

**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. 13127
ORDER NO. R-11674-A**

**APPLICATION OF BEACH EXPLORATION, INC. TO INCREASE THE
MAXIMUM SURFACE INJECTION PRESSURE WITHIN THE WEST HIGH
LONESOME (PENROSE SAND) UNIT 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 August 7, 2003, at Santa Fe, New Mexico, before Examiner William V. Jones.

NOW, on this 24th day of November, 2003, 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 this case and the subject matter.

(2) By Order No. R-11673 issued in Case No. 12684 on October 19, 2001, the Division, upon application of Beach Exploration, Inc., approved statutory unitization of portions of the High Lonesome-Queen Pool, Eddy County, New Mexico, called the West High Lonesome Unit. The Unitized Formation within this Unit is comprised of the "Penrose" sand member of the Queen formation extending from approximately 1,576 feet subsurface to approximately 1,820 feet subsurface.

(3) By Order No. R-11674 issued in Case No. 12685 on October 19, 2001, the Division, upon application of Beach Exploration, Inc., authorized the institution of a **waterflood** project within the West High Lonesome Unit Area located in portions of Township 16 South, Range 29 East, NMPM, High Lonesome-Queen Pool, Eddy County, New Mexico, by the injection of water into the Penrose member of the Queen formation through eighteen injection wells located in Sections 16, 18, 19 and 20.

(4) Order No. R-11674 required two wells previously plugged to be re-entered and re-plugged in a manner satisfactory to the supervisor of the Division's Artesia District Office. These wells had been plugged in the 1940's and 1950's, with 10-sack cement plugs after the casing had been recovered.

(5) As required prior to injection, these two wells were re-entered and re-plugged under supervision of the Artesia District Office in June of 2002, to protect ground water and prevent migration of injection water out of zone.

(6) Order No. R-11674 also limited the surface injection pressure on all injection wells to no more than 341 psi, which equates to a gradient of 0.20 psi per foot of depth to the average uppermost injection perforation.

(7) Beach Exploration, Inc. applied administratively (Reference No. pkrv0306434432) on March 4, 2003, to increase allowable injection pressures on injection wells within their West High Lonesome (Penrose Sand) Unit waterflood project. The application was set for hearing by the Division in order for the applicant to provide testimony pertinent to its application.

(8) In this case, the applicant, Beach Exploration, Inc., seeks an order increasing the allowable surface injection pressure on each of the eighteen existing injection wells within the West High Lonesome (Penrose Sand) Unit waterflood project to 1,100psi.

(9) The applicant presented the following engineering testimony.

(a) To limit injection pressure, appropriate pump bypasses must be in place and working properly. For short periods of time, this equipment was not working properly and surface injection pressure increased, at which time the waterflood began to respond. Conversely, when injection pressures were again limited, the waterflood production dropped off.

(b) Due to the reservoir being tighter than expected, each injection well is only able to inject approximately 35 barrels per day at the currently allowed 341 psi surface injection pressure.

(c) Within this waterflood, initial **in-situ** free gas volume is calculated at 1.6 million barrels. An injection rate of at least 200 barrels per day per injection well for 21 months is required to fill up this pore volume, to reach peak waterflood response, and to achieve acceptable economics.

(d) The six step rate tests run in April and July of 2003 on this waterflood project, show **fracture** pressures ranging from 830 to 1,220 psi. The average surface fracture pressure is 978 psi, which reflects an average surface gradient of 0.57 psi per foot and an average bottom hole gradient of 1.01 psi per foot (friction being negligible at these low rates). Similarly, on the offsetting Red Lake Unit (also Penrose sand), the average surface fracture pressure measured in 1991 **was 935 psi**.

(e) These fracture pressures roughly equate to the pressure resulting from a gradient of overburden rocks (red beds, anhydrites, and salt). This relationship implies that vertical and horizontal stresses are approximately equal and that some wells will fracture horizontally and some will fracture vertically.

(f) The **injection** formation is bounded top and bottom by thick, dense, **anhydritic** dolomites and shales. These rocks are normally "higher stress" than the reservoir rock and therefore provide resistance to vertical fracture migration.

(g) In 1992, using rock mechanic properties obtained by running a "full wave sonic" log, Halliburton created a processed (interpreted) "**frac-height**" log, which indicated that at 200 psi over fracture pressure (in wells which fracture vertically), the injection water will fracture up approximately 35 feet and down approximately **135 feet**.

(h) Injection profile logs were run in **1992** on four Penrose wells in the Red Lake Unit while injecting at 1,500 psi. Within the depths of investigation, no migration was seen more than six feet beyond the perforated interval.

(i) Fracturing either vertically or horizontally is not desirable. Fracturing horizontally will bypass oil and **defeat** the purpose of the waterflood. Therefore, careful consideration is being given to limiting injection pressures to measured fracture pressure in those wells tending to fracture horizontally. On wells tending to fracture vertically, fracturing up out of zone would lose water and become very expensive. Vertical fracturing is less sensitive to occasional over-**pressuring** than horizontal fracturing.

(j) The Penrose is a central member of the Queen formation. There are no productive intervals in the Queen either above or below the Penrose. Also, the Seven Rivers and Yates, which are above the Queen, are not productive in this area.

(k) There is a very small and intermittent amount of fresh ground water in this area normally about 75 feet deep. The waterflood is dependent on purchased fresh water until fill-up of the reservoir.

(l) There have been 363,000 barrels of water injected and only 32,000 barrels of fluid withdrawn from the waterflood. This injected water is filling up the pore volume and is not leaving the **injected interval**.

(m) Surface pipe is normally set at or above the top of the salt, which in this area is at approximately 340 feet. The main challenge in drilling wells in this area is cementing the surface pipe. Up to ten attempts were made on one well using different cements before an adequate cement job was obtained.

(10) The salt section in this area from approximate depths of 340 feet to 700 feet has at least one recorded instance of being charged up with high-pressure **salt** water. The **Brainard** Federal Well No. 1 (API 30-015-02761) located in Unit O, Section 20, less than one mile southeast of the West High Lonesome Unit boundary, encountered high flow rates from the surface casing shoe depth while attempting to spot a cement plug during plugging operations. Flow rates were reported at 500 to 800 barrels of salt water per hour from the salt section.

(11) The source of these salt section water problems has not been determined and further investigation should be done. As required while applying for waterflood status in Case 12685, the applicant has completed a comprehensive search for inadequately cemented wells within the area of review of all injection wells and, as a consequence, has re-entered and re-plugged two wells.

(12) By Order No. R-9453-A issued in Case No. 10495 on July 13, 1992, the Division, upon application of Beach Exploration, Inc., authorized an injection pressure increase to a maximum of 1,500 psi for all wells in the Red Lake Unit located in portions of Township 16 South, Ranges 28 and 29 East, **NMPM**, Eddy County, New Mexico. The Red Lake Unit is an analogous waterflood to the West High Lonesome (Penrose Sand) Unit and contains injection wells in the same formation and at similar depths.

(13) 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 **waterflood** the West High Lonesome (Penrose Sand) Unit and will allow the applicant to recover additional oil reserves, thereby preventing waste.

(14) 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 Queen formation and will not pose a threat to underground sources of drinking water in this area.

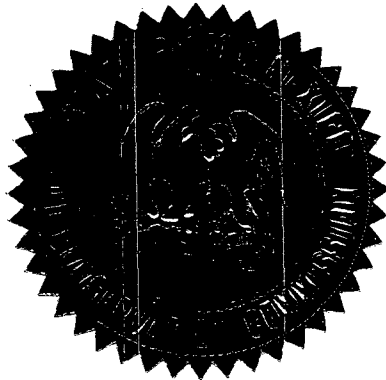
IT IS THEREFORE ORDERED THAT:

(1) Division Order No. R-11674 is hereby amended to authorize Beach Exploration, Inc. to inject water into eighteen previously approved injection wells (as more fully described on Exhibit "A" of Order No. R-1 1674) located within the West High Lonesome (Penrose Sand) Unit waterflood project in Sections 16, 18, 19 and 20, Township 16 South, Range 29 East, **NMPM**, High Lonesome-Queen Pool, Eddy County, New Mexico, at a maximum surface injection pressure of 1,100 psi.

(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 High Lonesome-Queen 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.



SEAL

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

Lori Wrotenbery
LORI WROTENBERY
Director