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. 14402
ORDER NO. R-4442-G

APPLICATION OF CHEVRON U.S.A., INC. FOR AMENDMENT OF DIVISION ORDER NO. R-4442, AS AMENDED, TO REVISE THE INJECTION WELL COMPLETION REQUIREMENTS AND TO CHANGE THE BASIS FOR THE CALCULATION OF THE AUTHORIZED INJECTION PRESSURE FOR CARBON DIOXIDE FROM SURFACE PRSSURE TO THE AVERAGE RESERVOIR PRESSURE IN ITS PREVIOUSLY APPROVED TERTIARY RECOVERY PROJECT IN THE VACUUM GRAYBURG SAN ANDRES PRESSURE MAINTENANCE PROJECT, LEA COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This case came on for hearing at 8:15 a.m. on December 3, 2009, at Santa Fe, New Mexico, before Examiner David K. Brooks.

NOW, on this 12th day of January, 2010, the Division Director, having considered the testimony, the record and the recommendations of the Examiner,

FINDS THAT:

(1) Due notice has been given, and the Division has jurisdiction of the subject matter of this case.

(2) Cases No. 14401 and 14402 were consolidated for hearing, and a joint record was made. However, separate orders will be issued.

BEFORE THE OIL CONSERVATION DIVISION
Santa Fe, New Mexico
Exhibit No. 7
Submitted by:
CONOCOPHILLIPS COMPANY, INC.
Hearing Date: March 29, 2012

(3) Chevron U.S.A. ("Applicant") seeks amendment of Orders No. R-4442-B and R-4442-C, which authorize injection of water, carbon dioxide (CO2) and produced gases for pressure maintenance into the Vacuum Grayburg San Andres Unit in Lea County, New Mexico, in three respects, as follows:

(a) amending Ordering Paragraph (4) of Order No. R-4442-B, which currently requires that the casing-tubing annulus in any injection well be filled with a inert fluid, and an approved leak detection device be attached to the annulus, to retroactively authorize injection into two wells where the tubing has been cemented in place;

(b) amending Ordering Paragraph (4) of Order No. R-4442-B, which currently requires that injection tubing be installed in a packer set within approximately 100 feet of the uppermost injection perforations or casing shoe, to retroactively and prospectively authorize setting packers in injection wells more than 100 feet above the uppermost injection perforations or casing shoe, provided that the packer is set within the Unitized formation, as defined in Order No. R-4442-C; and

(c) amending Ordering Paragraphs (5) and (6) of Order No. R-4442-B, and Exhibit A to Order No. R-4442-C, which currently limit surface injection pressure for CO2 to 350 pounds per square inch (psi) more than the pressure authorized for water injection, but in no event more than 1,850 psi, to establish an injection pressure limit for CO2 based on bottomhole pressure.

(4) At the hearing, Applicant appeared through counsel and presented geologic, operational and engineering testimony, as follows:

(a) Regarding the injection wells with <u>cemented tubing</u>, Applicant's witnesses testified:

(i) Applicant has cemented the tubing in two injection wells in the Vacuum Grayburg San Andres Unit (subject wells), as follows:

Vacuum Grayburg San Andres Unit Well No. 17 API No. 30-025-24316
Vacuum Grayburg San Andres Unit Well No. 47 API No. 30-025-24365

(ii) In each case, the tubing was cemented with the approval of the Division's Hobbs District Office following casing leaks and unsuccessful repair attempts.

(iii) Since filing this Application, Applicant has conducted blanking plug tests to determine tubing integrity on each of the subject wells, and each of them passed.

(iv) There is no practicable means to restore the casing-tubing annulus in the subject wells. Loss of the injection capacity of the subject wells and similarly constructed wells in the Central Vacuum Unit would result in loss of approximately 485 barrels of oil per day of production.

(v) Re-drilling the subject wells would cost an estimated $2 million dollars per well and would likely not be economic under Applicant's investment criteria. Discontinuing use of these wells for injection, if they were not re-drilled, would waste approximately 2.21 million barrels of proven reserves.

(vi) Applicant proposes to conduct annual blanking-plug tests on each of the subject wells to insure tubing integrity, and to continuously monitor injection pressures versus injection volumes with its Supervisory Control and Data Acquisition (SCADA) system, to monitor cement and casing integrity.

(vii) A leak anywhere down-hole in the injection well would occasion an anomaly in the normally consistent correlation between injection rate and injection pressure. The SCADA system will be programmed to report an "alarm" if an anomaly in this relationship for any of the subject wells persists for 24 hours. This will provide more rapid leak detection than conventional inspection methods.

(b) Regarding packer setting depths, Applicant's witnesses testified:

(i) Due to wear on the tubing in these old wells, it is often necessary, when re-setting the packer, to move up-hole in order to secure a reliable packer seat.

(ii) There are a total of 31 injection wells in the Central Vacuum Unit and the Vacuum Grayburg San Andres Unit in which the packers are currently set more than 100 feet above the highest injection perforation and the casing shoe. The packers in all of these wells are set within the Unitized Formation. The existing packer setting depths in these wells have been approved by the Division's Hobbs District Office.

(iii) There are additional wells in these units where the packers cannot be re-set within 100 feet of the highest injection perforation or the casing shoe.

(iv) Correlated formation tops in this unit generally are approximately 350 feet above the uppermost injection perforations.

(c) Regarding authorized injection pressure, Applicant's witnesses testified:

(i) Orders No. R-4442-B and R-4442-C limit surface injection pressure for CO2 to 350 psi greater than the applicable injection pressure limit for water, but in no event more than 1,850 psi.

(ii) In this unit, if Applicant were injecting 100% pure CO2, a surface injection pressure of 1,850 psi would produce an average bottomhole injection pressure of approximately 3,600 psi.

(iii) However, the CO2 being injected by the Applicant is approximately 87% pure, as determined by tests at the tailgate of Applicant's recycle facility.

(iv) Using 87% CO2, a surface injection pressure of 1,850 psi produces a bottomhole injection pressure of approximately 3,200 psi, or 400 psi less than was contemplated when these limits were set.

(v) Applicant has conducted step-rate tests resulting in approval of surface injection pressures for water from 1,920 psi to 2,500 psi. Allowing for the 350 psi differential authorized for CO2 injection, as compared to water injection, in Order No. R-4442-B, these tests indicate that a surface injection pressure of 2,200 psi for CO2 will not exceed formation fracture pressure.

(vi) Applicant would prefer that the CO2 injection pressure limit for this unit be set by reference to bottomhole pressure, at the originally contemplated 3,600 psi. However, if a surface injection pressure limit is needed for purposes of inspection, Applicant requests that it be raised to 2,200 psi.

The Division concludes that:

(5) The Division's district offices do not have authority to waive requirements set forth in hearing or administrative orders issued by the Director unless specifically authorized in the order or by rule. Hence, the injection wells where the tubing has been cemented, and where packers have been set substantially more than 100 feet above the uppermost injection perforation or casing shoe, are currently in violation of permit conditions.

(6) Applicant's proposed inspection protocol using blanking plug tests and SCADA monitoring provides a reasonable substitute for monitoring annular pressure. Hence, allowing continued utilization of the subject wells for injection, subject to the conditions proposed by Applicant and set forth in this Order, will not cause waste, impair correlative rights or endanger public health or the environment, and this application should be granted, as to these wells only, to allow their continued operation.

(7) Setting packers in which the injection tubing is installed in this unit more than 100 feet above the uppermost injection perforation or casing shoe will not cause waste, impair correlative rights or endanger public health or the environment so long as the packer in each well is set below the top of the Unitized Formation. Accordingly, this Application should be granted to allow packers to be set within these parameters both as to existing wells that are presently in violation, and as to wells in which a need may subsequently arise to raise the packer-setting depth.

(8) The evidence indicates that injection of CO2 in this unit at a bottomhole pressure not to exceed 3,600 psi will not damage the formation, and thus will not cause waste, impair correlative rights or endanger public health or the environment. However, to facilitate enforcement, the surface injection pressure limit should be set at 2,200. The operator of the unit should be directed to notify the Hobbs District Office of the Division prior to implementing any significant change in the purity of the CO2 being used for injection in this unit.

<u>IT IS THEREFORE ORDERED THAT:</u>

(1) Ordering Paragraph (4) of Order No. R-4442-B is hereby amended to read as follows:

> (3) For all injection wells, excluding heretofore permitted injection wells where the tubing has been cemented in place, injection shall be accomplished through internally coated tubing installed in a packer set as close as practically possible to the uppermost injection perforations or casing shoe; so long as the packer set point remains within the Unitized Formation, as defined in Ordering Paragraph (2) of Order No. R-4442-C, or as the same may be subsequently modified; and the casing-tubing annulus shall be filled with an inert fluid and a gauge or approved leak detection device shall be attached to the annulus in order to determine leakage in the casing, tubing or packer. Prior to re-setting any packer more than 100 feet above the uppermost injection perforation or casing shoe, the operator shall secure approval of the Division's Hobbs District Office.

(2) The two heretofore permitted injection wells identified below, which have had their injection tubing cemented in place, are hereby approved for continued use as water or CO2 injection wells provided that each well's mechanical integrity is verified annually by a blanking plug Mechanical Integrity Test and, provided further, that the operator maintains records of monitoring that demonstrate the absence of significant changes in the relationship between injection pressure and injection flow rate. Such records shall be available for inspection by the Division upon request.

Vacuum Grayburg San Andres Unit Well No. 17 API No. 30-025-24316
Vacuum Grayburg San Andres Unit Well No. 47 API No. 30-025-24365

(3) Ordering Paragraph (5) of Order No. R-4442-B is hereby amended as to read as follows:

> (5) For those injection wells within the enhanced tertiary recovery project with a current maximum surface injection pressure for water of less than 1,500 psi (pursuant to orders in effect on the date of issuance of Order No. R-4442-G), the applicant is hereby authorized to inject water into each of these wells at the current maximum surface injection pressure, provided however, such pressure may be administratively increased by the Division upon a showing that such increase will not result in the fracturing of the injection formation or confining strata. The Applicant is further authorized to inject CO2 and produced gasses at a maximum surface injection pressure of 750 psi above the current maximum surface injection pressure for water, provided however, such CO2 and produced water injection may not occur at a surface injection pressure in excess of 2,200 psi (which is estimated to be the equivalent of 3,600 psi average bottomhole injection pressure). Such pressure may be administratively increased by the Division upon a showing that such increase will not result in the fracturing of the injection formation or confining stata.

(4) Ordering Paragraph (6) of Order No. R-4442-B is hereby amended as to read as follows:

> (6) For those injection wells within the enhanced oil tertiary recovery project with a current maximum surface injection pressure for water exceeding 1,500 psi, the Applicant is hereby authorized to inject water at the current surface injection pressure, and is further authorized to inject CO2 and produced gasses at a maximum surface injection pressure of 2,200 psi (which is estimated to be the equivalent of 3,600 psi average bottomhole injection pressure). The Division may grant increases in the maximum surface injection pressure authorized by this paragraph by administrative order.

(5) Exhibit A to Order No. R-4442-C is hereby amended to change the "Pressure Limit (CO2)" specified for each of the wells listed in that exhibit from 1,850 to 2,200.

(6) No provision of this Order shall be construed to authorize injection of CO2 or produced gasses into any well in the unit that is currently authorized for injection of water only.

(7) Except as specifically modified hereby, Orders Nos. R-4442 through R-4442-F, inclusive, shall continue in effect to the same extent as immediately prior to the issuance of this Order.

(8) Jurisdiction of this case 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

MARK E. FESMIRE, P.E.
Director

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