STATE OF NEW MEXICO
ENERGY, MINERALS, AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

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

CASE NO. 13249
ORDER NO. R-11275-A

APPLICATION OF THUNDERBOLT PETROLEUM TO INCREASE THE MAXIMUM SURFACE INJECTION PRESSURE WITHIN THE CALMON STATE WATERFLOOD PROJECT, EDDY COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This case came on for hearing at 8:15 a.m. on June 10, 2004, at Santa Fe, New Mexico, before Examiner William V. Jones.

NOW, on this 8th day of October, 2004, the Division Director, having considered the testimony, the record, and the recommendations of the Examiner,

FINDS THAT:

(1) Due public notice has been given, and the Division has jurisdiction of these cases and the subject matter.

(2) By Order No. R-11275 issued in Case No. 12250 on November 9, 1999, the Division, upon application of Thunderbolt Petroleum, authorized the institution of a waterflood project within the Calmon State Lease located in the SW/4 of Section 16, Township 18 South, Range 29 East, NMPM, Eddy County, New Mexico, by the injection of water into the Queen, Grayburg, and San Andres formations through two injection wells. The project was designated the Calmon State Waterflood Project and is located within the Loco Hills-Queen Grayburg San Andres Pool.

(3) The Loco Hills-Grayburg pool was created prior to 1950. Subsequently, it was expanded to include the San Andres, and on May 24, 1972, it was expanded to include the Queen. In the area of the Calmon State Waterflood Project, the approximate vertical limits of this pool range from 2,048 feet to 3,976 feet.

(3) Order No. R-11275 also limited the surface injection pressure on both permitted injection wells to no more than 453psi, which equates to a gradient of 0.20psi per foot of depth to the uppermost injection perforation.

(4) The two wells permitted for injection are as follows.

(a) Calmon State Well No. 1 API No. 30-015-25635 located 2310 from the South line and 990 feet from the West line (Unit L) of Section 16. Perforations range from 2,265 feet in the Penrose (Queen) to 2,679 feet in the Grayburg.

(b) Calmon State Well No. 3 API No. 30-015-25754 located 990 from the South line and 990 feet from the West line (Unit M) of Section 16. Perforations range from 2,264 feet in the Penrose (Queen) to 2,599 feet in the Grayburg.

(5) On August 9, 2002, the Division administratively approved an increase in injection pressure for each of these two wells. The allowable pressure on the Calmon State Well No. 1 was raised to 650 psi based on a clear break in the step-rate-test. Similarly, the allowable pressure on the Calmon State Well No. 3 was raised to 550 psi.

(6) Thunderbolt Petroleum applied administratively on March 8, 2004, to increase allowable injection pressures on both injection wells to 1,100 psi based on new step-rate-tests and tracer surveys. This application was set to hearing.

(7) In this case, the applicant, Thunderbolt Petroleum, seeks an order to increase the allowable surface injection pressure on each of the two existing injection wells within the Calmon State waterflood project to 1,100 psi.

(8) The applicant presented the following engineering testimony.

(a) Injection volumes have been inconsistent depending on the availability of water to inject. However, when additional water was available to inject, the oil production rate has responded.

(b) The latest step-rate-tests run February 10, 2004 on this waterflood, show fracture pressures ranging from 787 to 805 psi. The average surface fracture pressure is 796 psi, which reflects an average surface gradient of 0.35 psi per foot. At this pressure, at least one of the perforated intervals begins to fracture, but it is not possible to know which one.

(c) An injection profile log was run in November 2003 on the Calmon State Well No. 3. During this test, the injection rate was 270 bwpd at 1,120 psi. The temperature log indicated the total injection interval, including all possible vertical migration, ranged from 2,140 feet to 2,716 feet and all perforations were taking fluid. The tracer surveys did not show vertical movement directly behind pipe.

(d) An injection profile log was run in December 2003 on the Calmon State Well No. 1. During this test, the injection rate was 285 bwpd at 1,000 psi. The log indicated the total injection interval, including all possible vertical migration, ranged from 2,492 feet to 2,634 feet. The uppermost perforations (Penrose) did not take any fluid at this pressure.

(e) The estimated initial reservoir pressure is 1,100 psi. Current reservoir pressure is approximately 400 psi. The original gas in solution was 270 scf per barrel. Initial producing GOR was 1,000 scf per barrel. Total voidage at the time the waterflood started from produced liquids and from original and produced gas is estimated at 490,000 barrels. Total injection to date is 233,000 barrels, which equates to less than 50 percent reservoir fillup. The 1,100 psi pressure limit will enable an increased water injection rate and will enable the reservoir to fillup the remaining voidage in 2 years versus the predicted 4 years at current rates. The reported injection to withdrawal ratio is still very high, but the injected water is filling up the pore volume and is not leaving the injected interval horizontically or vertically.

(f) The producing lenses in this waterflood are thin, scattered, and tight and are located within the Penrose member of the Queen formation as well as in the Grayburg. The reservoir sands contain some clays but also some radioactive salts. The lenses that are being waterflooded are also susceptible to plugging damage, particularly from iron precipitates.

(g) The interval between the top of the Queen to the top perforation is over 200 feet and is composed of tight, low porosity rock which is not conducive to fracture height growth. Similarly the interval between the bottom perforation and the bottom of the San Andres is over 1,000 feet and very tight.

(h) The dominant permeability direction is estimated to be northeast to southwest.

(i) All fresh ground water in this area is above 400 feet deep and is protected by casing and cement in all wells. All wells in this vicinity are adequately cemented over this injection interval.

(9) After reviewing the case and the testimony, the Division finds the following.

(a) The issue of the maximum stress direction in this area was not addressed but it could be implied from the results of the temperature surveys that fracture height growth will be primarily vertical. Vertical growth is not likely to grow beyond the pool boundaries. If the fractures grow horizontally, then water breakthrough will occur and reserves may be lost.

(b) The tracer/temperature surveys also showed that injection pressure must be higher than 1,000 psi to get water into the Penrose, which is the thickest formation member in the overall injection interval. For the project to be economical and successful, this interval must be swept.

(c) Measured fracture pressures have been rising in recent years and as the reservoir fills up, the fracture pressure should rise and the severity of the fracturing should lessen. An injection pressure of 1,100 psi equates to a gradient of 0.49 psi per foot.

(d) Without increased pressure, the operator is having trouble injecting a sufficient volume of water into this reservoir to achieve fill-up or to maintain a flood front, despite efforts to keep the injection water clean and free from oxygen and solids. The operator is also having difficulty maintaining stable water injection rates, because of the lack of a dependable water supply.

(e) Upon occasion and with adequate justification, the Division has granted approval to operators of other Queen sand water floods in Eddy County to inject water at a pressure at or above the measured fracture pressure.

(10) The applicant, through its engineering evidence and testimony, has satisfactorily demonstrated that injection at a higher surface injection pressure is necessary in order to efficiently and effectively water flood this reservoir and will allow the applicant to recover additional oil reserves, thereby preventing waste.

(11) The applicant has further satisfactorily demonstrated that injection into the injection wells at a surface injection pressure of 1,100 psi will not result in the migration of fluid from the Loco Hills-Queen Grayburg San Andres Pool and will not pose a threat to underground sources of drinking water in this area.

IT IS THEREFORE ORDERED THAT:

(1) Division Order No. R-11275 is hereby amended to authorize Thunderbolt Petroleum to inject water at a maximum surface injection pressure of 1,100 psi into all currently permitted injection wells located within the Calmon State Waterflood Project.

(2) The Division Director shall have the authority to reduce or rescind the surface injection pressure approved herein should it become apparent that the injected fluid is not being adequately confined to the Loco Hills-Queen Grayburg San Andres Pool.

(3) Jurisdiction is hereby 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

MARK E. FESMIRE, P.E.
Director

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