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DRILLING AND COMPLETION PROGRAM
WATER WELL NO. 1
NORTHEAST HOGBACK UNIT

Location: SW/4 NE/4 Section 10, T-30-N, R-16-W

Formation: Morrison

Total Depth: 2900 feet

Type Tools: Rotary

Logs: ES-Induction log from surface casing seat to total depth

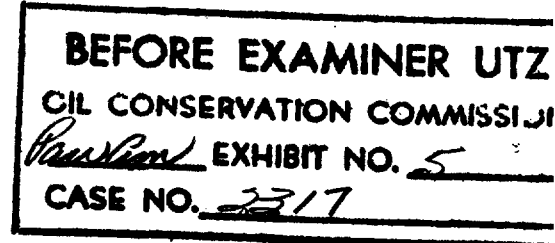
Mud Program: Native mud and water

Casing Program: Surface - 200' of 16" casing
Oil String - 2900' of 10-3/4" casing

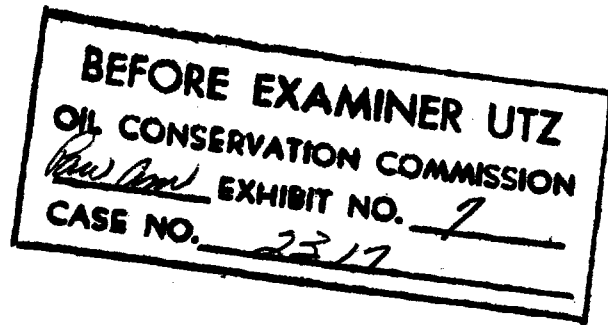
Cementing Program: Surface String - Neat cement will be circulated.
Oil String - Will be cemented by the two-stage method. First stage will be cemented with enough cement to bring top of cement to the top of the Dakota. Stage tool will be set at the top of the Greenhorn and enough cement will be placed to bring top of cement about 500 feet above the top of the Gallup formation.

Completion Program: Casing will be set at total depth and porous zones in the Morrison will be selectively perforated. A natural completion will be attempted, however, a sand-water fracture treatment will be used if necessary to obtain sufficient productivity.

Approximately 500 feet of Morrison sand is expected to be penetrated.



CASING AND CEMENTING PROGRAM
WATER INJECTION WELLS
PRESSURE MAINTENANCE PROJECT
NORTHEAST HOGBACK UNIT



PAN AMERICAN PETROLEUM CORPORATION

Northeast Hogback Unit No. 4

PB to 3206 with 275 sx. cmt. with 10% sn.
8-5/8" CSA 207 with 160 sx. of 2% CaCl₂ cmt.
5-1/2" CSA 3701 with 80 sx. 4% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 6

8-5/8" CSA 110 with 80 sx. of 2% CaCl₂ cmt.
5-1/2" CSA 1748 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 10

8-5/8" CSA 98 with 80 sx. of 2% CaCl₂ cmt.
5-1/2" CSA 2546 with 80 sx. of 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 11

8-5/8" CSA 210 with 160 sx. of 2% CaCl₂ cmt.
5-1/2" CSA 3133 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 13

8-5/8" CSA 217 with 160 sx. of 2% CaCl₂ cmt.
5-1/2" CSA 3813 with 80 sx. of 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 14

8-5/8" CSA 215 with 160 sx. 2% CaCl₂ Cmt.
5-1/2" CSA 3847 with 90 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 16

8-5/8" CSA 212 with 160 sx. 2% CaCl₂ cmt.
5-1/2" CSA 4004 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 17

8-5/8" CSA 211 with 160 sx. 2% CaCl₂ cmt.
5-1/2" CSA 3928 with 80 sx. 6% gel cmt plus 50 sx. neat.

Northeast Hogback Unit No. 20

8-5/8" CSA 215 with 160 sx. 2% CaCl₂ cmt.
5-1/2" CSA 4054 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 21

8-5/8" CSA 95 with 100 sx. of 1% CaCl₂ cmt.
5-1/2" CSA 1535 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 22

8-5/8" CSA 94 with 80 sx. 2% CaCl₂ cmt.
5-1/2" CSA 1867 with 80 sx. 6% gel cmt plus 50 sx. neat.

Northeast Hogback Unit No. 23

8-5/8" CSA 217 with 160 sx. neat.
5-1/2" CSA 1685 with 100 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 25

8-5/8" CSA 215 with 160 sx. neat.
4-1/2" CSA 1728 with 120 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 29

8-5/8" CSA 214 with 160 sx. neat.
4-1/2" CSA 1980 with 120 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 30

8-5/8" CSA 95 with 80 sx. 2% CaCl₂ cmt.
5-1/2" CSA 1602 with 80 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 32

8-5/8" CSA 211 with 135 sx. neat cmt.
4-1/2" CSA 1978 with 120 sx. 6% gel cmt. plus 50 sx. neat.

Northeast Hogback Unit No. 37

8-5/8" CSA 212 with 160 sx. 2% CaCl₂ cmt.
5-1/2" CSA 1882 with 80 sx. 6% gel cmt. plus 50 sx. neat.

EL PASO NATURAL GAS PRODUCTS COMPANY

Williams No. 2

8-5/8" CSA 120 with 125 sx.
5-1/2" CSA 2645 with 100 sx.

Williams No. 3

9-5/8" CSA 183 with 100 sx.
5-1/2" CSA 2166 with 100 sx.

ABRAHAM

Federal No. 3

10-3/4" CSA 115 with 75 sx.

5-1/2" CSA 2942 with 225 sx.

PERTINENT DATA SHEET
RESERVOIR ROCK AND RESERVOIR FLUID PROPERTIES

Original Reservoir Pressure, psig	215
Estimated Reservoir Pressure at Initial Injection, psig	40
Reservoir Temperature, °F	70-110
Saturation Pressure, psig	215
Solution Gas-Oil Ratio, ft ³ /Bbl.	147
Formation Volume Factor	1.07
Crude Viscosity, cp (87°F & 215 psig)	1.63
Water Viscosity, cp (87°F)	0.88
Crude Gravity, °API	41-42
Producing Mechanism	Solution Gas Drive
Average Porosity (Lower Zone), %	9.5
Average Porosity (Upper Zone), %	7.25
Permeability (Lower Zone), Md	0.25-105
Permeability (Upper Zone), Md	0.25-5.0
Average Water Saturation (Lower Zone), %	32.5
Average Water Saturation (Upper Zone), %	32.5
Average Pay Thickness (Lower), ft.	25
Average Pay Thickness (Upper), ft.	5

PRESSURE MAINTENANCE PERFORMANCE

Ultimate Primary Recovery, Bbls.	1,862,000
Ultimate Primary Recovery, %	11.4
Ultimate Recovery (Primary & Secondary), Bbls.	4,235,300
Ultimate Recovery (Primary & Secondary), %	25.8
Peak Production Rate, Bbls. per month	60,000
Water Injectivity, BWP/Well (Upper Zone)	100
Water Injectivity, BWP/Well (Lower Zone)	500
Water Injection Pressure, psig	700
Time for "Buzz" to Occur, Months After Initial Injection	4
Time for Fill-Up, Months After Initial Injection	11
Life of Project, Years	10
Water Cut at Abandonment, %	95

WATER SUPPLY

Formation	Morrison
Depth, ft.	2900'
Estimated Production Rate, BWP/Well	8,000-9,000
Sulfate Content, ppm	2,000-5,000
Static Fluid Level, ft.	400
Working Fluid Level, ft.	1,000

One filter will be used to remove mill scale when the project is started.

CASE NO. 2317

ESTIMATED PRIMARY AND SECONDARY PERFORMANCE

NORTHEAST HOGBACK UNIT

PRESSURE MAINTENANCE PROJECT

HORSESHOE CALLUP OIL POOL

SAN JUAN COUNTY, NEW MEXICO

Primary = 1,862,000 Bbls. (11.4%)

Primary & Secondary = 4,235,300 Bbls. (25.8%)

Start Project

"Buzz" 1-1-62

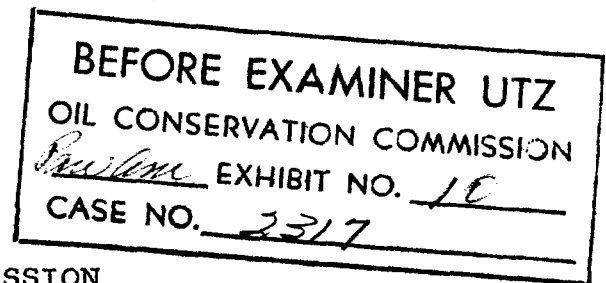
Abandon Flood Water Cut = 95%

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

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

CASE No. 1979
Order No. R-1699

APPLICATION OF THE ATLANTIC REFINING
COMPANY FOR A PRESSURE MAINTENANCE
PROJECT IN THE HORSESHOE-GALLUP OIL
POOL, SAN JUAN COUNTY, NEW MEXICO,
AND FOR THE PROMULGATION OF SPECIAL
RULES GOVERNING THE OPERATION OF
SAID PROJECT.



ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on June 1, 1960, at Santa Fe, New Mexico, before Elvis A. Utz, Examiner duly appointed by the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission," in accordance with Rule 1214 of the Commission Rules and Regulations.

NOW, on this 10th day of June, 1960, the Commission, a quorum being present, having considered the application, the evidence adduced, and the recommendations of the Examiner, Elvis A. Utz, and being fully advised in the premises,

FINDS:

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

(2) That the applicant, The Atlantic Refining Company, proposes to institute a pressure maintenance project in the Horseshoe-Gallup Oil Pool, San Juan County, New Mexico, by the injection of water into the Gallup formation through 15 wells initially, all of which wells are within the proposed project area which consists of the following-described acreage:

TOWNSHIP 31 NORTH, RANGE 16 WEST, NMPM

Section 18: S/2 SW/4

Section 19: W/2, W/2 E/2, SE/4 NE/4 and the
E/2 SE/4

Section 20: S/2, S/2 NW/4 and the SW/4 NE/4

Section 29: All

Section 30: All

Section 31: E/2, E/2 W/2, NW/4 SW/4 and the W/2 NW/4

Section 32: All

(3) That the applicant proposes that each month an allowable be established for the Horseshoe-Gallup Pressure Maintenance Project, said allowable to be determined by multiplying the current Northwest New Mexico normal unit allowable for a 40-acre proration unit times the number of 40-acre proration units in the project area on which an injection well is located, plus a normal unit allowable for each 40-acre proration unit on which is located a producing well which has received a response to the water injection, plus an amount for each 40-acre proration unit on which a producing well is located which has not received a response to water injection equal to the well's ability to produce up to normal unit allowable.

(4) That the "response" feature of the applicant's proposed project allowable formula would add considerably to the complexity of administering the project allowable, and it is not necessary from the standpoint of conservation or the protection of correlative rights, nor is it warranted on the basis of economics.

(5) That the necessary investment in order to develop a pressure maintenance project is based in large part on the total number of injection wells required for the efficient operation of the project, and the assignment of a top unit allowable to each injection well, together with the expected increased oil recovery, is an entirely adequate incentive for an operator to initiate a pressure maintenance project.

(6) That the allowable assigned to any producing well in the project area should be no greater than the demonstrated ability of the well to produce, subject to top unit allowable for the Pool. In the case of curtailed or shut-in producing wells, the allowable should be no greater than the demonstrated ability of such well to produce as reflected by a 24-hour test at a stabilized rate of production immediately prior to such shut-in or curtailment. In no event should such allowable be greater than the current normal unit allowable for the Horseshoe-Gallup Oil Pool during the month of transfer.

(7) That the applicant also proposes that an administrative procedure be established whereby the pressure maintenance project may be expanded for good cause shown, and whereby additional wells in the project area may be converted to water injection.

(8) That Special Rules and Regulations for the operation of the Horseshoe-Gallup Pressure Maintenance Project should be promulgated and, for operational convenience, such rules should provide certain flexibility in authorizing the production of the project allowable from any well or wells in the project in any proportion, provided that no well in the project area which directly or diagonally offsets a well outside the project area producing from the same common source of supply should be allowed

to produce in excess of two times top unit allowable for the Horseshoe-Gallup Oil Pool.

IT IS THEREFORE ORDERED:

(1) That the applicant be and the same is hereby authorized to institute a Pressure Maintenance Project in the Horseshoe-Gallup Oil Pool, San Juan County, New Mexico, by the injection of water into the Gallup formation through the following-described wells in Township 31 North, Range 16 West:

Navajo "B" Well No.	1, Unit N, Section 19
Navajo "B" Well No.	3, Unit P, Section 19
Navajo "B" Well No.	4, Unit J, Section 19
Navajo "B" Well No.	5, Unit F, Section 19
Navajo "B" Well No.	7, Unit N, Section 20
Navajo "B" Well No.	8, Unit L, Section 20
Navajo "A" Well No.	22, Unit J, Section 29
Navajo "A" Well No.	23, Unit F, Section 29
Navajo "A" Well No.	24, Unit D, Section 29
Navajo "A" Well No.	26, Unit B, Section 29
Navajo "A" Well No.	9, Unit B, Section 30
Navajo "A" Well No.	16, Unit H, Section 31
Navajo "A" Well No.	17, Unit B, Section 31
Navajo "A" Well No.	28, Unit J, Section 31
Navajo "A" Well No.	29, Unit F, Section 31

(2) That Special Rules and Regulations governing the operation of The Atlantic Refining Company Horseshoe-Gallup Pressure Maintenance Project, San Juan County, New Mexico, be and the same are hereby promulgated as follows, effective July 1, 1960:

SPECIAL RULES AND REGULATIONS FOR THE ATLANTIC
REFINING COMPANY HORSESHOE-GALLUP PRESSURE
MAINTENANCE PROJECT

RULE 1. The project area of The Atlantic Refining Company Horseshoe-Gallup Pressure Maintenance Project, hereinafter referred to as the Project, San Juan County, New Mexico shall comprise that area described as follows:

TOWNSHIP 31 NORTH, RANGE 16 WEST, NMPM
Section 18: S/2 of the SW/4
Section 19: W/2, W/2 E/2, SE/4 NE/4 and the
E/2 SE/4
Section 20: S/2, S/2 NW/4, SW/4 NE/4
Section 29: All
Section 30: All
Section 31: E/2, E/2 W/2, NW/4 SW/4 and
the W/2 NW/4
Section 32: All

RULE 2. The allowable for the Project shall be the sum of the allowables of the several wells within the project area, including those wells which are shut-in, curtailed, or used as injection wells. Allowables for all wells shall be determined in a manner hereinafter prescribed.

RULE 3. Allowables for injection wells may be transferred to producing wells within the project area, as may the allowables for producing wells which, in the interest of more efficient operation of the Project, are shut-in or curtailed because of high gas-oil ratio or are shut-in for any of the following reasons: pressure regulation, control of pattern or sweep efficiencies, or to observe changes in pressures or changes in characteristics of reservoir liquids or progress of sweep.

RULE 4. The allowable assigned to any well which is shut-in or which is curtailed in accordance with the provisions of Rule 3, which allowable is to be transferred to any well or wells in the project area for production, shall in no event be greater than its ability to produce during the test prescribed by Rule 6, below, or greater than the current top unit allowable for the pool during the month of transfer, whichever is less.

RULE 5. The allowable assigned to any injection well on a 40-acre proration unit shall be top unit allowable for the Horse-shoe-Gallup Oil Pool.

RULE 6. The allowable assigned to any well which is shut-in or curtailed in accordance with Rule 3, shall be determined by a 24-hour test at a stabilized rate of production, which shall be the final 24-hour period of a 72-hour test throughout which the well should be produced in the same manner and at a constant rate. The daily tolerance limitation set forth in Commission Rule 502 I (a) and the limiting gas-oil ratio (2,000 to 1) for the Horseshoe-Gallup Oil Pool shall be waived during such tests. The project operator shall notify all operators offsetting the well, as well as the Commission, of the exact time such tests are to be conducted. Tests may be witnessed by representatives of the offsetting operators and the Commission, if they so desire.

RULE 7. The allowable assigned to each producing well in the Project shall be equal to the well's ability to produce or to top unit allowable for the Horseshoe-Gallup Oil Pool, whichever is less, provided that any producing well in the project area which directly or diagonally offsets a well outside the project area producing from the same common source of supply shall not produce in excess of two times top unit allowable for the pool. Each producing well shall be subject to the limiting gas-oil ratio (2,000 to 1) for the Horseshoe-Gallup Oil Pool, except that any well or wells within the project area producing with a gas-oil ratio in excess of 2,000 cubic feet of gas per barrel of oil may be

produced on a "net" gas-oil ratio basis, which net gas-oil ratio shall be determined by applying credit for daily average gas injected, if any, into the Horseshoe-Gallup Oil Pool within the project area to such high gas-oil ratio well. The daily adjusted oil allowable for any well receiving gas injection credit shall be determined in accordance with the following formula:

$$A_{adj} = \frac{TUA \times F_a \times 2,000}{\frac{P_g - I_g}{P_o}}$$

where:

- A_{adj} = the well's daily adjusted allowable
- TUA = top unit allowable for the pool
- F_a = the well's acreage factor
- P_g = average daily volume of gas produced by the well during the preceding month, cubic feet
- I_g = the well's allocated share of the daily average gas injected during the preceding month, cubic feet
- P_o = average daily volume of oil produced by the well during the preceding month, barrels

In no event shall the amount of injected gas being credited to a well be such as to cause the net gas-oil ratio, $\frac{P_g - I_g}{P_o}$ to be less than 2,000 cubic feet of gas per barrel of oil produced.

RULE 8. Credit for daily average net water injected into the Horseshoe-Gallup Oil Pool through any injection well located within the project area may be converted to its gas equivalent and applied to any well producing with a gas-oil ratio in excess of two thousand cubic feet of gas per barrel of oil. Total credit for net water injected in the project area shall be the gas equivalent volume of the daily average net water injected during a one-month period. The daily average gas equivalent of net water injected shall be computed in accordance with the following formula:

$$E_g = (V_{w \text{ inj}} - V_{w \text{ prod}}) \times 5.61 \times \frac{P_a}{15.025} \times \frac{520^\circ}{T_r} \times \frac{1}{Z}$$

where:

- E_g = Average daily gas equivalent of net water injected, cubic feet
- $V_{w \text{ inj}}$ = Average daily volume of water injected, barrels
- $V_{w \text{ prod}}$ = Average daily volume of water produced, barrels
- 5.61 = Cubic foot equivalent of one barrel of water
- P_a = Average reservoir pressure at mid-point of the pay-zones of Horseshoe-Gallup Oil Pool in project area, psig + 12.01, as determined from most recent survey
- 15.025 = Pressure base, psi
- 520° = Temperature base of 60°F expressed as absolute temperature
- T_r = Reservoir temperature of 87°F expressed as absolute temperature (547°R)
- Z = Compressibility factor from analysis of Horseshoe-Gallup gas at average reservoir pressure, P_a , interpolated from compressibility tabulation below:

Reservoir Pressure	Z	Reservoir Pressure	Z	Reservoir Pressure	Z
50	.9725	300	.8325	550	.6560
100	.9465	350	.8030	600	.6135
150	.9215	400	.7710	650	.5655
200	.8885	450	.7220	700	.5220
250	.8600	500	.6900	750	.4630
				800	.3935

RULE 9. Each month the project operator shall, within three days after the normal unit allowable for Northwest New Mexico has been established, submit to the Commission a Pressure Maintenance Project Operator's Report, on a form prescribed by the Commission, outlining thereon the data required, and requesting allowables for each of the several wells in the Project as well as the total Project allowable. The aforesaid Pressure Maintenance Project Operator's Report shall be filed in lieu of Form C-120 for the Project.

RULE 10. The Commission shall, upon review of the report and

after any adjustments deemed necessary, calculate the allowable for each well in the Project for the next succeeding month in accordance with these rules. The sum of the allowables so calculated shall be assigned to the Project and may be produced from the wells in the Project in any proportion except that no well in the Project which directly or diagonally offsets a well outside the Project producing from the same common source of supply shall produce in excess of two times top unit allowable for the Pool.

RULE 11. The conversion of producing wells to injection, the drilling of additional wells for injection, and expansion of the project area shall be accomplished only after approval of the same by the Secretary-Director of the Commission. To obtain such approval, the Project operator shall file proper application with the Commission, which application, if it seeks authorization to convert additional wells to injection or to drill additional injection wells shall include the following:

(1) A plat showing the location of proposed injection well, all wells within the project area, and offset operators, locating wells which offset the project area.

(2) A schematic drawing of the proposed injection well which fully describes the casing, tubing, perforated interval, and depth showing that the injection of gas or water will be confined to the Gallup formation.

(3) A letter stating that all offset operators to the proposed injection well have been furnished a complete copy of the application and the date of notification.

The Secretary-Director may approve the proposed injection well, if within 20 days after receiving the application, no objection to the proposal is received. The Secretary-Director may grant immediate approval, provided waivers of objection are received from all offset operators.

Expansion of the project area may be approved by the Secretary-Director of the Commission administratively when good cause is shown therefor.

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

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

JOHN BURROUGHS, Chairman

MURRAY E. MORGAN, Member

S E A L

esr/

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

LARGE FORMAT
EXHIBIT HAS
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AND IS LOCATED
IN THE NEXT FILE