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-_____

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 PRESSURE 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.

CHEVRON U.S.A. INC.'S
PROPOSED 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 Examiners Terry G. Warnell and David K. Brooks.

NOW, on this ____ day of December, 2009, 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 the subject matter of this case.

2. The Applicant, Chevron U.S.A. Inc. (Chevron) seeks 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 in its previously approved tertiary recovery project in the Vacuum Grayburg-San Andres pressure Maintenance Project, Lea County, New Mexico.

3. In companion Case 14401, Chevron seeks amendment of Division Order No. R-5530-E, to revise the injection well completion requirements and to change the basis for the

calculation of the authorized injection pressure for carbon dioxide in its previously approved tertiary recovery project in the Central Vacuum Unit EOR Project Area, Lea County, New Mexico.

4. In each case, Chevron seeks to:

A. Amend the injection well completion requirements for these wells to authorize the current completions where the tubing has been cemented in the wellbore;

B. To authorize or grant exceptions for additional wells where the packers have been set more than 100 feet above the top of the injection perforations as long as the packer is set as close to the top most injection perforation as possible and within the unitized interval; and

C. To change the basis for the calculation of the authorized injection pressure for carbon dioxide from surface pressure to the average reservoir pressure.

5. The cases were consolidated for hearing with separate orders to be issued.

6. The Vacuum Grayburg-San Andres Unit was approved by the Oil Conservation Division by Order No. R-4433, dated November 8, 1972, and comprises approximately 1,486 acres, more or less, located in Lea County, New Mexico, more particularly described as follows:

TOWNSHIP 17 SOUTH, RANGE 34 EAST, N.M.P.M.

Section 35: W/2 SW/4

TOWNSHIP 18 SOUTH, RANGE 34 EAST, N.M.P.M.

Sections 1 and 2: All
Section 11: NE/4 NE/4
Section 12: N/2 NW/4

7. Pressure Maintenance Operations in the Vacuum Grayburg-San Andres Unit were authorized by Order No. R-4442 on November 27, 1972.

8. Chevron assumed operations from Texaco Exploration and Production, Inc. in October 2001. Testimony of Ingram.

9. Pursuant to the provisions of Division Order No. R-4442, as amended, Chevron, operates the Vacuum Grayburg-San Andres Unit in the Vacuum-Grayburg-San Andres Pool .

10. Order No. R-4442-A, dated September 18, 2001, authorized tertiary recovery operations by injection of CO2 within the Vacuum Grayburg-San Andres Unit. This order expired and CO2 injection was re-authorized by Order No. R-4442-B on December 11, 2007 which provides:

> "Enhanced tertiary injection operations shall be accomplished through internally coated tubing installed in a packer set within approximately 100 feet of the uppermost injection perforations or casing shoe; 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." Order Paragraph 4, Order No. R-4442-B.

11. In late 2002 the Central Vacuum Unit 58 Well failed a mechanical integrity test and attempts to repair the casing were unsuccessful. In a meeting between Chevron and the OCD District I Supervisor, Chevron was authorized to correct these problems by cementing the casing-tubing annulus and injecting down the tubing. A notice of intent was filed and approved and, after the work was completed, a Form C-103 (Sundry Notice) was filed and approved by the Division. Thereafter similar procedures were used on the Vacuum Grayburg-San Andres Unit 17 and 47. The OCD approved Sundry Notices for the cementing in both wells. Testimony of Ingram.

12. On June 5, 2009 Chevron filed additional information on Form C-103 concerning the cementing of tubing in the VGSAU Well No. 47. On June 23, 2009 the Division denied this Sundry Notice and following a meeting with the District Supervisor in Hobbs, Chevron was advised that the VGSAU Well No. 47 would have to be shut-in. In subsequent discussions with the Santa Fe Office of the Division, Chevron was allowed to continue to inject in the other wells in which this completion technique had been employed until this matter was resolved. Testimony of Ingram.

13. By letter dated August 4, 2009 the Division, through its Compliance and Enforcement Manager, advised Chevron that the District Office cannot grant exceptions to Division Orders and stated that Chevron either had to comply with the existing orders as written or seek to amend these orders through the hearing process. Testimony of Ingram.

14. Chevron filed its application for revision of the rules for each unit, reviewed its files on its New Mexico properties, identified a total of nine wells completed with this wellbore configuration, identified wells where packers could not be set within 100 feet of the upper most injection perforation and received authorization form the District Office to set packers above this interval. Testimony of Ingram.

15. With Division approval, Chevron ran a Blanking Plug Mechanical Integrity Test ("MIT") on each well to assure its integrity. The Division was notified by Chevron of these tests and some of the testing was witnessed by a Division Field Inspector. Chevron also met with the Division in Santa Fe to review possible ways to continue to monitor these injection wells to assure the protection of groundwater. Testimony of Ingram.

16. Scott Ingram, the Project Manager for the Vacuum Grayburg San Andres Unit and an Earth Scientist, testified that:

A. the remedial options available to Chevron are very limited due to the small casing used in these wells and that any option could cause Chevron to lose the wells;

B. the decision on whether or not to replace a well would be made on an individual well basis;

C. if the particular wells that are the subject of these consolidated cases are not available for injection, 2.210 MBO are put at risk; and

D. Chevron has previously invested over $1 million in its efforts to bring this situation into compliance with Division Rules and orders.

Testimony of Ingram, Chevron Exhibit 1, Slide 7.

ISSUE I: INJECTION WELLS WITH TUBING CEMENTED IN THE CASING:

17. Tejay Simpson, Operations Supervisor at the Vacuum Grayburg-San Andres Unit and the Central Vacuum Unit, reviewed the current operations at each Unit (Testimony of Simpson, Chevron Exhibit 1, Slides 10 and 11) and the status of each of the nine wells in which the casing has been cemented in the casing. Testimony of Simpson, Chevron Exhibit 1, Slide 11.

18. Mr. Simpson also reviewed the MIT's conducted on each of these wells where each was tested to pressures above their normal operating injection pressures. In each well the integrity of the tubing was confirmed. While there were problems with the wells during these tests, these problems were with the procedures used by Chevron and not with the integrity of the subject well bores. Testimony of Simpson; Chevron Exhibit 1, Slide 12.

19. From this testing, Chevron has been able to refine its procedures to enable it to get a good reading the first time a well is tested, thereby saving the OCD, as well as Chevron, the time required to conduct repeated tests on these wells. Testimony of Tejay Simpson.

20. Chevron revised its proposed Mechanical Integrity Testing Procedures for the subject wells based on its experience with these tests. Testimony of Simpson, Chevron Exhibit 1, Slides 15 and 16.

21. Mr. Simpson reviewed how Chevron monitors rate and pressure in each well and its system for surveillance, alarm monitoring and initial response to leaks. Testimony of Simpson, Chevron Exhibit 1, slides 17 and 18.

22. Koby Carlson, an Expert Automation Analyst, reviewed the Chevron Supervisory Control And Data Acquisition ("SCADA") System. Among other measurements, this system continuously monitors changes in well rate and pressure and enables Chevron to identify down hole leaks more quickly than the monitoring currently authorized by Division Rules. Testimony of Carlson, Chevron Exhibit 1, Slide 22 through 24. There is a high correlation in the relationship between rate and pressure in a well and an upset in the system caused by a leak can be quickly identified with SCADA. Testimony of Carlson, Chevron Exhibit 1, Slide 25.

23. The SCADA System has been used in the past to monitor for surface leaks and, since underground leaks demonstrate the same profile pattern as surface leaks, this system can be employed to detect underground leaks and will be used on each of the nine injection wells at issue in this case. Testimony of Carlson, Chevron Exhibit 1, Slides 26 and 27

24. Chevron recommended that (1) an annual Blanking Plug Mechanical Integrity Test be conducted on each of the nine injection wells that are the subject of these consolidated cases using the procedure set out in Chevron Exhibit 1, Slide 16, and (2) the SCADA System be used on each well to monitor changes in rate and pressure that would indicate upsets in the system from significant down hole leaks. Testimony of Ingram and Simpson, Chevron Exhibit 1, Slide 16.

25. These recommended methods of monitoring these injection wells have been approved in other jurisdictions and each is an authorized method for monitoring mechanical integrity under the Federal Underground Injection Control Program. See EPA 40 CFR 146.8 (b) (2)and (3), Testimony of Ingram, Chevron Exhibit 1, Slide 9.

26. The methods recommended by Chevron to monitor down hole leaks in these wells are reasonable and will enable Chevron to assure that each of the subject injection wells has mechanical integrity and that there is no significant fluid movement into any underground source of drinking water through vertical channels adjacent to the injection wellbore and should be approved. Chevron Exhibit 1, Slide 9.

ISSUE II: INJECTION WELL COMPLETION REQUIREMENTS – PACKER SETTING DEPTH

27. Order No. R-5530-E provides that "Enhanced tertiary injection shall be accomplished through internally coated tubing installed in a packer set within approximately 100 feet of the uppermost injection perforations or casing shoe." Order No. R-4442-B, Order Paragraph 4.

28. Paul Brown, Chevron Expert Petroleum Engineering witness, testified that once an injection packer is released for remedial actions, it is impossible to regain a packer seal at the same depth due to corrosion and therefore the packer must be reset higher in the well. Over time this requires packers to be set higher than the approved depth. Testimony of Brown, Chevron Exhibit 1, Slide 28.

29. In the past, the Division's District Office has approved a higher packer depth as long as the packer is within the unitized interval in an EOR unit. This practice violates the directive from the Division to Chevron that the District Office may not grant an exception to a Division order. Testimony of Brown, Chevron Exhibit 1, Slide 28.

30. Chevron has identified 31 wells in the Central Vacuum Unit and the Vacuum Grayburg-San Andres Unit with packers above the approved depth and 38 more injection wells where the next time the well is worked on the packers will have to be re-set above the approved depth. Testimony of Brown, Chevron Exhibit 1, Slide 29.

31. The upper boundaries of the Vacuum Grayburg-San Andres Unit are approximately 350 feet above the top perforation in the subject injection wells. Testimony of Brown, Chevron Exhibit 1, Slide 30.

32. Chevron requests that Order No. R-4442-B be amended to provide that the injection packer be 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 interval." Testimony of Brown, Chevron Exhibit 1, Slide 31.

33. This amendment of Order No. R-4442-B does not violate the Underground Injection Control Program. Testimony of Brown, Chevron Exhibit 1, Slide 32, See, EPA 40 CFR 146.8(2)(b)(i).

34. Chevron's requested amendment to Order No. R-4442-B will provide needed flexibility to operators and will assure that injected fluids are confined to the unitized interval in the Vacuum Grayburg-San Andres Unit thereby preventing any threat to groundwater and should be granted.

ISSUE III: CHANGING RULES TO BASE AUTHORIZED MAXIMUM INJECTION PRESSURE ON AVERAGE RESERVOIR PRESSURE

35. In the Vacuum Grayburg-San Andres Unit, Chevron is "authorized to inject CO2 and produced gases at a maximum surface injection pressure of 350 psi above the current maximum surface injection pressure for water, provided however, such CO2 injection shall not occur at a surface injection pressure in excess of 1850 psi." Order No. R-4442-B, Order Paragraph 5.

36. This injection pressure was based on the assumption that only pure CO2 would be injected. Testimony of Brown, Chevron Exhibit 1, Slide 33.

37. Chevron now injects a contaminated gas stream that contains only 87.032% carbon dioxide (See Chevron Slide 34, Buckeye Plant Recycle Gas Analysis) which decreases the density of the gas, reduces the bottom hole injection pressure and decreases injectivity in the Vacuum Grayburg-San Andres Unit. Testimony of Brown, Chevron Exhibit 1, Slide 36. The impact of this CO2 dilution results in a 400 pound reduction in bottom hole pressure below what was originally authorized in this unit. Testimony of Brown, Pipephase Calculation Table Chevron Exhibit 1, Slide 35.

38. The offsetting East Vacuum Grayburg-San Andres Unit was previously granted an injection pressure based on bottom hole pressure.

39. To maintain the previously authorized bottom hole pressure, an average mid-perforation maximum bottom hole injection pressure of 3600 psi is needed or a surface pressure of 2200 pounds. Testimony of Brown, Chevron Exhibit 1, Slide 36.

40. To maintain the desired and permitted bottom hole pressure with recycled CO2, thereby allowing Chevron to efficiently manage tertiary recovery of hydrocarbons from the Vacuum Grayburg-San Andres Unit, the requested amendment to the provisions of Order No. R-4442-B to authorize an average mid-perforation maximum bottom hole injection pressure of 3600 psi or a surface injection pressure of 2200 psi should be **approved.**

IT IS THEREFORE ORDERED THAT:

1. The application of Chevron U.S.A. Inc. for amendment of Division Order No. R-4442-B to revise the injection well completion requirements and to change the basis for the calculation of the authorized injection pressure for carbon dioxide in its previously approved tertiary recovery project in the Vacuum Grayburg-San Andres Pressure Maintenance Project, Lea County, New Mexico is hereby **granted**.

2. Order paragraphs 4 through 6 of Order No. R-4442-B are hereby amended as follows:

(4) For all injection wells, excluding those specifically approved for injection where the tubing has been cemented in place, injection shall be accomplished through internally coated tubing installed in a packer set, within the operators discretion, as close as practically possible to the uppermost injection perforations or casing shoe, so long as the packer set point remains within the unitized interval; 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.

(5) The two injection wells, identified on Exhibit A to this order, 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 project operator maintains records of monitoring that demonstrate the absence of significant changes in the relationship between injection rate and injection flow rate. See, EPA 40 CFR 146.8(b)(3).

(6) The applicant is further authorized to inject CO2 and produced gases at pressures up to an average maximum mid-perforation bottom hole pressure of 3600 psi, or up to a maximum surface injection pressure of 700 psi above the current maximum surface injection pressure for water, provided however, such CO2 and produced gas injection shall not occur at a surface pressure in excess of 2200 psi.

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

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MARK E. FESMIRE, DIRECTOR

S E A L

OIL CONSERVATION DIVISION
CASE NO. 14401

EXHIBIT A

CENTRAL VACUUM UNIT (CVU) INJECTION WELLS

Well Name	API Number	Footage Location	Unit	S-T-R
VGSAU 17	30-025-24316	1400' FSL & 10' FEL	I	2-18S-34-E
VGSAU 47	30-025-24365	1330' FNL & 10' FEL	H	2-18S-34E