies and numerical reservoir simulations, which have been reported or submitted to the Division at various times, and which were considered by the Division in the findings and orders within Order No. R-6054, are soundly based on appropriate geological evidence.

Q. And what is it that you propose to show, Mr. Stramp?

A. First we will show through reference to testimony in Case 6553, heard June 13th, 1979, highlights of the evidence placed before the Conservation Division and its technical staff, which led to its finding and rules in Order No. R-6054. Okay.

The finding stated that "infill producing wells were, and are hereby found, to be necessary to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units."

Also, we will again review Case 6553, Exhibit Sixteen, which outlined the quantity of added oil reserves shown by reservoir engineering studies to be recovered by the infill drilling program.

Second, we will review testimony at the hearing of Case 6553 on June 13th, as to the estimated new gas volumes that will be recovered as a result of the new oil reserves gained by the infill drilling program.

Third, we will show that the reservoir engineering studies and reservoir simulator projections which showed added reserves from infill drilling were based on appropriate geological evidence, in addition to the engineering evidence presented.

Q. All right, Mr. Stramp, would you please refer to what we've marked as Exhibits One through Five and explain what these are and what they show?

A. Okay. Exhibits One through Five will be references to and excerpts from testimony and exhibits presented in the New Mexico Oil Conservation Division Case 6553, heard June 13th, 1979, out of which came Division Order R-6054, dated July 10th, 1979.

Okay, Exhibit One is from the transcript of the testimony during the Division Case No. 6553, heard on June 13th.

Exhibit Two states some general principles as to the added recovery effects of infill drilling in a gravity drainage reservoir, such as Empire Abo. It is a portion of the transcript of Case 6553, beginning with page 13, line 24, and continuing to page 14, line 22.

Exhibit Three is again a copy of a part of the transcript of Case 6553, emphasizing the portion beginning with page 16, line 17, and continuing through page 17, line 22. The ARCO witness was entering into evidence Exhibit Thirteen, Case 6553, which was a copy of an engineering report titled Field Management Study, Abo Reservoir, Empire Abo Pool, October 2, 1970. This report was reviewed and copies were presented to the Oil Conservation Division staff at a meeting held in Santa Fe on May 11, 1972.

SALLY WALTON BOYD
CERTIFIED SHORTHAND REPORTER
1010 Plaza Blanca (505) 471-2462
Santa Fe, New Mexico 87501

The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap drape along structure, details on how the reservoir numeric simulator was built, and applied, and also how future projections of recovery were made.

Moving on to Exhibit Four, this is a copy from the transcript once again of Case 6553 emphasizing the part beginning with page 19, line 5, and continuing through page 20, line 25. These two pages are presented to show the technical background on gas coning that has been presented to the Conservation Division staff. Here is summarized why the gas coning problem is one of our more important reasons for added reserves from infill drilling in the Empire Abo reservoir.

Exhibit Five is again from the transcript of Case 6553, emphasizing the statements starting on page 21, line 14, and continuing through page 22, line 6.

This illustrates the possibility that infill wells could gain added reserves by drilling into zones where anhydrite infilling or other irregularities would have prevented flow to wells on wider spacing.

Q. Mr. Stramp, turn now to what has been marked as Exhibit Six and explain what this reflects.

A. Exhibit Six is an additional portion of the transcript of Case 6553, being copies of pages 23, 24, 25,

and 26. The ARCO witness is discussing results of various reservoir studies, including reservoir simulator projections to determine added oil reserves from infill drilling. An estimate of added gas reserves is also covered. I will point out significant portions of this transcript.

First, added oil reserves from the 158-well infill drilling program are estimated based on the latest reservoir simulator studies to be 14,510,000 barrels of oil. That's from page 24, lines 23 through 25, and page 25, lines 1 and 2.

Also, added gas reserves due to the added oil from infill drilling are calculated to be an additional 2.6 billion cubic feet of gas. That's from page 25, lines 3 through 12.

Okay. Also, the ARCO technical witness states, "The effect of ARCO's infill drilling program has been to increase the recovery of hydrocarbon reserves from the reservoir, both through the closer spacing to take advantage of the heterogeneity of the reservoir to reduce the effect of coning, and also to allow more production at lower gas/oil ratios. This is a more efficient method of producing the reservoir." That's from page 25, lines 16 through 22.

Okay. The ARCO technical witness further states, "That in my opinion the infill drilling of these wells is necessary to effectively and to efficiently recover reserves

that would not otherwise be recovered." That's page 26, lines 3 through 6.

Q. All right. Now go to what has been marked as Exhibits Seven through Twelve and explain what these exhibits represent or show.

A. Exhibits One through Six have reviewed in summary Case 6553, and have shown that, first, because of the geological nature of the Empire Abo reservoir, the infill drilling program will result in recovery of additional oil reserves as calculated from reservoir studies based on forecasts by reservoir simulators.

Second, recovery of this added oil will mean recovery of additional gas that would not otherwise be recovered.

Now, Exhibits Seven through Twelve will show that extensive geological studies and geological data were used as the basis for building these reservoir simulators and for the engineering studies which forecast this additional recovery by infill drilling.

Exhibit Seven is a copy of the transcript of Case 6553, page 16, lines 17 through 25, and page 17, lines 1 through 16, are being emphasized. The ARCO witness is entering a copy of the field management study Abo Reservoir, Empire Abo Pool, October 2nd, 1970. This exhibit shows that the subject field study was discussed in detail before the

Conservation Division staff on May 11th, 1972, in Santa Fe. On page 17, lines 12 through 16, we see, quote, "The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap drape along structure, details on how the reservoir numeric simulator was built and applied, and how future projections were made."

The following Exhibits Eight through Twelve will be excerpts from this report of October 2nd, 1970, which illustrates some of the geological background behind the reservoir studies and simulator forecasts.

Exhibit Eight is a copy of the discussion section, pages 2, 3, 4, and 5, titled Field Development and Natural Depletion History. Attention is particularly directed to the section entitled Geology, pages 2 and 3. Careful reading will show to the knowledgeable reader that a tremendous amount of geological study lies behind this very brief summary, and all of this geological study was used in the reservoir engineering studies and in building the reservoir simulators.

For example, it was the geologists' in depth study of the main reef cores which gave the earliest indication of the excellent vertical communication so important to a gravity drainage system. The geology discussion refers to many geological structure maps and gamma ray neutron log cross sections on various pages of the report. Included

in the October 2nd, 1970, report are the following:

What we have marked as Exhibit Nine, which is a copy of the reef map; Exhibit Ten, which is a base of the reef map; and Exhibit Eleven, which is a structural cross section Back Reef to Fore Reef cross section. These are selected examples. Actually, there were many studies by geologists, and geological cross sections were made covering most of the wells in the field. All of these cross sections were used in building the reservoir simulators, and simulator runs showed that the infill wells would mean increased recoveries.

In addition, geologic studies involving drill stem tests and log calculations established the original locations of both the initial gas cap and the water level. This data was also used in setting up the reservoir simulator.

Exhibit Twelve is another inclusion from the report and is a copy of page 9, entitled Reservoir Performance, History and Predictions. A study of the portion titled Volumetric Oil-In-Place, shows how geologic data, cores and logs, were used to get detailed porosity and permeability for each cell on the reservoir simulator.

Q. All right, Mr. Stramp, could you please summarize briefly ARCO's presentation which you've just gone through in detail?

A. Yes, sir. It's my opinion that first of

all, the infill drilling program as pursued by ARCO will result in additional oil -- the recovery of additional oil reserves, as calculated from reservoir studies based on forecasts by reservoir simulators.

Second, recovery of this added oil will mean recovery of additional gas that would not otherwise be recovered.

And third, extensive geological studies and geological data were used as the basis for building the reservoir simulators and the engineering studies which forecast this additional recovery through infill drilling.

Q. Mr. Stramp, were these Exhibits One through Twelve either prepared by you or under your supervision, or if neither of those, were any which were not so prepared, have they been reviewed by you and do you concur fully in matters represented therein?

A. Yes, sir.

Q. And is it your opinion, Mr. Stramp, that approval of this application will be in the interest of prevention of waste and protection of correlative rights?

A. Yes, sir.

MR. COFFIELD: Mr. Examiner, I move the admission of Exhibits One through Twelve.

MR. STAMETS: These exhibits will be admitted.

MR. COFFIELD: And I have no further questions of Mr. Stramp at this time.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Stramp, you referred a lot to the Case 6553 and I didn't happen to sit in on that case, haven't read the transcript. I understand the reasoning behind the additional oil recoveries from the infill wells. Would you just briefly give me the logic for the additional gas recovery? My own thinking being that the mobility of the gas would be such that you would recover approximately the same amount of gas with or without the infill program.

A. Well, the additional gas recovery is a direct result of the additional oil recovery. If you consider how the reservoir would be situated at abandonment, the extra 14.5 billion barrels of oil you recovered, had it not been recovered, would contain an amount of solution gas at abandonment, and --

Q. At abandonment pressure?

A. Yes. So we took the solution ratio at our estimated abandonment pressure and that's where the estimated additional gas reserves number was calculated.

Q. Okay, that was a very concise explanation. The best one I've had all day.

MR. STAMETS: Any other questions of the witness?

MR. PADILLA: I have a question.

CROSS EXAMINATION

BY MR. PADILLA:

Q. Mr. Stramp, do you know whether you will be trying to get some kind of an informal conference with FERC regarding this matter?

A. We've already tried to do that and their response to us was that they would not consult with us while our case was still pending, you know. If they rejected our case, they would talk to us and say why the case was -- the filings were not approved; however, while the case was pending they don't want to have any direct contact with the producing company.

Q. How about following a decision by the Division? It's my understanding that -- it's my understanding that this hearing is here to give an explanation as to why infill drilling will obtain additional gas reserves.

A. Uh-huh.

Q. And following the decision by the Division for amendment of Order -- this order here --

A. 6054.

Q. -- will they grant -- it seems to me --

well, what I'm trying to drive at, it seems to me that they will have to have some kind of an explanation from -- from the company so that they can understand what -- what the coning process is.

A. Well, their position, as I understand it, is that the producing company testifies before the state jurisdictional agency and if the state jurisdictional agency finds that the wells were necessary, then it's -- the burden is placed on the state agency to defend their finding that the wells were necessary. It seems that they don't -- they want to have an impartial third party to evaluate our testimony and summarize it and then present it to FERC, so they don't have to rely on the producing company's testimony on its own. So the basis that we set up this hearing was that our -- we had a whole batch of our infill findings that had been approved as being necessary to effectively and efficiently drain the reservoir by the State. You sent it to FERC and they said it did not meet all the criteria that they had established. They sent a letter back to the Division stating the points that they felt had not been covered, and we just got a copy of the letter and we felt like we would take the opportunity to try to amend this case in ways we thought would help you in your decision, but basically what they want is a response from the Division, I believe, as to the questions they raised in their letter, if you could follow any of that.

Q. Yes. Well, now going back to the 2.6 or 2,611,000 additional Mcf of gas.

A. Uh-huh.

Q. Would you attribute that to the entire Empire Abo Unit?

A. Yes, sir.

Q. In other words --

A. It's not a -- that figure does not apply only to the wells that we have filed for and that they rejected. That is a total number for the entire 158-well infill drilling program in the unit.

Q. So the best way to attribute all of this additional gas to individual proration units would be to divide the entire number of proration units by -- into this figure.

A. That would be one way of doing it, not necessarily the best. That would be a psuedo number, you know. It's very difficult in this reservoir to assign specific reserves to a particular well because of the mechanism that it's being produced under. We, if you would like, we'll try to work an allocation of those gas reserves by well and on a little more scientific basis than just dividing by the total number of wells, because there are other factors involved, the particular spacing that the well is on, and the pay section, and whatnot. If you like, we'll do that and

submit it as additional testimony in this case.

MR. STAMETS: What factors would that be based on?

A. Well, I'm not sure. We'd have to investigate it. It would be a -- a large factor would be what sort of location that infill well is on, whether it's -- some of our infill wells are on essentially 10-acre locations and some are on 5-acre locations, so you would expect the 10-acre locations to recover more additional reserves than the 5-acre locations would, and --

MR. STAMETS: It would still be based on the additional recovery only you'd try and get it down to the individual tracts for these wells.

A. Yeah. I guess, if it would be acceptable, we could just take the total reserves and divide by the total number of wells, and that would give a good estimate.

MR. STAMETS: I think the scientific way would certainly have more validity.

A. Well, that was our feeling, too, so we'd be happy to work that out, if you like.

MR. STAMETS: That sounds fine, if you could submit that along with an explanation of how the facts were arrived at, we will add that to the record in this case.

Also, I would suggest that a proposed order would certainly speed things along in this case, if you would

like to submit one.

A. Okay, we'd be happy to do that.

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

Anything further in this case?

The case will be taken under advisement.

(Hearing concluded.)

SALLY WALTON BOYD
CERTIFIED SHORTHAND REPORTER
1010 Plaza Blanca (505) 471-2465
Santa Fe, New Mexico 87501

REPORTER'S CERTIFICATE

I, SALLY W. BOYD, a Certified Shorthand Reporter, DO HEREBY CERTIFY that the foregoing and attached Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability from my notes taken at the time of the hearing.

Sally W. Boyd C.S.R.
Sally W. Boyd, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 6746, heard by me on 11-28 19 79.

Richard L. Stamets, Examiner
Oil Conservation Division

SALLY WALTON BOYD
CERTIFIED SHORTHAND REPORTER
3010 Plaza Blanca (505) 471-2463
Santa Fe, New Mexico 87501

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO
28 November 1979

EXAMINER HEARING

IN THE MATTER OF:

Application of ARCO Oil and Gas Company for amendment to Order No. R-6054, Eddy County, New Mexico.

CASE 6741

BEFORE: Richard L. Stamets

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division: Ernest L. Padilla, Esq.
Legal Counsel for the Division
State Land Office Bldg.
Santa Fe, New Mexico 87501

For the Applicant: Conrad Coffield, Esq.
HINKLE LAW FIRM
P. O. BOX 3580
Midland, Texas

I N D E X

RYAN STRAMP

E X H I B I T S

MR. STAMETS: We will call next Case 6741.

MR. PADILLA: Application of ARCO Oil and Gas Company for amendment to Order No. R-6054, Eddy County, New Mexico.

MR. COFFIELD: Conrad Coffield, with the Hinkle Law Firm of Midland, Texas, appearing on behalf of ARCO Oil and Gas Company. I have one witness.

MR. STAMETS: Any other appearances in this case? I'd like to have the witness stand and be sworn.

(Witness sworn.)

RYAN STRAMP

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

DIRECT EXAMINATION

BY MR. COFFIELD:

Q. Mr. Stramp, would you please state your name and address, occupation and employer?

A. Yes, sir. My name is Ryan Stramp, S-T-R-A-M-P, and I reside in Midland, Texas, and I work for ARCO Oil and Gas there as a petroleum engineer.

Q. Are you familiar with ARCO's application in this case?

A. Yes, sir, I am.

Q. Have you previously testified before the Division as a petroleum engineer?

A. Yes, sir, I have.

Q. And were your qualifications made a matter of record and accepted by the Division?

A. They were.

MR. COFFIELD: Mr. Examiner, is the witness considered qualified?

MR. STAMETS: Yes, he is.

Q. Mr. Stramp, would you please state your connections with the Empire Abo Unit?

A. I've been assigned to the Empire Abo Unit engineering group within ARCO for approximately the past year and a half, and I've held various positions in that engineering group.

Q. Okay, Mr. Stramp, are you familiar with testimony and with the record which was established before the Oil Conservation Division in Cases numbered 4952, 4953, which were heard on April 25, 1973, as well as Cases numbered 5211, 5212, 5213, heard on April 10, 1974, and Case 6553, with its exhibits, heard on June 13, 1979, as a result of which the Division issued Order No. R-6054, dated July 10, 1979, and also are you familiar with the Order R-6054?

A. Yes, I am.

MR. COFFIELD: If the Examiner please, reference will be made to these cases throughout Mr. Stramp's testimony, and we would respectfully request that administrative notice be taken of matters reflected therein.

MR. STAMETS: It will be.

Q Mr. Stramp, would you state briefly what ARCO seeks in this application?

A By amendment of Order No. R-6054, dated July 10th, 1979, ARCO seeks a finding that these same unorthodox producing well locations in the Empire Abo Unit area which were found in Order 6054, order two, to be necessarily to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units, be found to be necessary to effectively and efficiently drain both as to oil and gas the portion of the reservoir covered by the respective existing proration units which could not be so drained by existing wells on the units.

ARCO further seeks the finding by amendment of Order 6054 that the Empire Abo reservoir studies and numerical reservoir simulations, which have been reported or submitted to the Division at various times, and which were considered by the Division in the findings and orders within Order No. R-6054, are soundly based on appropriate geological evidence.

Q And what is it that you propose to show, Mr. Stramp?

A. First we will show through reference to testimony in Case 6553, heard June 13th, 1979, highlights of the evidence placed before the Conservation Division and its technical staff, which led to its finding and rules in Order No. R-6054. Okay.

The finding stated that "infill producing wells were, and are hereby found, to be necessary to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units."

Also, we will again review Case 6553, Exhibit Sixteen, which outlined the quantity of added oil reserves shown by reservoir engineering studies to be recovered by the infill drilling program.

Second, we will review testimony at the hearing of Case 6553 on June 13th, as to the estimated new gas volumes that will be recovered as a result of the new oil reserves gained by the infill drilling program.

Third, we will show that the reservoir engineering studies and reservoir simulator projections which showed added reserves from infill drilling were based on appropriate geological evidence, in addition to the engineering evidence presented.

Q. All right, Mr. Stramp, would you please refer to what we've marked as Exhibits One through Five and explain what these are and what they show?

A. Okay. Exhibits One through Five will be references to and excerpts from testimony and exhibits presented in the New Mexico Oil Conservation Division Case 6553, heard June 13th, 1979, out of which came Division Order R-6054, dated July 10th, 1979.

Okay, Exhibit One is from the transcript of the testimony during the Division Case No. 6553, heard on June 13th.

Exhibit Two states some general principles as to the added recovery effects of infill drilling in a gravity drainage reservoir, such as Empire Abo. It is a portion of the transcript of Case 6553, beginning with page 13, line 24, and continuing to page 14, line 22.

Exhibit Three is again a copy of a part of the transcript of Case 6553, emphasizing the portion beginning with page 16, line 17, and continuing through page 17, line 22. The ARCO witness was entering into evidence Exhibit Thirteen, Case 6553, which was a copy of an engineering report titled Field Management Study, Abo Reservoir, Empire Abo Pool, October 2, 1970. This report was reviewed and copies were presented to the Oil Conservation Division staff at a meeting held in Santa Fe on May 11, 1972.

The AMCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap drape along structure, details on how the reservoir numeric simulator was built, and applied, and also how future projections of recovery were made.

Moving on to Exhibit Four, this is a copy from the transcript once again of Case 6553 emphasizing the part beginning with page 19, line 5, and continuing through page 20, line 25. These two pages are presented to show the technical background on gas coning that has been presented to the Conservation Division staff. Here is summarized why the gas coning problem is one of our more important reasons for added reserves from infill drilling in the Empire Abo reservoir.

Exhibit Five is again from the transcript of Case 6553, emphasizing the statements starting on page 21, line 14, and continuing through page 22, line 6.

This illustrates the possibility that infill wells could gain added reserves by drilling into zones where anhydrite infilling or other irregularities would have prevented flow to wells on wider spacing.

Q Mr. Stramp, turn now to what has been marked as Exhibit Six and explain what this reflects.

A Exhibit Six is an additional portion of the transcript of Case 6553, being copies of pages 23, 24, 25,

and 26. The ARCO witness is discussing results of various reservoir studies, including reservoir simulator projections to determine added oil reserves from infill drilling. An estimate of added gas reserves is also covered. I will point out significant portions of this transcript.

First, added oil reserves from the 153-well infill drilling program are estimated based on the latest reservoir simulator studies to be 14,510,000 barrels of oil. That's from page 24, lines 23 through 25, and page 25, lines 1 and 2.

Also, added gas reserves due to the added oil from infill drilling are calculated to be an additional 2.6 billion cubic feet of gas. That's from page 25, lines 3 through 12.

Okay. Also, the ARCO technical witness states, "The effect of ARCO's infill drilling program has been to increase the recovery of hydrocarbon reserves from the reservoir, both through the closer spacing to take advantage of the heterogeneity of the reservoir to reduce the effect of coning, and also to allow more production at lower gas/oil ratios. This is a more efficient method of producing the reservoir." That's from page 25, lines 16 through 22.

Okay. The ARCO technical witness further states, "That in my opinion the infill drilling of these wells is necessary to effectively and to efficiently recover reserves

that would not otherwise be recovered." That's page 26, lines 3 through 6.

Q All right. Now go to what has been marked as Exhibits Seven through Twelve and explain what these exhibits represent or show.

A Exhibits One through Six have reviewed in summary Case 6553, and have shown that, first, because of the geological nature of the Empire Abo reservoir, the infill drilling program will result in recovery of additional oil reserves as calculated from reservoir studies based on forecasts by reservoir simulators.

Second, recovery of this added oil will mean recovery of additional gas that would not otherwise be recovered.

Now, Exhibits Seven through Twelve will show that extensive geological studies and geological data were used as the basis for building these reservoir simulators and for the engineering studies which forecast this additional recovery by infill drilling.

Exhibit Seven is a copy of the transcript of Case 6553, page 16, lines 17 through 25, and page 17, lines 1 through 16, are being emphasized. The ARCO witness is entering a copy of the field management study Abo Reservoir, Empire Abo Pool, October 2nd, 1970. This exhibit shows that the subject field study was discussed in detail before the

Conservation Division staff on May 11th, 1972, in Santa Fe. On page 17, lines 12 through 16, we see, quote, "The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap drape along structure, details on how the reservoir numeric simulator was built and applied, and how future projections were made."

The following Exhibits Eight through Twelve will be excerpts from this report of October 2nd, 1970, which illustrates some of the geological background behind the reservoir studies and simulator forecasts.

Exhibit Eight is a copy of the discussion section, pages 2, 3, 4, and 5, titled Field Development and Natural Depletion History. Attention is particularly directed to the section entitled Geology, pages 2 and 3. Careful reading will show to the knowledgeable reader that a tremendous amount of geological study lies behind this very brief summary, and all of this geological study was used in the reservoir engineering studies and in building the reservoir simulators.

For example, it was the geologists' in depth study of the main reef cores which gave the earliest indication of the excellent vertical communication so important to a gravity drainage system. The geology discussion refers to many geological structure maps and gamma ray neutron log cross sections on various pages of the report. Included

in the October 2nd, 1979, report are the following:

What we have marked as Exhibit Nine, which is a copy of the reef map; Exhibit Ten, which is a base of the reef map; and Exhibit Eleven, which is a structural cross section Back Reef to Fore Reef cross section. These are selected examples. Actually, there were many studies by geologists, and geological cross sections were made covering most of the wells in the field. All of these cross sections were used in building the reservoir simulators, and simulator runs showed that the infill wells would mean increased recoveries.

In addition, geologic studies involving drill stem tests and log calculations established the original locations of both the initial gas cap and the water level. This data was also used in setting up the reservoir simulator.

Exhibit Twelve is another inclusion from the report and is a copy of page 9, entitled Reservoir Performance, History and Predictions. A study of the portion titled Volumetric Oil-In-Place, shows how geologic data, cores and logs, were used to get detailed porosity and permeability for each cell on the reservoir simulator.

Q. All right, Mr. Stramp, could you please summarize briefly ARCO's presentation which you've just gone through in detail?

A. Yes, sir. It's my opinion that first of

all, the infill drilling program as pursued by ARCO will result in additional oil --- the recovery of additional oil reserves, as calculated from reservoir studies based on fore-casts by reservoir simulators.

Second, recovery of this added oil will mean recovery of additional gas that would not otherwise be recovered.

And third, extensive geological studies and geological data were used as the basis for building the reservoir simulators and the engineering studies which forecast this additional recovery through infill drilling.

Q. Mr. Stramp, were these Exhibits One through Twelve either prepared by you or under your supervision, or if neither of those, were any which were not so prepared, have they been reviewed by you and do you concur fully in matters represented therein?

A. Yes, sir.

Q. And is it your opinion, Mr. Stramp, that approval of this application will be in the interest of prevention of waste and protection of correlative rights?

A. Yes, sir.

MR. COFFIELD: Mr. Examiner, I move the admission of Exhibits One through Twelve.

MR. STAMETS: These exhibits will be admitted.

MR. COPPLE: And I have no further questions of Mr. Stramp at this time.

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Stramp, you referred a lot to the Case 6553 and I didn't happen to sit in on that case, haven't read the transcript. I understand the reasoning behind the additional oil recoveries from the infill wells. Would you just briefly give me the logic for the additional gas recovery? My own thinking being that the mobility of the gas would be such that you would recover approximately the same amount of gas with or without the infill program.

A. Well, the additional gas recovery is a direct result of the additional oil recovery. If you consider how the reservoir would be situated at abandonment, the extra 14.5 billion barrels of oil you recovered, had it not been recovered, would contain an amount of solution gas at abandonment, and --

Q. At abandonment pressure?

A. Yes. So we took the solution ratio at our estimated abandonment pressure and that's where the estimated additional gas reserves number was calculated.

Q. Okay, that was a very concise explanation. The best one I've had all day.

MR. STAMETS: Any other questions of the witness?

MR. PADILLA: I have a question.

CROSS EXAMINATION

BY MR. PADILLA:

Q. Mr. Stramp, do you know whether you will be trying to get some kind of an informal conference with FERC regarding this matter?

A. We've already tried to do that and their response to us was that they would not consult with us while our case was still pending, you know. If they rejected our case, they would talk to us and say why the case was -- the filings were not approved; however, while the case was pending they don't want to have any direct contact with the producing company.

Q. How about following a decision by the Division? It's my understanding that -- it's my understanding that this hearing is here to give an explanation as to why infill drilling will obtain additional gas reserves.

A. Uh-huh.

Q. And following the decision by the Division for amendment of Order -- this order here --

A. 6054.

Q. -- will they grant -- it seems to me --

well, what I'm trying to drive at, it seems to me that they will have to have some kind of an explanation from -- from the company so that they can understand what -- what the coning process is.

A. Well, their position, as I understand it, is that the producing company testifies before the state juris ictional agency and if the state jurisdictional agency finds that the wells were necessary, then it's -- the burden is placed on the state agency to defend their finding that the wells were necessary. It seems that they don't -- they want to have an impartial third party to evaluate our testimony and summarize it and then present it to FERC, so they don't have to rely on the producing company's testimony on its own. So the basis that we set up this hearing was that our -- we had a whole batch of our infill findings that had been approved as being necessary to effectively and efficiently drain the reservoir by the State. You sent it to FERC and they said it did not meet all the criteria that they had established. They sent a letter back to the Division stating the points that they felt had not been covered, and we just got a copy of the letter and we felt like we would take the opportunity to try to amend this case in ways we thought would help you in your decision, but basically what they want is a response from the Division, I believe, as to the questions they raised in their letter, if you could follow any of that.

Q Yes. Well, now going back to the 2.6 or 2,611,000 additional Mcf of gas.

A Uh-huh.

Q Would you attribute that to the entire Empire Abo Unit?

A Yes, sir.

Q In other words --

A It's not a -- that figure does not apply only to the wells that we have filed for and that they rejected. That is a total number for the entire 158-well infill drilling program in the unit.

Q So the best way to attribute all of this additional gas to individual proration units would be to divide the entire number of proration units by -- into this figure.

A That would be one way of doing it, not necessarily the best. That would be a psuedo number, you know. It's very difficult in this reservoir to assign specific reserves to a particular well because of the mechanism that it's being produced under. We, if you would like, we'll try to work an allocation of those gas reserves by well and on a little more scientific basis than just dividing by the total number of wells, because there are other factors involved, the particular spacing that the well is on, and the pay section, and whatnot. If you like, we'll do that and

submit it as additional testimony in this case.

MR. STAMETS: What factors would that be based on?

A. Well, I'm not sure. We'd have to investigate it. It would be a -- a large factor would be what sort of location that infill well is on, whether it's -- some of our infill wells are on essentially 10-acre locations and some are on 5-acre locations, so you would expect the 10-acre locations to recover more additional reserves than the 5-acre locations would, and --

MR. STAMETS: It would still be based on the additional recovery only you'd try and get it down to the individual tracts for these wells.

A. Yeah. I guess, if it would be acceptable, we could just take the total reserves and divide by the total number of wells, and that would give a good estimate.

MR. STAMETS: I think the scientific way would certainly have more validity.

A. Well, that was our feeling, too, so we'd be happy to work that out, if you like.

MR. STAMETS: That sounds fine, if you could submit that along with an explanation of how the facts were arrived at, we will add that to the record in this case.

Also, I would suggest that a proposed order would certainly speed things along in this case, if you would

like to submit one.

A. Okay, we'd be happy to do that.

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

Anything further in this case?

The case will be taken under advisement.

(Hearing concluded.)

REPORTER'S CERTIFICATE

I, SALLY W. BOYD, a Certified Shorthand Reporter, DO HEREBY CERTIFY that the foregoing and attached Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability from my notes taken at the time of the hearing.

Sally W. Boyd, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. _____ heard by me on _____ 19____.

_____, Examiner
Oil Conservation Division

EXH. # 1
CASE 6741

CASE NO. 6741

EXHIBIT NO. 1

Testimony from the transcript of Oil Conservation Division Case No. 6553, heard in Santa Fe, New Mexico, June 13, 1979. The testimony begins on page 8, line 22, and continues to page 9, line 12.

"In order for the Conservation Division to determine that the infill wells would recover additional oil, it was necessary for them to be aware of the following facts:

That this was a gravity drainage reservoir with good vertical communication.

That there was an extensive, expanding gas cap.

That individual producing wells had a tendency to cone in gas, shortening their life and reducing recovery.

That reserves would be increased by producing the oil at low gas/oil ratios.

That the proposed infill wells were being located so as to take advantage of the gravity drainage mechanism."

The above quotation sets out some of the key facts the Division would need to know to make the finding that infill drilling would result in the recovery of added reserves.

Transcript pages 9 through 23, line 10, with Exhibits 3 through 15 show that material supporting these facts has been presented to the Conservation Division and its technical staff.

BEFORE EXAMINER STATTS
OIL CONSERVATION DIVISION
EXHIBIT 1
CASE 6741
ARCO
11/28/79

EXH. # 2
CASE 6741

that's probably a typographical error there. They show 25,036 barrels of water per day. That should have been 2536 barrels per day.

Exhibit Nine, a secondary gas cap has expanded to extend over most of the reservoir.

This is page 30, lines 20 through 26, and page 31, lines 1 through 17.

Exhibit Ten, Field production history and reservoir numeric models studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism.

Statement read from Unit Plan of Operation by ARCO technical witness. Page 25a, lines 4, 5, and 6.

In summary, all points above were in the sworn record prior to the Oil Conservation Division consideration of the first ARCO infill proposal.

They show that the Division had plenty of evidence to establish that the Empire Abo reservoir was governed by gravity drainage with an overlying expanding gas cap.

Q All right. Please refer to what we've marked as Exhibits 11, 12, 13, and 14, and identify these, please.

A First, having established as shown in Exhibits Five through Ten that the Empire Abo reservoir

recovery mechanism is governed by gravity drainage with an expanding gas cap, the Division technical people would have known what is widely known among experienced reservoir engineers, that there are at least two major ways to increase hydrocarbon recovery from such a reservoir.

They are, first, conservation of gas energy, and that is to retain gas in the reservoir, void a minimum of reservoir space per barrel of oil produced, achieved by shutting in or curtailing inefficient, high GOR, producers, aided by injection.

Second would be minimum -- minimize gas coning into producing wells by dispersing withdrawal points going to closer well spacing, especially mid- and down-structure.

The Conservation Division would have seen that ARCO's proposal to produce oil from the more efficient infill wells, using them to replace production from inefficient high GOR wells, would act toward achieving both one and two above, hence increasing recovery.

But the Division also had much evidence available to support this conclusion. Some of this evidence will be shown in Exhibits Eleven through Fourteen.

The reservoir voidage efficiency factor defined as the ratio of barrels of reservoir space voided to barrels of stock tank oil produced is a good yardstick

EXH. # 3
CASE 6741

voir if you want to maximize ultimate recovery."

Also, with a voidage limit, operators will "... try to get as low in the reef as they can and produce at as low a gas/oil ratio as they can ...".

There again this is Case 5212 and 13, transcript page 92, lines 9 through 23, and page 93, lines 1 through 7.

Line 9 is the one right after the A and the start of a new paragraph.

MR. NUTTER: And then it's the rest of that paragraph?

A. Yes, sir, the rest of that page.

MR. NUTTER: All right.

A. And the first seven lines on the following page.

MR. NUTTER: We've got that.

A. Okay, here is Exhibit Thirteen. I have only one copy of this exhibit.

This is a copy of a report on ARCO's reservoir study prior to unitization, including results of reservoir numeric model runs. Its purpose will be to show the wealth of engineering data that the Division staff had available prior to the infill well proposals, plus how that data could show the potential for added recovery by infill drilling.

The Exhibit Thirteen report, Field Management Study, October 2nd, 1970, was presented to various members of the Oil Conservation Division staff by ARCO representatives at a background meeting held May 11th, 1972 in Santa Fe, New Mexico.

Attending this meeting for the Conservation Division were Messrs. A. L. Porter, Richard Stamets, Dan Nutter, Elvis Utz, Jim Kapteina, and George Hatch.

This meeting lasted several hours and ranged over every area of the reservoir mechanics and the status of unitization at that time.

The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap "drape" along structure, details on how the Reservoir Numeric Simulator was built and applied, and how future projections were made, as to recovery.

It was pointed out that ARCO's method of operations would be to shut in high GOR wells and transfer production to low structure, low GOR locations, and that shutting in high GOR wells to conserve gas cap gas was equivalent in reservoir voidage terms to re-injecting residue gas into the gas cap.

Key points in the report were that under ultimate recovery under natural depletion was estimated to be 172.6 million barrels. Ultimate recovery under uniti-

EXH. #4
CASE 6741

would be 200.3 million barrels.

As an item of interest, I think as of June the 1st we had recovered approximately 178 million barrels out of this reservoir.

Coning of gas, at the bottom of page 3 there is a list of wells which have required recompletion lower to reduce high GOR.

At the top of page 4 gas coning is mentioned as a problem that has already shown up in the performance of these wells.

The discussion of the future forecasts went into the probability that coning of gas into producing wells would be a factor in future reservoir performance.

Referring to Exhibit Fourteen, this was distributed at that meeting. It is a background report on the type of coning simulator that was used in conjunction with the field-wide model to forecast future performance. A three-dimensional drawing of a single well coning model was used to show development of a typical gas cone.

The drawing was also used to examine the coning phenomenon and discuss the fact that the chief reason gas coning would be a problem in this reservoir was the fact that vertical permeability was equal to hori-

zontal permeability, and therefore, gas cap gas, much more mobile than the oil, had to move vertically a matter of only 200 feet or less to reach the perforated interval, while the more viscous oil had to move much greater distances horizontally. This was especially true with the 40-acre spacing then in effect.

The point being made with the above coning discussion rehash is that in May, 1972, before submittal of the first infill application, which was September 10th, 1974, the Conservation Division staff had enough background on gas coning flow mechanics in the Empire Abo to be able to reach the same conclusion as ARCO engineers, that closer spacing of the wells in the Abo should result in recovery of additional oil due to reducing gas coning effects.

In addition, dispersal of withdrawal points can mean less pressure drawdown at each point, therefore less tendency to cone gas, and greater recovery.

The Division staff also had prior information on the added recovery to be gained by maximizing low GOR production from sworn testimony and the ARCO Reservoir Simulator results in the October 2nd, 1970 report.

Thus, they could see that the low GOR production to come from the infill wells was going to increase ultimate recovery.

EXH. #5
CASE 6741

Q Mr. Tweed, refer to what we've marked as Exhibit Fifteen, please, and explain what that shows.

A Exhibit Fifteen, this is a copy of the written portion of the first plan of operation proposed for the Empire Abo Unit, dated April 25th, 1973.

This plan was entered into evidence as Exhibit Six of Case Number 4952 and Case Number 4953, application of Atlantic Richfield Company for a unit agreement and for a pressure maintenance project, heard before Examiner R. L. Stamets on April 25th, 1973.

Entry of the plan of operation into evidence is made on the transcript on page 23, line 10. Discussion continues through page 28, line 19.

The plan of operations contains a great deal of background material that could have been used by the Conservation Division in a determination of added recovery resulting from infill drilling.

Following are several examples:

On page 3, under "1. Project Area, history, and background", in the second paragraph, fourth through seventh lines from the top we see, "Vugs, fractures, and fissures have been observed in cores throughout the main reef with local anhydrite -- in cores throughout the main reef, excuse me, with local anhydrite infilling sometimes restricting flow."

In applying this statement to the infill drilling proposals, the Conservation Division could have reasoned, as ARCO engineers did, that increasing well density might recover some added oil by drilling into zones where anhydrite infilling or other irregularities would have prevented flow to wells on wider spacing.

On page four, first paragraph, lines 4 through 7 down from the top, we see, "Field performance and detailed study of cores indicate excellent vertical permeability. The principal producing mechanism is gravity drainage with an expanding gas cap."

On page four, second paragraph, lines 6 through 9 from the top, we see, "Unitized residue gas injection for pressure maintenance is calculated to increase future recovery by about 30 million barrels compared to continued primary operations."

In comparing this 30 million barrels gain from residue gas injection to the 27.7 million barrels gain over primary by simply maximizing production from low GOR wells, the Conservation Division could have reasoned that control of the GOR was more important to added recovery than gas injection, and addition of the infill wells at low GORs would help control the overall GOR.

On page four we see, "Basic Concepts Governing Future Unit Operations.

EXH. #6
CASE 6741

Field production history and reservoir numeric model studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism. With unitization the operator will be able to maximize beneficial effects of this most efficient recovery mechanism by careful observation of well performance and shutting in or curtailing production from inefficient wells."

The Conservation Division could have seen the infill wells as a chance to replace the production from inefficient high GOR wells, thus gaining reserves.

Q Mr. Tweed, go to what we've marked as Exhibit Sixteen and explain that to the Examiner.

A This is a table listing several studies that ARCO has made to determine added reserves resulting from infill drilling.

To summarize ARCO's reservoir studies relating to infill drilling:

a. The study covered in the October 2nd, 1970 report showed added recovery by keeping the producing GOR low.

The 8-74 study was preliminary but was to justify the first two infill wells. The 8-74 study was just a preliminary study to determine if enough additional recovery could be obtained from the new wells to make it economical. It did show that it would be economical to

drill the infill wells and therefore, we proceeded.

The 1975 study took more factors into account and evaluated 20-acre spacing. And you might see at that time, the 1975 study indicated that we would recover some 100,000 barrels per well additional recovery due to the infill drilling program.

The 1977 study was the more complete reservoir model and evaluated both 20-acre and 10-acre development. This study indicated that the average of the 158 wells we proposed to drill would recover -- the average well would recover some 92,000 barrels.

Of course, these studies were necessary to get a better fix on added reserves as more data and more sophisticated simulators became available and to evaluate conomic benefits.

Having done these studies, ARCO then sought and received administrative approval rather than a formal hearing. In doing this we felt that the Conservation Division and its staff, with their solid technical abilities and considerable background in the Empire Abo reservoir mechanics, would see that there are indeed increased reserves to be gained from infill drilling.

In addition, I might point out that all of our studies, especially our 1977 study, which was the most sophisticated numeric simulator that we run, indicated

that the total recovery from all of our infill drilling would be some 14,510,000 barrels.

We had submitted to the Commission on our original hearing a -- okay, it was in NMOCD Order R-4549, Attachment B, was a table of gas volume factors versus reservoir pressure. At that time our estimate was, and still is, that the abandoned pressure of the reservoir would be 100 psia. At that, at that pressure a barrel of oil would have 180 standard cubic feet of gas still in solution. The additional recovery of some 14,560,000 barrels would thus recover some additional 2,611,800 Mcf of gas.

Q. Okay, Mr. Tweed, in your opinion what will be your -- what has been the effect of ARCO's infill drilling program as you've discussed it here today?

A. The effect of ARCO's infill drilling program has been to increase the recovery of hydrocarbon reserves from the reservoir both due to the closer spacing to take advantage of the heterogeneity of the reservoir to reduce the effect of coning, and also to allow more production at lower GOR -- more efficient low GOR wells than high GOR production.

I might add that as of 5-1-79 the 129 infill wells that were on production had recovered some 16,292,000 barrels of oil.

Q. Do you have anything else to add, Mr. Tweed?

A. No, not other than the fact that in my opinion the infill drilling of these wells is necessary to effectively and efficiently recover reserves that would not otherwise have been recovered.

Q. All right, Mr. Tweed, were these exhibits One through Sixteen either prepared or assembled by you or under your supervision?

A. Yes, they were.

MR. COFFIELD: I move the admission of Exhibits One through Sixteen.

MR. NUTTER: ARCO Exhibits One through Sixteen will be admitted.

MR. COFFIELD: I have no further questions on direct examination.

CROSS EXAMINATION

BY MR. NUTTER:

Q. Mr. Tweed, I presume what we're seeking here is actually a sort of a retroactive order, isn't it, that we would find that when we originally approved this infill drilling program that these wells were necessary to effectively and efficiently -- and more efficiently drain those proration units that they're located on.

EXH. #7
CASE 6741

voir if you want to maximize ultimate recovery."

Also, with a voidage limit, operators will "... try to get as low in the reef as they can and produce at as low a gas/oil ratio as they can ...".

There again this is Case 5212 and 13, transcript page 92, lines 9 through 23, and page 93, lines 1 through 7.

Line 9 is the one right after the A and the start of a new paragraph.

MR. NUTTER: And then it's the rest of that paragraph?

A. Yes, sir, the rest of that page.

MR. NUTTER: All right.

A. And the first seven lines on the following page.

MR. NUTTER: We've got that.

A. Okay, here is Exhibit Thirteen. I have only one copy of this exhibit.

This is a copy of a report on ARCO's reservoir study prior to unitization, including results of reservoir numeric model runs. Its purpose will be to show the wealth of engineering data that the Division staff had available prior to the infill well proposals, plus how that data could show the potential for added recovery by infill drilling.

7
6741
ARCO
11/28/79

The Exhibit Thirteen report, Field Management Study, October 2nd, 1970, was presented to various members of the Oil Conservation Division staff by ARCO representatives at a background meeting held May 11th, 1972 in Santa Fe, New Mexico.

Attending this meeting for the Conservation Division were Messrs. A. L. Porter, Richard Stamets, Dan Nutter, Elvis Utz, Jim Kapteina, and George Hatch.

This meeting lasted several hours and ranged over every area of the reservoir mechanics and the status of unitization at that time.

The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap "drape" along structure, details on how the Reservoir Numeric Simulator was built and applied, and how future projections were made, as to recovery.

It was pointed out that ARCO's method of operations would be to shut in high GOR wells and transfer production to low structure, low GOR locations, and that shutting in high GOR wells to conserve gas cap gas was equivalent in reservoir voidage terms to re-injecting residue gas into the gas cap.

Key points in the report were that under ultimate recovery under natural depletion was estimated to be 172.6 million barrels. Ultimate recovery under uniti-

EXH. # 8
CASE 6741

FIELD MANAGEMENT STUDY

ABO RESERVOIR

EMPIRE ABO POOL

Eddy County, New Mexico

October 2, 1970

FIELD DEVELOPMENT AND NATURAL DEPLETION HISTORY

Discovery and Development

The Empire Field is located 8 miles southeast of the town of Artesia in Eddy County, New Mexico. Empire Abo reservoir saw its initial completion in November, 1957. The well was Pan American's Malco "A" No. 1, located in NE NW-11-18S-27E. Development rapidly moved west, east, and north from the discovery which proved to be only one location removed from the fore-reef edge of productive limits. Within three years some 215 of the eventual 250 producing wells had been completed. In defining the reservoir, 29 dry holes were also drilled. At present there are 201 flowing and 38 pumping wells for a field total of 239 wells. A graph portraying field performance history is on page 7. Other current and basic data may be found in the Reservoir Data Summary, page 6.

Geology

The Abo producing zone is a Lower Leonard (Permian) carbonate reef, one of several in a trend flanking the northern margin of the Delaware Basin. Abo development is of the barrier reef type. Dolomitization of the original corraline reef material has been complete. Vugs, fractures, and fissures have been observed in examinations of cores from throughout the main reef. Anhydrite infilling has acted to restrict flow in localized areas. Reef development is long and narrow, being about $12\frac{1}{2}$ miles in length from southwest to northeast, and averaging about $1\frac{1}{2}$ miles in width from backreef (north) to forereef (south). The reef dips gradually (about 1^{o}, or 92' per mile) from southwest to northeast on the long axis, with the highest point being -1621' at the Pan American Malco "G" No. 8 (J9-18S-27E). About $11\frac{1}{4}$ miles to the northeast the reef crest dips below the -2665' water level. Characteristically for barrier reefs, across the width of the reef there is sharp dip (10^{o}-20^{o}) from the crest toward the fore-reef. This is thought to be because the fore-reef was subject to more violent wave-action from the open sea than was the quieter lagoonal area of the back-reef. Reef configuration may be seen from the Structure maps and cross-sections on pages 13 through 19. Front elevation and back to fore-reef profile views may be found on pages 21 and 22.

Productive limits to the southwest are the result largely of increasing anhydrite content, while on the back-reef north side there is a facies change to an impermeable carbonate "mud" interspersed with green shale. Limits on the south and east result as the reef dips below the water-oil contact.

ARCo geologists have made an in-depth study of main reef cores, including a large number of samples slabbed for detailed examination. A major conclusion reached was to confirm the prevalence of hydrocarbon-stained fractures and linear vugs with the major orientation

being between 0-45 degrees from the vertical plane of the core. A further conclusion was that well-to-well correlation of porosity development was not possible.

Field Performance

Original Gas-Oil Contact and Gas Cap Expansion

There was a small original gas cap located in the structurally high west portion of the field with pore volume only 0.7% of oil column pore volume. The original gas-oil contact datum at -1750' has been supported with well-test data presented on pages 2 and 3 of the Engineering Subcommittee Phase I Study of August 1968.

Initial reservoir pressure at -2264' datum was 2359 psia, while the bubble point of the composite fluid analysis used in all study calculations was 2231 psia. (See graph, page 8). The presence of a small gas cap is not incompatible with a datum pressure above the bubble-point. This is seen when it is realized that with more than 1000' of structural difference within the reservoir, a bubble-point variance of 200 psi or more is possible.

The history of gas cap expansion is best shown by study of individual well graphs illustrating gas-oil ratio variation with time. Performance of some of the wells located immediately under the original gas cap is shown by:

Pan American Windfohr Fed. No. 1 (P-4-18S-27E, graph page 29),
Windfohr Fed. No. 3 (O-4-18S-27E, graph page 31),
Malco Fed. "G" No. 11 (B-9-18S-27E, graph page 32).

Although it is an east offset to the Malco Fed. "G" No. 11, the Malco Fed. "G" No. 3 (A-9-18S-27E, graph page 33), is completed 42' lower subsea, and was not yet showing a severe increase in gas-oil ratio at the end of the history match plot shown. However, by June, 1970, the Malco "G" No. 3 had a gas-oil ratio of 2,330:1.

A significant number of wells have required workovers to lower the perforated interval due to high gas-oil ratio, caused by the expanding gas cap. Some of these are:

Pan American Malco Fed. "E" No. 1 (P-3-18S-27E, graph page 35),
Malco Fed. "E" No. 2 (O-3-18S-27E, graph page 37),
Malco Fed. "H" No. 1 (I-3-18S-27E, graph page 36),
State "AT" No. 1 (L-2-18S-27E, graph page 39),
State "AT" No. 2 (E-2-18S-27E, graph page 38),
ARCo State "AO" No. 1 (J-2-18S-27E, graph page 41).

As shown by the graphs, all these wells enjoy a considerable period of production at or near solution gas-oil ratio, with first a gradual increase as free gas begins to cone into the well, followed by a sharper increase indicative that higher gas saturation has moved into the well's producing area. Recompletion to a lower subsea interval results in return to production at about the former solution gas-oil ratio.

The Pan American Malco "E" No. 1 has been the classic example of gas cap expansion, as documented first in the Engineering Subcommittee Phase I Report (Also see graph, page 35 of this report). After several years' production at gas-oil ratios of around 1100:1 or less, from perforations at -1824' to -1864', the gas-oil ratio increased to some 3000:1 and, in December, 1964, the well was recompleted to a 620' lower subsea interval at -2444' to -2474', resulting in a return to gas-oil ratios of 1000:1 or less. The "E" No. 1 was equipped to test either the old or new completion intervals separately and it was found that datum bottom-hole pressures from the two zones were virtually identical, indicating excellent formation communication. They have continued to test the upper zone, which now carries a gas-oil ratio over 220,000:1, while the lower interval has a June, 1970, gas-oil ratio of 1020:1.

Until recently there has been little field data to provide information on gas cap location in the east portion of the reservoir, particularly township 28 East. However, a number of wells which had previously been low ratio producers have shown sustained increases in gas-oil ratio in recent months. ARCo's Yates B-ARC No. 14 (B-33-17S-28E), completed in the interval -2197' to -2337', after years of production at gas-oil ratios of 1500:1 or less, has in the last year begun an increase which in June, 1970, reached 2660:1. ARCo Eddy State 32 No. 2 (F-32-17S-28E, graph page 43), completed in the interval -2146' to -2194', was originally a low ratio producer (1000:1) and has had several years of erratic increase in GOR and is now averaging a GOR of about 2000:1. These two wells are significant because they have been low-ratio oil producers in the past and the bulk of the wells in their area are completed near the reef base -- structurally too low to reveal anything as to gas cap expansion as yet.

Farther to the east, in Section 25-17S-28E, are three wells which are completed from 57' to 154' beneath the structural crest of the reef, and have shown gas-oil ratio increases in recent months. These wells are the Hondo State "A" No. 20, "A" No. 23, and "A" No. 37. These wells, all located along the reef crest, have had gas-oil ratio increases from about 1100:1 to the range of 1440:1 to 1640:1 while surrounding wells, located off the reef crest, remain at average ratios of 1100:1 or less.

Most revealing of downstructure gas cap formation have been the tests made by Pan American on their State "BU" No. 1 well, located at E-34-17S-28E. On test in January 1969, perforations in the interval -2507' to -2577', near reef base, flowed 120 BOPD with gas-oil ratio 1025:1. The lower perfs were then packed off and a section at the crest of the reef (-2125' to -2195') flowed 11 BOPD with a gas-oil ratio of 201,273:1. Separate bottom-hole pressure tests yielded pressures of 1780 psi for the upper zone and 1835 psi for the lower zone, with the interzone gradient of 0.15 psi/foot revealing a gas-oil transition zone. At the time the upper zone was testing as a gas-well, many wells located miles to the west were producing at or near solution gas-oil ratio from completion intervals as high or higher subsea than the State "BU" No. 1. This appears to be strongly indicative of gas cap "drape" along the major axis of the structure (see cross-section, page 22).

Water Production and Encroachment

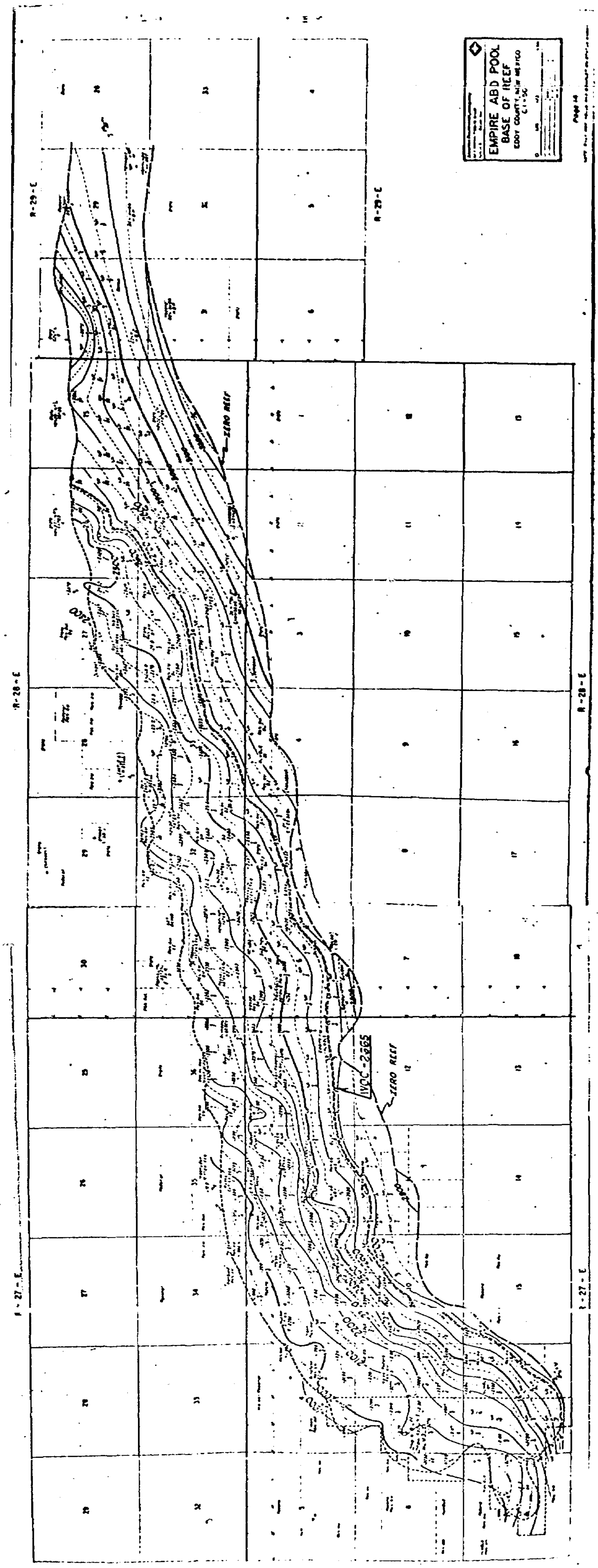
The Engineering Subcommittee Phase I Report established that the level of the field water-oil contact was originally -2665'. This level is supported by drill-stem tests, completion tests and resistivity log calculations along the southeast reef flank from the Hondo-State "A" No. 30 (I-6-18S-28E) to the far east end of the reservoir. Field data appears to support some influx of water into the east end of the reservoir. Supporting evidence is:

1.) Wells in Section 30-17S-29E which formerly made top allowable, little water, now show increasing water cuts and decreasing oil rates. Continental State S-30 No. 1 and S-30 No. 2 are examples.

2.) The three easternmost sections in the reservoir had produced from 25% - 30% of their original oil in place by the time of the July, 1969, reservoir pressure survey, and yet their datum pressures as of that date were very close to the pressures in sections farther west that had produced only 15% of their original oil in place (see pressure survey map, page 20).

In addition, ARCo's reservoir simulator studies showed a calculated water influx averaging 1950 BWPD over the life of the field. Model runs at a lower rate of water influx indicated that movement of fluid from the main reef toward the east end was not sufficient to sustain east-end pressures at levels actually measured on pressure surveys.

EXH. #10
CASE 6741



10
6741
ARCO
11/28/79

EXH. #12
CASE 6741

FIELD MANAGEMENT STUDY

ABO RESERVOIR

EMPIRE ABO POOL

Eddy County, New Mexico

October 2, 1970

RESERVOIR PERFORMANCE - HISTORY AND PREDICTIONS:

Numeric Reservoir Simulator

The model used for all reservoir history and future performance calculations was the Coats-Intercomp-Three-Dimensional, Three-Phase, Unsteady-State, Compressible Flow Model. This model solves numerically the standard partial differential equations describing simultaneous oil, gas, and water flow between reservoir segments in three dimensions. The version actually used included technical updating as of February, 1970. For Empire Abo reservoir, production history, detailed rock property data, previous model runs and trial runs using this model, all indicated that modeling in two dimensions would give excellent results. Therefore, the three-dimensional model was run in a two-dimensional format. This resulted in large reductions in both engineering and computer time required.

Volumetric Oil-In-Place

In the Engineering Committee Phase I Study, porosity values were calculated for each two-foot interval of the total 74,780 feet of gross reef logged or cored. This was based on the relationship between core porosities and open hole neutron log readings, (see example graph, page 58). A straight-line relationship between porosity and the log of permeability was also derived from analysis of 2,600 feet of core data. It was then possible to calculate permeability from porosity, (see example graph, page 59). Permeability values were calculated for each two-foot interval in each of the 250 wells in the reservoir.

This basic porosity and permeability data, digitized and computer sorted, and with log permeabilities modified in line with Field test P. I. values, was used to determine pore-volume and flow properties for each of the 211 cells into which the reservoir was divided for numeric modeling. The 211 cells were grouped into 15 blocks for model runs (see maps, pages 21 and 22). Use of a porosity cut-off of 3.4% and a permeability factor of 0.5 millidarcy (see graphs, pages 59, 60, and 61), resulted in an original oil-in-place of 452 MMBO. This compares to the Engineering Committee volumetric oil-in-place of 467 MMBO. In view of material-balance oil-in-place figures ranging from 360 MMBO to 400 MMBO, prior to any model runs, the total volume was reduced to 400 MMBO by applying the same ratio to each cell. Numeric model runs soon showed that oil-in-place would have to be reduced to the final history-match figure of 383.2 MMBO.

Numeric Model Match of Field Producing History

More than 12 years of Empire Abo production history were available for matching with model calculations. During this time about 16% of the original oil-in-place had been produced. During the history-match period only the oil production rate was input by individual wells. Using cell lengths and cross-sectional areas, pore-volumes and permeabilities, relative fluid flow properties, (see graphs, pages 25 and 26), and volumetric fluid properties (see graph, page 8), the model then calculated pressures and flow volumes between individual cells and gas and water production from each well. After

EXH. #1
CASE 6741

CASE NO. 6741

EXHIBIT NO. 1

Testimony from the transcript of Oil Conservation Division Case No. 6553, heard in Santa Fe, New Mexico, June 13, 1979. The testimony begins on page 8, line 22, and continues to page 9, line 12.

"In order for the Conservation Division to determine that the infill wells would recover additional oil, it was necessary for them to be aware of the following facts:

That this was a gravity drainage reservoir with good vertical communication.

That there was an extensive, expanding gas cap.

That individual producing wells had a tendency to cone in gas, shortening their life and reducing recovery.

That reserves would be increased by producing the oil at low gas/oil ratios.

That the proposed infill wells were being located so as to take advantage of the gravity drainage mechanism."

The above quotation sets out some of the key facts the Division would need to know to make the finding that infill drilling would result in the recovery of added reserves.

Transcript pages 9 through 23, line 10, with Exhibits 3 through 15 show that material supporting these facts has been presented to the Conservation Division and its technical staff.

1

6741
ARCO
11/20/79

that's probably a typographical error there. They show 25,036 barrels of water per day. That should have been 2536 barrels per day.

Exhibit Nine, a secondary gas cap has expanded to extend over most of the reservoir.

This is page 30, lines 20 through 26, and page 31, lines 1 through 17.

Exhibit Ten, Field production history and reservoir numeric models studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism.

Statement read from Unit Plan of Operation by ARCO technical witness. Page 25a, lines 4, 5, and 6.

In summary, all points above were in the sworn record prior to the Oil Conservation Division consideration of the first ARCO infill proposal.

They show that the Division had plenty of evidence to establish that the Empire Abo reservoir was governed by gravity drainage with an overlying expanding gas cap.

Q All right. Please refer to what we've marked as Exhibits 11, 12, 13, and 14, and identify these, please.

A First, having established as shown in Exhibits Five through Ten that the Empire Abo reservoir

recovery mechanism is governed by gravity drainage with an expanding gas cap, the Division technical people would have known what is widely known among experienced reservoir engineers, that there are at least two major ways to increase hydrocarbon recovery from such a reservoir.

They are, first, conservation of gas energy, and that is to retain gas in the reservoir, void a minimum of reservoir space per barrel of oil produced, achieved by shutting in or curtailing inefficient, high GOR, producers, aided by injection.

Second would be minimum -- minimize gas coning into producing wells by dispersing withdrawal points going to closer well spacing, especially mid- and down-structure.

The Conservation Division would have seen that ARCO's proposal to produce oil from the more efficient infill wells, using them to replace production from inefficient high GOR wells, would act toward achieving both one and two above, hence increasing recovery.

But the Division also had much evidence available to support this conclusion. Some of this evidence will be shown in Exhibits Eleven through Fourteen.

The reservoir voidage efficiency factor defined as the ratio of barrels of reservoir space voided to barrels of stock tank oil produced is a good yardstick

EXH. # 3
CASE 674.1

voir if you want to maximize ultimate recovery."

Also, with a voidage limit, operators will "... try to get as low in the reef as they can and produce at as low a gas/oil ratio as they can ...".

There again this is Case 5212 and 13, transcript page 92, lines 9 through 23, and page 93, lines 1 through 7.

Line 9 is the one right after the A and the start of a new paragraph.

MR. NUTTER: And then it's the rest of that paragraph?

A. Yes, sir, the rest of that page.

MR. NUTTER: All right.

A. And the first seven lines on the following page.

MR. NUTTER: We've got that.

A. Okay, here is Exhibit Thirteen. I have only one copy of this exhibit.

This is a copy of a report on ARCO's reservoir study prior to unitization, including results of reservoir numeric model runs. Its purpose will be to show the wealth of engineering data that the Division staff had available prior to the infill well proposals, plus how that data could show the potential for added recovery by infill drilling.

3
6741
ARCO
11/28/79

The Exhibit Thirteen report, Field Management Study, October 2nd, 1970, was presented to various members of the Oil Conservation Division staff by ARCO representatives at a background meeting held May 11th, 1972 in Santa Fe, New Mexico.

Attending this meeting for the Conservation Division were Messrs. A. L. Porter, Richard Stamets, Dan Nutter, Elvis Utz, Jim Kapteina, and George Hatch.

This meeting lasted several hours and ranged over every area of the reservoir mechanics and the status of unitization at that time.

The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap "drape" along structure, details on how the Reservoir Numeric Simulator was built and applied, and how future projections were made, as to recovery.

It was pointed out that ARCO's method of operations would be to shut in high GOR wells and transfer production to low structure, low GOR locations, and that shutting in high GOR wells to conserve gas cap gas was equivalent in reservoir voidage terms to re-injecting residue gas into the gas cap.

Key points in the report were that under ultimate recovery under natural depletion was estimated to be 172.6 million barrels. Ultimate recovery under uniti-

EXH. #4
CASE 6741

would be 200.3 million barrels.

As an item of interest, I think as of June the 1st we had recovered approximately 178 million barrels out of this reservoir.

Coning of gas, at the bottom of page 3 there is a list of wells which have required recompletion lower to reduce high GOR.

At the top of page 4 gas coning is mentioned as a problem that has already shown up in the performance of these wells.

The discussion of the future forecasts went into the probability that coning of gas into producing wells would be a factor in future reservoir performance.

Referring to Exhibit Fourteen, this was distributed at that meeting. It is a background report on the type of coning simulator that was used in conjunction with the field-wide model to forecast future performance. A three-dimensional drawing of a single well coning model was used to show development of a typical gas cone.

The drawing was also used to examine the coning phenomenon and discuss the fact that the chief reason gas coning would be a problem in this reservoir was the fact that vertical permeability was equal to hori-

zontal permeability, and therefore, gas cap gas, much more mobile than the oil, had to move vertically a matter of only 200 feet or less to reach the perforated interval, while the more viscous oil had to move much greater distances horizontally. This was especially true with the 40-acre spacing then in effect.

The point being made with the above coning discussion rehash is that in May, 1972, before submittal of the first infill application, which was September 10th, 1974, the Conservation Division staff had enough background on gas coning flow mechanics in the Empire Abo to be able to reach the same conclusion as ARCO engineers, that closer spacing of the wells in the Abo should result in recovery of additional oil due to reducing gas coning effects.

In addition, dispersal of withdrawal points can mean less pressure drawdown at each point, therefore less tendency to cone gas, and greater recovery.

The Division staff also had prior information on the added recovery to be gained by maximizing low GOR production from sworn testimony and the ARCO Reservoir Simulator results in the October 2nd, 1970 report.

Thus, they could see that the low GOR production to come from the infill wells was going to increase ultimate recovery.

EXH. # 5
CASE 6741

Q Mr. Tweed, refer to what we've marked as Exhibit Fifteen, please, and explain what that shows.

A Exhibit Fifteen, this is a copy of the written portion of the first plan of operation proposed for the Empire Abo Unit, dated April 25th, 1973.

This plan was entered into evidence as Exhibit Six of Case Number 4952 and Case Number 4953, application of Atlantic Richfield Company for a unit agreement and for a pressure maintenance project, heard before Examiner R. L. Stamets on April 25th, 1973.

Entry of the plan of operation into evidence is made on the transcript on page 23, line 10. Discussion continues through page 28, line 19.

The plan of operations contains a great deal of background material that could have been used by the Conservation Division in a determination of added recovery resulting from infill drilling.

Following are several examples:

On page 3, under "1. Project Area, history, and background", in the second paragraph, fourth through seventh lines from the top we see, "Vugs, fractures, and fissures have been observed in cores throughout the main reef with local anhydrite -- in cores throughout the main reef, excuse me, with local anhydrite infilling sometimes restricting flow."

In applying this statement to the infill drilling proposals, the Conservation Division could have reasoned, as ARCO engineers did, that increasing well density might recover some added oil by drilling into zones where anhydrite infilling or other irregularities would have prevented flow to wells on wider spacing.

On page four, first paragraph, lines 4 through 7 down from the top, we see, "Field performance and detailed study of cores indicate excellent vertical permeability. The principal producing mechanism is gravity drainage with an expanding gas cap."

On page four, second paragraph, lines 6 through 9 from the top, we see, "Unitized residue gas injection for pressure maintenance is calculated to increase future recovery by about 30 million barrels compared to continued primary operations."

In comparing this 30 million barrels gain from residue gas injection to the 27.7 million barrels gain over primary by simply maximizing production from low GOR wells, the Conservation Division could have reasoned that control of the GOR was more important to added recovery than gas injection, and addition of the infill wells at low GORs would help control the overall GOR.

On page four we see, "Basic Concepts Governing Future Unit Operations.

EXH. # 6
CASE 6741

Field production history and reservoir numeric model studies have demonstrated that reservoir recovery is governed by a gravity drainage mechanism. With unitization the operator will be able to maximize beneficial effects of this most efficient recovery mechanism by careful observation of well performance and shutting in or curtailing production from inefficient wells."

The Conservation Division could have seen the infill wells as a chance to replace the production from inefficient high GOR wells, thus gaining reserves.

Q Mr. Tweed, go to what we've marked as Exhibit Sixteen and explain that to the Examiner.

A This is a table listing several studies that ARCO has made to determine added reserves resulting from infill drilling.

To summarize ARCO's reservoir studies relating to infill drilling:

a. The study covered in the October 2nd, 1970 report showed added recovery by keeping the producing GOR low.

The 8-74 study was preliminary but was to justify the first two infill wells. The 8-74 study was just a preliminary study to determine if enough additional recovery could be obtained from the new wells to make it economical. It did show that it would be economical to

drill the infill wells and therefore, we proceeded.

The 1975 study took more factors into account and evaluated 20-acre spacing. And you might see at that time, the 1975 study indicated that we would recover some 100,000 barrels per well additional recovery due to the infill drilling program.

The 1977 study was the more complete reservoir model and evaluated both 20-acre and 10-acre development. This study indicated that the average of the 158 wells we proposed to drill would recover -- the average well would recover some 92,000 barrels.

Of course, these studies were necessary to get a better fix on added reserves as more data and more sophisticated simulators became available and to evaluate conomic benefits.

Having done these studies, ARCO then sought and received administrative approval rather than a formal hearing. In doing this we felt that the Conservation Division and its staff, with their solid technical abilities and considerable background in the Empire Abo reservoir mechanics, would see that there are indeed increased reserves to be gained from infill drilling.

In addition, I might point out that all of our studies, especially our 1977 study, which was the most sophisticated numeric simulator that we run, indicated

that the total recovery from all of our infill drilling would be some 14,510,000 barrels.

We had submitted to the Commission on our original hearing a -- okay, it was in NMOCD Order R-4549, Attachment B, was a table of gas volume factors versus reservoir pressure. At that time our estimate was, and still is, that the abandoned pressure of the reservoir would be 100 psia. At that, at that pressure a barrel of oil would have 180 standard cubic feet of gas still in solution. The additional recovery of some 14,560,000 barrels would thus recover some additional 2,611,800 Mcf of gas.

Q. Okay, Mr. Tweed, in your opinion what will be your -- what has been the effect of ARCO's infill drilling program as you've discussed it here today?

A. The effect of ARCO's infill drilling program has been to increase the recovery of hydrocarbon reserves from the reservoir both due to the closer spacing to take advantage of the heterogeneity of the reservoir to reduce the effect of coning, and also to allow more production at lower GOR -- more efficient low GOR wells than high GOR production.

I might add that as of 5-1-79 the 129 infill wells that were on production had recovered some 16,292,000 barrels of oil.

Q. Do you have anything else to add, Mr. Tweed?

A. No, not other than the fact that in my opinion the infill drilling of these wells is necessary to effectively and efficiently recover reserves that would not otherwise have been recovered.

Q. All right, Mr. Tweed, were these exhibits One through Sixteen either prepared or assembled by you or under your supervision?

A. Yes, they were.

MR. COFFIELD: I move the admission of Exhibits One through Sixteen.

MR. NUTTER: ARCO Exhibits One through Sixteen will be admitted.

MR. COFFIELD: I have no further questions on direct examination.

CROSS EXAMINATION

BY MR. NUTTER:

Q. Mr. Tweed, I presume what we're seeking here is actually a sort of a retroactive order, isn't it, that we would find that when we originally approved this infill drilling program that these wells were necessary to effectively and efficiently -- and more efficiently drain those proration units that they're located on.

EXH. # 7
CASE 6741

voir if you want to maximize ultimate recovery."

Also, with a voidage limit, operators will "... try to get as low in the reef as they can and produce at as low a gas/oil ratio as they can ...".

There again this is Case 5212 and 13, transcript page 92, lines 9 through 23, and page 93, lines 1 through 7.

Line 9 is the one right after the A and the start of a new paragraph.

MR. NUTTER: And then it's the rest of that paragraph?

A. Yes, sir, the rest of that page.

MR. NUTTER: All right.

A. And the first seven lines on the following page.

MR. NUTTER: We've got that.

A. Okay, here is Exhibit Thirteen. I have only one copy of this exhibit.

This is a copy of a report on ARCO's reservoir study prior to unitization, including results of reservoir numeric model runs. Its purpose will be to show the wealth of engineering data that the Division staff had available prior to the infill well proposals, plus how that data could show the potential for added recovery by infill drilling.

The Exhibit Thirteen report, Field Management Study, October 2nd, 1970, was presented to various members of the Oil Conservation Division staff by ARCO representatives at a background meeting held May 11th, 1972 in Santa Fe, New Mexico.

Attending this meeting for the Conservation Division were Messrs. A. L. Porter, Richard Stamets, Dan Nutter, Elvis Utz, Jim Kapteina, and George Hatch.

This meeting lasted several hours and ranged over every area of the reservoir mechanics and the status of unitization at that time.

The ARCO review of the report included field history, geology, performance, evidence of secondary gas cap, gas cap "drape" along structure, details on how the Reservoir Numeric Simulator was built and applied, and how future projections were made, as to recovery.

It was pointed out that ARCO's method of operations would be to shut in high GOR wells and transfer production to low structure, low GOR locations, and that shutting in high GOR wells to conserve gas cap gas was equivalent in reservoir voidage terms to re-injecting residue gas into the gas cap.

Key points in the report were that under ultimate recovery under natural depletion was estimated to be 172.6 million barrels. Ultimate recovery under uniti-

EXH. # 8
CASE 6741

FIELD MANAGEMENT STUDY

ABO RESERVOIR

EMPIRE ABO POOL

Eddy County, New Mexico

October 2, 1970

FIELD DEVELOPMENT AND NATURAL DEPLETION HISTORY

Discovery and Development

The Empire Field is located 8 miles southeast of the town of Artesia in Eddy County, New Mexico. Empire Abo reservoir saw its initial completion in November, 1957. The well was Pan American's Malco "A" No. 1, located in NE NW-11-18S-27E. Development rapidly moved west, east, and north from the discovery which proved to be only one location removed from the fore-reef edge of productive limits. Within three years some 215 of the eventual 250 producing wells had been completed. In defining the reservoir, 29 dry holes were also drilled. At present there are 201 flowing and 38 pumping wells for a field total of 239 wells. A graph portraying field performance history is on page 7. Other current and basic data may be found in the Reservoir Data Summary, page 6.

Geology

The Abo producing zone is a Lower Leonard (Permian) carbonate reef, one of several in a trend flanking the northern margin of the Delaware Basin. Abo development is of the barrier reef type. Dolomitization of the original corraline reef material has been complete. Vugs, fractures, and fissures have been observed in examinations of cores from throughout the main reef. Anhydrite infilling has acted to restrict flow in localized areas. Reef development is long and narrow, being about $12\frac{1}{2}$ miles in length from southwest to northeast, and averaging about $1\frac{1}{2}$ miles in width from backreef (north) to forereef (south). The reef dips gradually (about 1^{o}, or 92' per mile) from southwest to northeast on the long axis, with the highest point being -1621' at the Pan American Malco "G" No. 8 (J9-18S-27E). About $11\frac{1}{4}$ miles to the northeast the reef crest dips below the -2665' water level. Characteristically for barrier reefs, across the width of the reef there is sharp dip (10^{o}-20^{o}) from the crest toward the fore-reef. This is thought to be because the fore-reef was subject to more violent wave-action from the open sea than was the quieter lagoonal area of the back-reef. Reef configuration may be seen from the Structure maps and cross-sections on pages 13 through 19. Front elevation and back to fore-reef profile views may be found on pages 21 and 22.

Productive limits to the southwest are the result largely of increasing anhydrite content, while on the back-reef north side there is a facies change to an impermeable carbonate "mud" interspersed with green shale. Limits on the south and east result as the reef dips below the water-oil contact.

ARCo geologists have made an in-depth study of main reef cores, including a large number of samples slabbed for detailed examination. A major conclusion reached was to confirm the prevalence of hydrocarbon-stained fractures and linear vugs with the major orientation

being between 0-45 degrees from the vertical plane of the core. A further conclusion was that well-to-well correlation of porosity development was not possible.

Field Performance

Original Gas-Oil Contact and Gas Cap Expansion

There was a small original gas cap located in the structurally high west portion of the field with pore volume only 0.7% of oil column pore volume. The original gas-oil contact datum at -1750' has been supported with well-test data presented on pages 2 and 3 of the Engineering Subcommittee Phase I Study of August 1968.

Initial reservoir pressure at -2264' datum was 2359 psia, while the bubble point of the composite fluid analysis used in all study calculations was 2231 psia. (See graph, page 8). The presence of a small gas cap is not incompatible with a datum pressure above the bubble-point. This is seen when it is realized that with more than 1000' of structural difference within the reservoir, a bubble-point variance of 200 psi or more is possible.

The history of gas cap expansion is best shown by study of individual well graphs illustrating gas-oil ratio variation with time. Performance of some of the wells located immediately under the original gas cap is shown by:

Pan American Windfohr Fed. No. 1 (P-4-18S-27E, graph page 29),
Windfohr Fed. No. 3 (O-4-18S-27E, graph page 31),
Malco Fed. "G" No. 11 (B-9-18S-27E, graph page 32).

Although it is an east offset to the Malco Fed. "G" No. 11, the Malco Fed. "G" No. 3 (A-9-18S-27E, graph page 33), is completed 42' lower subsea, and was not yet showing a severe increase in gas-oil ratio at the end of the history match plot shown. However, by June, 1970, the Malco "G" No. 3 had a gas-oil ratio of 2,330:1.

A significant number of wells have required workovers to lower the perforated interval due to high gas-oil ratio, caused by the expanding gas cap. Some of these are:

Pan American Malco Fed. "E" No. 1 (P-3-18S-27E, graph page 35),
Malco Fed. "E" No. 2 (O-3-18S-27E, graph page 37),
Malco Fed. "H" No. 1 (I-3-18S-27E, graph page 36),
State "AT" No. 1 (L-2-18S-27E, graph page 39),
State "AT" No. 2 (E-2-18S-27E , graph page 38),
ARCo State "AO" No. 1 (J-2-18S-27E, graph page 41).

As shown by the graphs, all these wells enjoy a considerable period of production at or near solution gas-oil ratio, with first a gradual increase as free gas begins to cone into the well, followed by a sharper increase indicative that higher gas saturation has moved into the well's producing area. Recompletion to a lower subsea interval results in return to production at about the former solution gas-oil ratio.

The Pan American Malco "E" No. 1 has been the classic example of gas cap expansion, as documented first in the Engineering Subcommittee Phase 1 Report (Also see graph, page 35 of this report). After several years' production at gas-oil ratios of around 1100:1 or less, from perforations at -1824' to -1864', the gas-oil ratio increased to some 3000:1 and, in December, 1964, the well was recompleted to a 620' lower subsea interval at -2444' to -2474', resulting in a return to gas-oil ratios of 1000:1 or less. The "E" No. 1 was equipped to test either the old or new completion intervals separately and it was found that datum bottom-hole pressures from the two zones were virtually identical, indicating excellent formation communication. They have continued to test the upper zone, which now carries a gas-oil ratio over 220,000:1, while the lower interval has a June, 1970, gas-oil ratio of 1020:1.

Until recently there has been little field data to provide information on gas cap location in the east portion of the reservoir, particularly township 28 East. However, a number of wells which had previously been low ratio producers have shown sustained increases in gas-oil ratio in recent months. ARCo's Yates B-ARC No. 14 (B-33-17S-28E), completed in the interval -2197' to -2337', after years of production at gas-oil ratios of 1500:1 or less, has in the last year begun an increase which in June, 1970, reached 2660:1. ARCo Eddy State 32 No. 2 (F-32-17S-28E, graph page 43), completed in the interval -2146' to -2194', was originally a low ratio producer (1000:1) and has had several years of erratic increase in GOR and is now averaging a GOR of about 2000:1. These two wells are significant because they have been low-ratio oil producers in the past and the bulk of the wells in their area are completed near the reef base -- structurally too low to reveal anything as to gas cap expansion as yet.

Farther to the east, in Section 25-17S-28E, are three wells which are completed from 57' to 154' beneath the structural crest of the reef, and have shown gas-oil ratio increases in recent months. These wells are the Hondo State "A" No. 20, "A" No. 23, and "A" No. 37. These wells, all located along the reef crest, have had gas-oil ratio increases from about 1100:1 to the range of 1440:1 to 1640:1 while surrounding wells, located off the reef crest, remain at average ratios of 1100:1 or less.

Most revealing of downstructure gas cap formation have been the tests made by Pan American on their State "BU" No. 1 well, located at E-34-17S-28E. On test in January 1969, perforations in the interval -2507' to -2577', near reef base, flowed 120 BOPD with gas-oil ratio 1025:1. The lower perfs were then packed off and a section at the crest of the reef (-2125' to -2195') flowed 11 BOPD with a gas-oil ratio of 201,273:1. Separate bottom-hole pressure tests yielded pressures of 1780 psi for the upper zone and 1835 psi for the lower zone, with the interzone gradient of 0.15 psi/foot revealing a gas-oil transition zone. At the time the upper zone was testing as a gas-well, many wells located miles to the west were producing at or near solution gas-oil ratio from completion intervals as high or higher subsea than the State "BU" No. 1. This appears to be strongly indicative of gas cap "drape" along the major axis of the structure (see cross-section, page 22).

Water Production and Encroachment

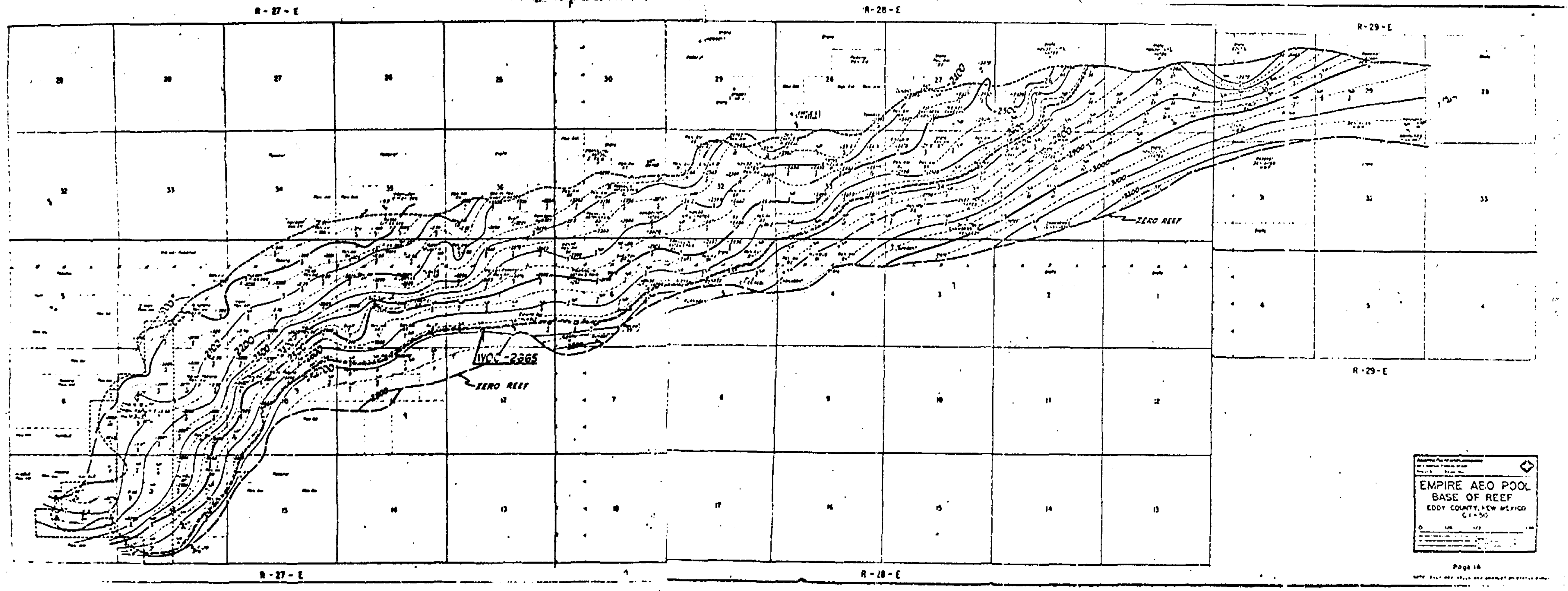
The Engineering Subcommittee Phase I Report established that the level of the field water-oil contact was originally -2665'. This level is supported by drill-stem tests, completion tests and resistivity log calculations along the southeast reef flank from the Hondo-State "A" No. 30 (I-6-18S-28E) to the far east end of the reservoir. Field data appears to support some influx of water into the east end of the reservoir. Supporting evidence is:

1.) Wells in Section 30-17S-29E which formerly made top allowable, little water, now show increasing water cuts and decreasing oil rates. Continental State S-30 No. 1 and S-30 No. 2 are examples.

2.) The three easternmost sections in the reservoir had produced from 25% - 30% of their original oil in place by the time of the July, 1969, reservoir pressure survey, and yet their datum pressures as of that date were very close to the pressures in sections farther west that had produced only 15% of their original oil in place (see pressure survey map, page 20).

In addition, ARCo's reservoir simulator studies showed a calculated water influx averaging 1950 BWPD over the life of the field. Model runs at a lower rate of water influx indicated that movement of fluid from the main reef toward the east end was not sufficient to sustain east-end pressures at levels actually measured on pressure surveys.

BEFORE EXAMINER STAMETS
OIL CONSERVATION DIVISION
EXHIBIT NO. 10
CASE NO. 6741
ARCO
11/28/79



EXH. # 10
CASE 6741

EXH. #12
CASE 6741

FIELD MANAGEMENT STUDY

ABO RESERVOIR

EMPIRE ABO POOL

Eddy County, New Mexico

October 2, 1970

RESERVOIR PERFORMANCE - HISTORY AND PREDICTIONS:

Numeric Reservoir Simulator

The model used for all reservoir history and future performance calculations was the Coats-Intercomp-Three-Dimensional, Three-Phase, Unsteady-State, Compressible Flow Model. This model solves numerically the standard partial differential equations describing simultaneous oil, gas, and water flow between reservoir segments in three dimensions. The version actually used included technical updating as of February, 1970. For Empire Abo reservoir, production history, detailed rock property data, previous model runs and trial runs using this model, all indicated that modeling in two dimensions would give excellent results. Therefore, the three-dimensional model was run in a two-dimensional format. This resulted in large reductions in both engineering and computer time required.

Volumetric Oil-In-Place

In the Engineering Committee Phase I Study, porosity values were calculated for each two-foot interval of the total 74,780 feet of gross reef logged or cored. This was based on the relationship between core porosities and open hole neutron log readings, (see example graph, page 58). A straight-line relationship between porosity and the log of permeability was also derived from analysis of 2,600 feet of core data. It was then possible to calculate permeability from porosity, (see example graph, page 59). Permeability values were calculated for each two-foot interval in each of the 250 wells in the reservoir.

This basic porosity and permeability data, digitized and computer sorted, and with log permeabilities modified in line with Field test P. I. values, was used to determine pore-volume and flow properties for each of the 211 cells into which the reservoir was divided for numeric modeling. The 211 cells were grouped into 15 blocks for model runs (see maps, pages 21 and 22). Use of a porosity cut-off of 3.4% and a permeability factor of 0.5 millidarcy (see graphs, pages 59, 60, and 61), resulted in an original oil-in-place of 452 MMBO. This compares to the Engineering Committee volumetric oil-in-place of 467 MMBO. In view of material-balance oil-in-place figures ranging from 360 MMBO to 400 MMBO, prior to any model runs, the total volume was reduced to 400 MMBO by applying the same ratio to each cell. Numeric model runs soon showed that oil-in-place would have to be reduced to the final history-match figure of 383.2 MMBO.

Numeric Model Match of Field Producing History

More than 12 years of Empire Abo production history were available for matching with model calculations. During this time about 16% of the original oil-in-place had been produced. During the history-match period only the oil production rate was input by individual wells. Using cell lengths and cross-sectional areas, pore-volumes and permeabilities, relative fluid flow properties, (see graphs, pages 25 and 26), and volumetric fluid properties (see graph, page 8), the model then calculated pressures and flow volumes between individual cells and gas and water production from each well. After

LAW OFFICES

HINKLE, COX, EATON, COFFIELD & HENSLEY

1000 FIRST NATIONAL BANK TOWER

POST OFFICE BOX 3580

MIDLAND, TEXAS 79702

(915) 683-4691

LEWIS C. COX, JR.
PAUL W. EATON, JR.
CONRAD E. COFFIELD
HAROLD L. HENSLEY, JR.
STUART D. SHANOR
C. D. MARTIN
PAUL J. KELLY, JR.
JAMES H. BOZARTH

DOUGLAS L. LUNSFORD
PAUL M. BOHANNON
J. DOUGLAS FOSTER
K. DOUGLAS PERRIN
C. RAY ALLEN
JACQUELINE W ALLEN
T. CALDER EZZELL, JR.
WILLIAM B. BURFORD
JOHN S. NELSON
RICHARD E. OLSON

OF COUNSEL
CLARENCE E. HINKLE

W. E. BONDURANT, JR. (1914-1973)

ROSWELL, NEW MEXICO OFFICE
600 HINKLE BUILDING
(505) 622-6510

ONLY ATTYS. COFFIELD, MARTIN, BOZARTH, BOHANNON, FOSTER, ALLEN, ALLEN & BURFORD LICENSED IN TEXAS

November 20, 1979

RECEIVED
NOV 23 1979
OIL CONSERVATION DIVISION
SANTA FE

Case 6741

Mrs. Florene Davidson
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Re: Arco Oil and Gas Company
Application for Amendment
of Order R-6054

Dear Mrs. Davidson:

Please be advised that in reviewing our file copy of the above referenced Application for Arco Oil and Gas Company, which was transmitted to Dan Nutter on November 16, I note that we have incorrectly stated the Order Number for the Order which we wish to have amended. The Order Number should be R-6054. Therefore, it would be appreciated if you would correct the Application to reflect the correct number.

Thank you.

Very truly yours,

HINKLE, COX, EATON,
COFFIELD & HENSLEY

Conrad E. Coffield

CEC:rh

xc: Mr. Ryan Stramp
Atlantic Richfield Company
Post Office Box 1610
Midland, Texas 79702

CASE 6736: Application of Doyle Hartman for compulsory pooling and a non-standard gas proration unit, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Jalmat Gas Pool to form a 360-acre non-standard gas proration unit comprising the S/2 SE/4 of Section 36, Township 24 South, Range 36 East; SW/4 of Section 31, Township 24 South, Range 37 East; and the N/2 NW/4 and NW/4 NE/4 of Section 6, Township 25 South, Range 37 East, to be dedicated to a well to be drilled 660 feet from the South line and 990 feet from the West line of said Section 31. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6707: (Continued from November 14, 1979, Examiner Hearing)

Application of Gulf Oil Corporation for a unit agreement, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the Southeast Bisti Unit Area, comprising 7,048 acres, more or less, of State and Federal lands in Townships 24 and 25 North, Range 10 West.

CASE 6737: Application of Gulf Oil Corporation for compulsory pooling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Pennsylvanian formation underlying the W/2 of Section 4, Township 19 South, Range 32 East, North Lusk-Morrow Gas Pool, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 6739: Application of Mobil Oil Corporation for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the downhole commingling of Gavilan-Pictured Cliffs and Blanco Mesaverde production in the wellbore of its Jicarilla D Well No. 1 located in Unit N of Section 24, Township 26 North, Range 3 West. Applicant further seeks the establishment of an administrative procedure for approval of downhole commingling of the aforesaid pools in others of its wells in Sections 7, 8, 17, 18, and 19, Township 26 North, Range 2 West, Sections 1, 2, 11 thru 14, 23, and 24, Township 26 North, Range 3 West, and Sections 11 thru 15, 22 thru 27, 35, and 36, Township 27 North, Range 3 West.

CASE 6740: Application of Hondo Oil and Gas Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of a Pennsylvanian test well to be drilled 1550 feet from the North line and 660 feet from the West line of Section 10, Township 18 South, Range 28 East, the N/2 of said Section 10 to be dedicated to the well.

CASE 6741: Application of ARCO Oil and Gas Company for an amendment to Order No. R-6054, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the amendment of Order No. R-6054 to amend the findings in said order to make said findings more specific as to the necessity for the drilling of infill wells in the Empire Abo Unit in order to recover additional gas pursuant to the Natural Gas Policy Act of 1978; further to amend said order to make such findings applicable to present and future drilling operations including the drilling of horizontal drainholes.

CASE 6720: (Continued from November 14, 1979, Examiner Hearing)

Application of ARCO Oil and Gas Company to drill a horizontal drainhole, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval to drill and complete its Empire Abo Unit Well No. J-213, located in Unit F of Section 6, Township 18 South, Range 28 East, Empire-Abo Pool, with a single horizontal drainhole of about 200 feet in length in the Abo formation.

CASE 6742: Application of ARCO Oil and Gas Company for an administrative procedure, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the establishment of an administrative procedure for approval of the drilling of horizontal drainholes in the Empire Abo Unit, Empire-Abo Pool.

CASE 6743: (This case will be dismissed.)

Application of Exxon Corporation for an exception to Order No. R-3221, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an exception to Order No. R-3221 to permit disposal of produced brine in several unlined surface pits located on its Laguna Grande Unit Area in Sections 16, 21, 28, 29, 32, and 33, Township 23 South, Range 29 East.

CASE 6744: Application of Texas Oil & Gas Corporation for special pool rules, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks the promulgation of special pool rules for the Riverside-Morrow Gas Pool to provide for 320-acre spacing rather than 160 acres. In the absence of objection, this pool will be placed on the standard 320-acre spacing for Pennsylvanian gas pools rather than the present 160-acre spacing.

LAW OFFICES

HINKLE, COX, EATON, COFFIELD & HENSLEY

1000 FIRST NATIONAL BANK TOWER

POST OFFICE BOX 3580

MIDLAND, TEXAS 79702

(915) 683-4691

LEWIS C. COX, JR.
PAUL W. EATON, JR.
CONRAD E. COFFIELD
HAROLD L. HENSLEY, JR.
STUART D. SHANOR
C. D. MARTIN
PAUL J. KELLY, JR.
JAMES H. BOZARTH

DOUGLAS L. LUNSFORD
PAUL M. BOHANNON
J. DOUGLAS FOSTER
X. DOUGLAS PERRIN
C. RAY ALLEN
JACQUELINE W. ALLEN
T. CALDER EZZELL, JR.
WILLIAM B. BURFORD
JOHN S. NELSON
RICHARD E. OLSON

OF COUNSEL
CLARENCE E. HINKLE

W. E. BONDURANT, JR. (1914-1973)

ROSWELL, NEW MEXICO OFFICE
600 HINKLE BUILDING
(505) 622-6510

ONLY ATTYS. COFFIELD, MARTIN, BOZARTH, BOHANNON, FOSTER, ALLEN, ALLEN & BURFORD LICENSED IN TEXAS

November 16, 1979

Mr. Dan Nutter
Chief Engineer
Oil Conservation Division
Post Office Box 2088
Santa Fe, New Mexico 87501

Dear Dan:

Transmitted herewith you will find triplicate executed copies of an Application for ARCO Oil and Gas Company for an Amendment to Division Order R-6054 to include findings that (1) the recovery of additional gas reserves will be realized from infill wells in the Empire Abo Unit and (2) Geological facts were considered in the previous determination that infill wells in the Empire Abo Unit are necessary to effectively and efficiently drain their respective proration units.

It is my understanding that the docket setting for November 28, 1979 is still available for this matter, and accordingly, we request that it be heard on that date.

I trust that the enclosed copies of the Application are all that is needed in order for this to be set for the November 28, 1979 hearing. However, if anything is needed in addition, please let me know.

Very truly yours,

HINKLE, COX, EATON,
COFFIELD & HENSLEY

Conrad E. Coffield

CEC:rh
Enclosures

xc/enc: Mr. Jerry L. Tweed
xc/enc: Mr. Ryan Stramp
xc/enc: Mr. Horace Burton

BEFORE THE OIL CONSERVATION DIVISION OF

THE DEPARTMENT OF ENERGY AND MINERALS

STATE OF NEW MEXICO

APPLICATION OF ARCO OIL AND GAS COMPANY, DIVISION OF ATLANTIC RICHFIELD COMPANY, UNIT OPERATOR OF THE EMPIRE ABO UNIT, TO AMEND DIVISION ORDER R-6054 TO INCLUDE FINDINGS THAT: (1) THE RECOVERY OF ADDITIONAL GAS RESERVES WILL BE REALIZED FROM INFILL WELLS IN THE EMPIRE ABO UNIT, AND (2) GEOLOGICAL FACTS WERE CONSIDERED IN THE PREVIOUS DETERMINATION THAT INFILL WELLS IN THE EMPIRE ABO UNIT ARE NECESSARY TO EFFECTIVELY AND EFFICIENTLY DRAIN THEIR RESPECTIVE PRORATION UNITS.	)

Case 6741

APPLICATION

Comes ARCO Oil and Gas Company, Division of Atlantic Richfield Company, Unit Operator of the Empire Abo Unit, Eddy County, New Mexico, acting through the undersigned attorneys, and hereby makes application to amend Division Order R-~~6045~~ 6054 to include findings that additional gas reserves will be recovered from the drilling of infill wells in the Empire Abo Unit and also that geological facts were considered in the previous determination that said infill wells are necessary to effectively and efficiently drain their respective proration units, Empire Abo Pressure Maintenance Project as approved by Orders R-4549B, R-4549C and R-4549D, and in support thereof respectfully shows:

1. The Oil Conservation Division, Department of Energy and Minerals, of the State of New Mexico, granted approval of the Empire Abo Unit Agreement by Order R-4548, dated July 15, 1973 and granted approval of the ARCO - Empire Abo Unit Pressure Maintenance Project by Order R-4549 also dated June 15, 1973, as subsequently amended by Order R-4549A, dated January 15, 1974, Order R-4549B, dated April 30, 1974, Order R-4549C, dated July 1, 1975 and Order R-4549D, dated November 17, 1975.

2. The Oil Conservation Division, Department of Energy and Minerals, issued Order R-6054 on July 10, 1979, stating that all unorthodox infill well locations which had been approved by the Division pursuant to Orders R-4549B or R-5906 were found to be necessary to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units.

3. The applicant proposes to offer further testimony that both additional oil reserves and additional gas reserves will be recovered from previously drilled infill wells in the Empire Abo Unit.

4. The applicant also proposes to offer testimony as to the geological information used in the engineering studies of infill drilling in the Empire Abo Unit.

5. In the opinion of the applicant, the drilling of the previously mentioned infill wells was in the interest of conservation, prevention of waste, the protection of correlative rights and will tend to promote the greatest recovery of oil and gas from the unitized area.

6. The applicant requests that this matter be set for hearing at the Examiner's hearing to be held November 28, 1979.

HINKLE, COX, EATON,
COFFIELD & HENSLEY

By: _____
Conrad E. Coffield
Post Office Box 3580
Midland, Texas 79702
Attorneys for ARCO Oil and Gas Company

BEFORE THE OIL CONSERVATION DIVISION OF

THE DEPARTMENT OF ENERGY AND MINERALS

STATE OF NEW MEXICO

APPLICATION OF ARCO OIL AND GAS COMPANY, DIVISION OF ATLANTIC RICHFIELD COMPANY, UNIT OPERATOR OF THE EMPIRE ABO UNIT, TO AMEND DIVISION ORDER R-6054 TO INCLUDE FINDINGS THAT: (1) THE RECOVERY OF ADDITIONAL GAS RESERVES WILL BE REALIZED FROM INFILL WELLS IN THE EMPIRE ABO UNIT, AND (2) GEOLOGICAL FACTS WERE CONSIDERED IN THE PREVIOUS DETERMINATION THAT INFILL WELLS IN THE EMPIRE ABO UNIT ARE NECESSARY TO EFFECTIVELY AND EFFICIENTLY DRAIN THEIR RESPECTIVE PRORATION UNITS.	)

Case 6741

APPLICATION

Comes ARCO Oil and Gas Company, Division of Atlantic Richfield Company, Unit Operator of the Empire Abo Unit, Eddy County, New Mexico, acting through the undersigned attorneys, and hereby makes application to amend Division Order R-~~6045~~ 6054 to include findings that additional gas reserves will be recovered from the drilling of infill wells in the Empire Abo Unit and also that geological facts were considered in the previous determination that said infill wells are necessary to effectively and efficiently drain their respective proration units, Empire Abo Pressure Maintenance Project as approved by Orders R-4549B, R-4549C and R-4549D, and in support thereof respectfully shows:

1. The Oil Conservation Division, Department of Energy and Minerals, of the State of New Mexico, granted approval of the Empire Abo Unit Agreement by Order R-4548, dated July 15, 1973 and granted approval of the ARCO - Empire Abo Unit Pressure Maintenance Project by Order R-4549 also dated June 15, 1973, as subsequently amended by Order R-4549A, dated January 15, 1974, Order R-4549B, dated April 30, 1974, Order R-4549C, dated July 1, 1975 and Order R-4549D, dated November 17, 1975.

2. The Oil Conservation Division, Department of Energy and Minerals, issued Order R-6054 on July 10, 1979, stating that all unorthodox infill well locations which had been approved by the Division pursuant to Orders R-4549B or R-5906 were found to be necessary to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units.

3. The applicant proposes to offer further testimony that both additional oil reserves and additional gas reserves will be recovered from previously drilled infill wells in the Empire Abo Unit.

4. The applicant also proposes to offer testimony as to the geological information used in the engineering studies of infill drilling in the Empire Abo Unit.

5. In the opinion of the applicant, the drilling of the previously mentioned infill wells was in the interest of conservation, prevention of waste, the protection of correlative rights and will tend to promote the greatest recovery of oil and gas from the unitized area.

6. The applicant requests that this matter be set for hearing at the Examiner's hearing to be held November 28, 1979.

HINKLE, COX, EATON,
COFFIELD & HENSLEY

By: _____

Conrad E. Coffield
Post Office Box 3580
Midland, Texas 79702
Attorneys for ARCO Oil and Gas Company

BEFORE THE OIL CONSERVATION DIVISION OF

THE DEPARTMENT OF ENERGY AND MINERALS

STATE OF NEW MEXICO

APPLICATION OF ARCO OIL AND GAS COMPANY, DIVISION OF ATLANTIC RICHFIELD COMPANY, UNIT OPERATOR OF THE EMPIRE ABO UNIT, TO AMEND DIVISION ORDER R-6054 TO INCLUDE FINDINGS THAT: (1) THE RECOVERY OF ADDITIONAL GAS RESERVES WILL BE REALIZED FROM INFILL WELLS IN THE EMPIRE ABO UNIT, AND (2) GEOLOGICAL FACTS WERE CONSIDERED IN THE PREVIOUS DETERMINATION THAT INFILL WELLS IN THE EMPIRE ABO UNIT ARE NECESSARY TO EFFECTIVELY AND EFFICIENTLY DRAIN THEIR RESPECTIVE PRORATION UNITS.	)

Case 6741

APPLICATION

Comes ARCO Oil and Gas Company, Division of Atlantic Richfield Company, Unit Operator of the Empire Abo Unit, Eddy County, New Mexico, acting through the undersigned attorneys, and hereby makes application to amend Division Order R-~~6045~~ 6054 to include findings that additional gas reserves will be recovered from the drilling of infill wells in the Empire Abo Unit and also that geological facts were considered in the previous determination that said infill wells are necessary to effectively and efficiently drain their respective proration units, Empire Abo Pressure Maintenance Project as approved by Orders R-4549B, R-4549C and R-4549D, and in support thereof respectfully shows:

1. The Oil Conservation Division, Department of Energy and Minerals, of the State of New Mexico, granted approval of the Empire Abo Unit Agreement by Order R-4548, dated July 15, 1973 and granted approval of the ARCO - Empire Abo Unit Pressure Maintenance Project by Order R-4549 also dated June 15, 1973, as subsequently amended by Order R-4549A, dated January 15, 1974, Order R-4549B, dated April 30, 1974, Order R-4549C, dated July 1, 1975 and Order R-4549D, dated November 17, 1975.

2. The Oil Conservation Division, Department of Energy and Minerals, issued Order R-6054 on July 10, 1979, stating that all unorthodox infill well locations which had been approved by the Division pursuant to Orders R-4549B or R-5906 were found to be necessary to effectively and efficiently drain the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units.

3. The applicant proposes to offer further testimony that both additional oil reserves and additional gas reserves will be recovered from previously drilled infill wells in the Empire Abo Unit.

4. The applicant also proposes to offer testimony as to the geological information used in the engineering studies of infill drilling in the Empire Abo Unit.

5. In the opinion of the applicant, the drilling of the previously mentioned infill wells was in the interest of conservation, prevention of waste, the protection of correlative rights and will tend to promote the greatest recovery of oil and gas from the unitized area.

6. The applicant requests that this matter be set for hearing at the Examiner's hearing to be held November 28, 1979.

HINKLE, COX, EATON,
COFFIELD & HENSLEY

By: _____

Conrad E. Coffield
Post Office Box 3580
Midland, Texas 79702
Attorneys for ARCO Oil and Gas Company

Application for Hearings

called in by Stamp of ARCO

(1) Amend R-6054 to include future additional infill drilling including drainholes and amend findings in said order.

(2) Establish an administrative procedure for approval to drill drainholes

Also request continuance of Case No. 6720 to Nov 28, 1979

ROUGH

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION

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

CASE NO. 6741

Order No. R-6258

Application of ARCO Oil and Gas Company for an amendment to Order No. R-6054, Eddy County, New Mexico.

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 9 a.m. on Nov. 28, 19 79, at Santa Fe, New Mexico, before Examiner R. L. S.

NOW, on this _____ day of _____, 19____, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner, and being fully advised in the premises,

FINDS:

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

(2) That the applicant ARCO Oil and Gas Company, seeks the amendment of Order No. R-6054 to amend the findings in said order to make said findings more specific as to the necessity for the drilling of infill wells in the Empire Abo Unit in order to recover additional gas pursuant to the Natural Gas Policy Act of 1978.

(3) That the applicant further seeks to amend said order to make such findings applicable to present and future drilling operations including the drilling of horizontal drainholes.

(4) That Finding No (13) of Order No R-6054 should be amended to reflect that the necessity for the drilling of infill wells in Applicants Empire Abo Unit is based upon engineering and geological evidence.

(5) That Order No (2) of Order No R-6054 should be amended to reflect that said infill wells are necessary to effectively and efficiently drain both oil and gas reserves which would not otherwise be recovered by the existing well on the appropriate proration unit.

(6) That said Finding No (13) and said Order No 2 should each be amended to ~~reflect~~ cover ~~infill wells which are horizontal~~ infill wells drilled under the provisions of Orders Nos R-4549-D and R-6203 (horizontal drain holes).

(7) That these findings amendments are consistant with the evidence presented in Division Cases No. ~~5177, 6409,~~ (corr) 5177, 6409, 6553, 6720, and 6742.

IT IS THEREFORE ORDERED

(1) That Finding No(13) of Division Order No R-6054 entered July 10, 1979, is hereby amended to read in its entirety as follows:

"(13) ~~Finding~~ That the Division has recognized, based on engineering and geological evidence, the necessity for the drilling of such additional wells in order to more effectively and efficiently drain the portion of the proration units upon which said wells are located which could not be so drained by the existing well(s) thereon, and, by its orders nos. R-4549-B, ~~and~~ R-5906, has approved their being drilled as infill wells. ~~in exception to the applicable well spacing requirements for the Empire Abo Pool.~~"

R-4549-D and R-6203

needed now?

(2) That Order No (2) of said Order No R-6054 is hereby amended to read in its entirety as follows:

"(2)

That such unorthodox producing well locations as have been approved persuant to said order no. R-4549-B, ~~order~~ R-5906, as infill producing wells were, and are hereby found, to be necessary to effectively and efficiently drain both oil and gas reserves in the portion of the reservoir covered by their respective existing proration units which could not be so drained by the existing wells on the units, ~~and that the existing well spacing requirements were waived to permit their approval.~~"

or R-4549-D, or R-6203

needed now?

(3) Jurisdiction.