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BEFORE THE OIL CONSERVATION COMMISSION

OF NEW MEXICO

IN THE MATTER OF THE APPLICATION
OF J. R. CONE FOR APPROVAL OF
A WATER FLOOD PROJECT IN THE CONE
JALMAT YATES POOL UNIT, LEA COUNTY,
NEW MEXICO.

Case 2803

A P P L I C A T I O N

Comes now J. R. Cone, as unit operator of the Cone Jalmat Yates Pool Unit, Lea County, New Mexico, and applies to the Oil Conservation Commission of New Mexico for approval of a secondary recovery project in the said unit by water injection and in support thereof would show:

1. Attached hereto is the Cone Jalmat Yates Pool Unit Water Flood Development proposal, setting forth the proposed waterflood pilot program, and development plan, together with plat showing injection wells, location of offsetting wells, lease ownership, log of the Nix State No. 3 well, and other information.

2. Water supply is anticipated from the Santa Rosa Sand from the British American well No. 1, located in Section 14, Township 22 South, Range 36 East. It is anticipated that not to exceed 9,000 bbls. of water per day will be required for the project at maximum injection rates.

3. Description of the casing program of injection wells will be supplied prior to date of hearing of this application.

4. Copy of this application is submitted simultaneously to the office of the State Engineer.

5. This secondary recovery project will operate under the provisions of Rule 701 of theCommission's Rules and Regulations.

DOCKET MAILED

Date 5/4/63

WHEREFORE, applicant prays that this application be set for hearing and that after notice and hearing as required by law, the Commission enter its order approving the water flood project for the Cone Jalmat Yates Pool Unit, Lea County, New Mexico, as applied for.

Respectfully submitted,

J. R. CONE

By Jason W. Kellahin

KELLAHIN & FOX
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ATTORNEYS FOR APPLICANT

Case 2803

CONE JALMAT YATES POOL UNIT

WATER FLOOD DEVELOPMENT PROPOSAL

Contents

CONE JALMAT YATES POOL UNIT
Water Flood Development Proposal

I

INTRODUCTION

The Cone Jalmat Yates Pool Unit under consideration here is composed of all or a portion of Sections 13, 23, 24, 25 and 36 in Township 22 South, Range 35 East NMPM, Lea County, New Mexico. The area expected to be occupied by the unit is set out in more specific detail in Figure I, which is included as an appendix to this report.

The Purpose of the subject unit is to facilitate the development of a Water Flood project through which additional oil and gas may be recovered from the Yates Sand formation.

The Intent of the unit effort is to effect the maximum recovery of oil and gas from the Yates sand formation, as it exist under the unit area, through the use of fluid injection practices. It is realized that these practices are not at this time proven to be effective in the area of interest. It is further realized that the unit area contains a significant reserve of oil and gas that can be recovered through continuation of production practices now in use in the wells to be affected by the proposed secondary recovery development. It therefore is the intent of the unit participants to fully evaluate the process of water flood operations in the area of interest and at the same time jeopardize a minimum volume of known remaining primary oil

and gas reserve toward the end that the unit will recover the maximum reserve at a minimum cost.

In order that this end may be accomplished; a pilot water flood project is planned. This pilot project will affect a total 200 acre area of which 160 acres will be inside the pilot project and 40 acres will be adjacent.

The pilot water flood project will require the conversion of four existing unit producing wells to water injection service. In addition British American Oil Producing Company will supply two water injection wells to fully inclose the 160 acre pilot flood area. This project will contain two inside oil and gas producing wells and two external but adjacent producing wells. All other unit wells will remain in their present producing status until such time that the pilot project has proven the adviseability of expanding the water injection program to include the entire unit area

II

DEFINITION AND HISTORY

The Jalmat Yates Pool Reservoir is composed of a series of sand members in the upper portion of the Permian aged Gualdalupe series of sediments. The sand members are seperated by anhydritic dolomite members. The total sand section has a thickness of some 150' in the area of interest although an average of only 32' of sand with characteristics adequate to support commercial rates of oil production is present in the total section. The sand is calcareous, light to moderately cemented and friable. It is composed of fine to medium grains of rounded quartz exhibiting a color ranging from tan to red.

The Jalmat Yates Pool occupies the greater portion of an area some 30 miles north and south by 6 miles east and west which is centered some 10 miles northwest from Eunice, Lea County, New Mexico. The area under consideration here is located in the south central portion of the west flank of the greater Pool area.

Production was extended into the unit area with the completion of the J. R. Cone No. 1 Nix State well in May 1954. This well was initially completed as a gas well from the upper portion of the Yates sand section. It was later completed lower in the Yates section as a high GOR oil well. The last well completed in the unit area was the Delhi-Taylor Oil Corp. No. 3 Amerada State "B" in November 1957.

The production history of the Yates sand in the unit area is typical of that expected for a reservoir whose energy is supplied by solution gas. Although the reservoir has available a large gas cap, energy from that source has evidently had little, if any, influence on oil production from the reservoir.

Through August 1962 the 37 wells included in the unit area have produced a total 1,501,908 bbl of stock tank oil. These wells averaged 6.8 bbl per well per day during the first 6 months of 1962. Individual well production ranged from an average 1 to 10 bbl per day during this time. Production rate from wells in the unit area is declining at a rate of approximately 2% per month.

Primary production of commercial quality from the reservoir was established in the wells thus far completed only through the use of well stimulation processes in the form of acid or hydraulic fracturing practices.

III

RESERVOIR DATA AND RESERVES

The Jalmat Yates Reservoir in the area of the unit may be subdivided into 4 distinct members. Each of these members may in turn be subdivided to some degree; however, these secondary subdivisions do not exhibit an area wide continuity that is equal in any respect to that of the 4 major subdivisions. The members identified as subdivisions of the reservoir are set out in Figure II in the appendix to this report which is a typical log from the Yates sand section in the unit area.

The Gas/Oil Contact in this reservoir appears to occur, within rather narrow limits, at approximately the same level in all sand members of the reservoir. Production and well test data has been used to establish the gas/oil contact datum at between -75' and -100' sub sea level.

The Fluids produced from the Yates sand reservoir are sour. The oil has a gravity of 36° API and the gas has an estimated specific gravity of 0.87. Water production from the reservoir is practically negligible in volume leading to the conclusion that the reservoir water saturation under original conditions was at or very near irreducible.

Although specific data is lacking regarding the true nature of the oils produced from the reservoir estimates indicate that the oil was originally saturated with solution gas and that its saturation pressure was in the vicinity of 1000 psi. The original oil formation volume factor was 1.35 and the original solution GOR was 250/1. Indicated reservoir oil viscosity is 1.50 cp.

The Reservoir Rack characteristics have been determined from core analysis data, electrical well surveys and well test data. These average characteristics are set out as follows:

	Reservoir Zone			
	I	II	III	IV
Net Pay thickness ft.	6.0	10.4	9.8	5.8
Porosity %	19.3	19.0	19.9	18.9
Interstitual Water %	43.0	39.0	39.0	42.0
Air Permiability md.	8.6	23.0	23.0	16.0
%Total Reservoir Storage	18.7	31.9	31.6	17.8
%Total Reservoir Flow Capacity	8.5	39.3	37.0	15.2

The physical nature of the reservoir along with the production history of the wells completed therein suggest an ultimate yield of some 73.4 bbl stack tank oil per acre foot through primary depletion of solution gas energy. Primary reservoir performace suggest that only some 50% of the indicated net reservoir volume has been effective in primary production. Energy from the entire section must have contributed to this recovery in order to supply the gas necessary for the high GOR production. This limitation of effectiveness is the result of low permiability supplying inadequate flow capacity to materially effect commercial rates of production and a slight limitation to the drainage radius for the individual wells.

Primary Production from the Yates sand reservoir underlying the unit area has accounted for the recovery of 1,510,908 bbl of stock tank oil through August 31, 1962. It is expected that an additional 230,092 bbl will be recovered from these wells to yield an ultimate primary recovery of 1,741,000 bbl of stock tank oil.

Primary depletion of the reservoir is expected to yield

an average 73.4 bbl stock tank oil per acre foot of effective pay. This recovery will amount to 15% of the movable stock tank oil originally contained in that effective pay section. Primary production will reduce original reservoir oil saturation from 61% of pore space to 44.6%.

Secondary Recovery Reserves that are expected to be recovered from the Yates sand reservoir as it exists under the unit area amount to a total 3,952,000 bbl after January 1, 1963. This assumes that water injection will commence in a pilot water flood project on or about January 1, 1963. This reserve amounts to 3,748,308 bbl over and above estimated ultimate primary production for a ratio of 2.16 bbl of water flood recovery oil per bbl of ultimate primary recoverable oil.

Secondary recovery by water injection into this reservoir will reduce reservoir oil saturation from the 44.6% of pore space expected after primary depletion to 27.4% of pore space.

The recovery of this secondary oil is expected to require a total 16 years of operation. This time consist of 1.5 years pilot flood operation, 1.5 years water flood expansion to full scale operation and 13 years full scale operation. This prediction is based on producing wells of maximum rate within allowable limits of 42 bbl per gross well per day. The rate at which this reserve is expected to accrue is shown in graphic form through Figure III, attached hereto as a part of the Appendix to this report. (Figure IV attached hereto is a graphic representation of the performance expected from the proposed 160 acre pilot flood area which will contain two internal producing wells and 6 water injection wells. Pro-

duction that will result from influence on producing wells external to the 160 acre pilot area has not been taken into consideration in this figure although it does influence the planning of expansion rate for the project beyond the pilot flood test period.)

IV

WATER FLOOD OPERATIONS

Water Injection into the reservoir is a direct function of the reservoir rock and its contained fluid characteristic.

Injection Pressure for the proposed project should be limited to a maximum 1000 psi at the injection well head. Well treatment history indicates that the sand section may be expected to break down above this pressure.

Injection Capacity into the Yates sand reservoir under reasonable pressure limitation is expected to range from 16.3 bbl water per foot of sand per day during early fill up period to 8.3 bbl per foot per day after initial fill up. These volumes are based on an injection well head pressure of 1000 psi.

Water Requirement for the recovery of the predicted water flood reserve from the unit area is estimated to be 5.7 bbl water per bbl of oil produced. Fill up requirement for the pilot flood area is estimated to be 600,000 bbl. These volumes are exclusive of excess water break through which is expectable in some areas of the anticipated project, yet unpredictable at this time. It is further estimated that some 1,500,000 bbl water will be required to control the movement of

reservoir liquids from migration into the gas cap area. It may therefore be estimated that total make-up water requirement for the project will approximate 22,000,000 bbl. The average daily requirement is then estimated to be 3800 bbl per day and range from 8800 maximum to a minimum of some 2000 bbl per day.

Water Supply for the injection program into the subject area may be derived from either of two primary sources. These being the Santa Rosa sand section in the interval 900' to 1200' beneath the surface and the Capitan Reef section encountered at approximately 4100' beneath the surface.

British American Oil Producing Co. has tested both supply sources set out above. These test suggest that a Santa Rosa well should be expected to yield a stable supply of good water at the rate of 3,000 bbl per well per day. Their test of the Reef section suggest a stable capacity of some 10,000 bbl per well per day of water that chemically is much less attractive than that of the Santa Rosa. These test indicate that 3 Santa Rosa wells or 1 Reef well would supply the total water requirements for the proposed project.

The cost requirement to drill and complete a Reef water supply well for the subject unit is estimated at $92,600.00. The cost requirement to drill and complete a Santa Rosa water supply well for the unit is estimated at $23,000.00. Three Santa Rosa water supply wells will satisfy the estimated requirements for the subject unit project. These three wells with an estimated productivity of 3,000 bbl each will cost

$7.67 per daily barrel of water as compared to $9.26 per daily barrel of water from the Capitan Reef. In addition the three Santa Rosa well program will lend flexability to the project and become more adoptable to the plans for growth of the project from a pilot flood area into a full scale operation.

Water Injection Plant facilities for the proposed project in the unit area will require the ultimate injection into 18 wells to be drilled in the future. The shape of the unit area being some 2 1/4 times longer in a north-south direction than east-west and the evidence that multiple water supply wells will be required leads naturally to the plan of multiple water injection plant facilities. A companion water injection plant for each of three supply wells has therefore been determined the most practical approach to plant facility planning.

Each such plant with its companion water supply well will be required to handle a maximum 3,000 bbl water per day at 1,300 psi. For purposes of flexability each plant facility will be connected to the other such that low pressure water may be transferred from one plant to the other.

Water Treatment necessary to furnish clean, chemically compatable water to the injection well head is expected to be minor. The Santa Rosa water supply is indicated to be totally compatable with that from the Yates sand reservoir. The presence of minor concentrations of carbon dioxide in the Santa Rosa water will require mechanical as well as chemical attention.

V

DEVELOPMENT PLAN

Initial Development will be constituted by the pilot water flood consisting of 4 injection wells as outlined above. Expansion of the pilot flood project to include 2 additional injection wells is expected after 6 to 9 months of operation. This expansion will complete development in the Plant I area.

After approximately 6 months operation of the expanded Plant I the second plant is expected to be justified and approximately 12 months later the third plant will be justified.

Total Development of the unit area is expected to extend over a period of some 27 total months from the date the first plant is started to the date of full unit development.

Water Injection Plant facilities will consist of three identical systems each consisting of a water supply well, water injection pressure pumps and injection measurement and treating equipment.

VI

WATER INJECTION PLANT DESIGN

The Requirement for each plant will be the injection of a maximum 2900 bbl water per day of 1000 psi well head pressure. This volume will reduce as the project moves toward completion to approximately 1600 bbl per day. It is also anticipated that some of the injection wells may require a maximum 1300 psi well head pressure during the later life of the project.

Water Supply Well Completion will require the lifting of 3000 bbl water per day from a depth of 950'. 85/8" casing is recommended for the handling of a submersible pump of this capacity.

In the completion of the water supply well 85/8" casing will be run and cemented back to the surface from a TD of approximately 910' or the top of the Santa Rosa sand section. 75/8" hole will be drilled below the 85/8" casing seat to the base of the Santa Rosa sand section (Estimate 225') for a TD of 1135'±. 7" shop cut slotted liner will be run to TD and set without cement. Liner slots will be of 0.05" or less.

A submersible pump will be run on 27/8" EUE tubing to approximately 900'. The pumping cycle for the well will be controlled by demand determined from the water level in the plant clear water tank.

The water well location will be as near as practical to the water injection plant location and will be connected to the plant water tanks with 3" linepipe that is to be internally plastic coated.

The Injection Plant will consist of water storage facilities, triplex injection pumps, pressure and volume meters and controls as well as injection lines and filtration equipment for the individual water injection wells.

Water storage will consist of two 500 bbl, 16' tanks plastic coated internally. Row water will be produced into one of these tanks and plant suction from the other with provisions for taking plant water supply from either tank.

The suction line leading from tanks to pumps will be 6" line pipe, plastic coated and buried from tank outlet to plant suction header.

The Suction Header will be fabricated from 12' of 85/8" casing. Individual well suction lines will be 4" set at a 45° angle to the header axis. A 2" inlet into the suction header will serve as high pressure water return to the suction line.

The Injection Pump facilities should consist of 2 triplex pumps with electrical prime movers. These pumps should be of a 3" stroke and adoptable to plunger diameters ranging from 11/2" to 21/2" and safe operating speed range from 250 to 400 cycles per minute. The fluid end should be of aluminum bronze with a pressure rating of 1500 psi with 11/2" plungers and 1000 psi with 2" plungers.

The Pressure Header into which the pumps will deliver their high pressure water should consist of 12" of 85/8" J casing equipped for 2-2" inlets and 10-2" outlets.

Individual Well Injection Lines will take off from the injection pressure header through a stop valve, volume meter, check valve and throttle valve. These lines will be of 2" tubing or equivilent without internal protection. The injection lines will terminate at the injection well through an individual cartiridge type filter and master gate valve. Dual injection lines will be placed in operation in the case of the Cone-Nix State No.4, one serving the oil column and the other the gas cap. Similar dual injection treatment will

be given later injection wells along the east boundry of the Unit which will serve to control pressure in the gas cap area.

Injection Well Treatment will consist of pulling tubing from the selected producing wells, cleaning the exposed formation face and re-running 2" tubing with packer to be set approximately 100' above the highest perforations. Dual service injection wells will require the pack be set at or as near as practical to a -100' sub sea level datum. In these cases water will be injected into the gas cap through the annular space between tubing and casing.

VII

ECONOMICS

Pilot Flood Development Cost is expected to amount to $61,639.00. The pilot flood development is expected to yield a gross 409,415 bbl of stock tank oil. Expansion of the pilot flood into full plant operation will require an additional expenditure of $11,500.00 for a total cost for Plant I of $73,139.00.

Total Unit Development for full scale operation will require the construction of 3 plants identical to the expanded Plant I at a cost of $73,139.00 each and a minimum of 1 additional producing well completed in the Yates sand at an estimated cost of $39,500.00. This full development is therefore estimated to require an expenditure of $258,917.00, and result in the development of 3,748,308 gross bbl of stock tank oil for an average development cost of $0.069 per gross bbl. Operation of the project is expected to cost $1,604,400.00

or an average $0.482 per gross bbl. Royalty interest and production tax is expected to cost $0.83 per gross bbl for a total ultimate cost of $1.381 per gross bbl of estimated recovery. When based on an average current price of crude oil of $2.83 per bbl the working interest owners should expect to realize an ultimate net $1.449 per gross bbl of estimated reserve for an ultimate net return $21.00 per dollar invested in development.

WATER ANALYSIS

Water Source: Santa Rosa Sand

Location of Source: Section 14 T22S R35E Lea County, New Mexico
from British American WSW #1

Depth of Source: 1000' to 1240'

Temperature	°F	78
pH		7.6
Carbon Dioxide	ppm	13
Dissolved Oxygen	ppm	None
Residual Chlorine	ppm	None
Turbidity	ppm	3.6
Manganese	ppm	None
Iron	ppm	0.7
Total Alkalinity	ppm	250
Sulfates	ppm	360
Chlorides	ppm	225
Total Hardness Ca CO_3	ppm	200
Silica	ppm	None
Calcium	ppm	26
Magnesium	ppm	33
Total Solids	ppm	1,350

Case 2803

WATERFLOOD DATA
Cone Jalmat Yates Pool Unit

Lea County, New Mexico

OPERATOR J. R. Cone DATE April 1963

FIELD Jalmat COUNTY Lea

RESERVOIR Yates Sand

Date of completion of first well in reservoir May 13, 1954

Other operators injecting into this reservoir in this field British-American Oil Prod. Co. into their Jalmat Yates Sand Unit

I. Reservoir and fluid characteristics
A. Information on entire reservoir

1. Name of reservoir Yates Sand
2. Rock composition of reservoir Sand
3. Structural nature of reservoir Monocline
4. Reservoir energy source during primary production Solution Gas
5. Original reservoir pressure 1400 psi
6. Average well density 40 acres per well

B. Information on proposed project area

7. Number of productive acres in project area 1760
8. Average depth to top of pay 3700'
9. Estimated average effective pay thickness 32'
10. Average Porosity (% of bulk volume) 19.3%
11. Average Permiability (md) 19 md Range 0.1md-150md.
12. Interstitual Water Content (%pore space) 40.3% (Log data)
13. Gravity of oil (API) 36°
14. Viscosity of oil (centipoise) 1.5 cp.
15. Solution GOR @ bubble point 250 cf per Bbl.

II. Primary production history and present status

1. Date of first well completion in project area May 13, 1954 J. R. Cone #1 Nix State
2. Stage of depletion of project area Stripper with 89% of ultimate primary recovered
3. Number of wells in project area 36
4. Average present oil production 5.3 bbl per well per day
5. Cumulative oil produced to 4/1/63 from project area 1,555,458 Bbl
6. Estimated oil saturation in reservoir at present time (% pore space) 46.4%
7. Estimated ultimate primary recovery from project area 1,741,000 bbl of oil
8. Estimated remaining primary reserve 186,000 bbl oil

III. Fluid Injection plan

1. Source of injection water Santa Rosa sand at 1000'
2. Nature of water Brackish (see analysis attached)
3. Type of Injection System Fully closed
4. Water treatment Chemical as required
5. Injection pattern and spacing 5-spot pattern, 80 acres per like well
6. Injection pressures at well head Maximum estimated 1000 psi
7. Estimated initial injection rate bbl per well 400 bbl per day

IV. Results expected

1. Estimated oil saturation in reservoir at abandonment (%pore space) 27.4%
2. Estimated increase in ultimate oil recovery resulting from project 3,748,000 bbl oil
3. Estimated original oil in place 17,960,000 bbl oil
4. Estimated total water requirements 22,000,000 bbl of water