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. 13961
ORDER NO. R-4442-B

APPLICATION OF CHEVRON USA, INC. FOR AMENDMENT OF DIVISION ORDER NO. R-4442, AS AMENDED, TO AUTHORIZE A TERTIARY RECOVERY PROJECT BY THE INJECTION OF CARBON DIOXIDE IN ITS VACUUM GRAYBURG-SAN ANDRES UNIT AREA, APPROVAL OF AMENDMENT OF THE COOPERATIVE WATER INJECTION AGREEMENT BETWEEN THE CENTRAL VACUUM UNIT AND THE VACUUM GRAYBURG-SAN ANDRES UNIT, LEA COUNTY, NEW MEXICO

ORDER OF THE DIVISION

BY THE DIVISION:

This cause came on for hearing at 8:15 a.m. on August 23, 2007 at Santa Fe, New Mexico, before Examiners David K. Brooks, Esq., and William V. Jones.

NOW, on this 11th day of December, 2007, the Division Director, having considered the testimony, the record and the recommendations of the Examiners,

FINDS THAT:

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

(2) By Order No. R-4433, issued in Case No. 4851 on November 8, 1972, as amended by Order No. R-4433-A dated December 11, 1972, the Division, upon application of Texaco, Inc., approved the Vacuum Grayburg-San Andres Unit comprising the 1405.64 acres, more or less, of State lands described as follows:

Township 18 South, Range 34 East, NMPM, Lea County, New Mexico

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

This Unit was expanded in 1981 to include the following additional 80 acres of State lands, by approval of the: **(i)** New Mexico State Land Office by letter dated February 2, 1981; and **(ii)** Division by letter Dated December 9, 1980:

Township 17 South, Range 34 East, NMPM, Lea County, New Mexico
Section 35: W/2 SW/4

(3) By Order No. R-4442, issued in Case No. 4852 on November 27, 1972, the Division authorized Texaco, Inc. to institute a pressure maintenance project within the aforementioned Vacuum Grayburg-San Andres Unit by the injection of water into the Grayburg and the San Andres formations, Vacuum-Grayburg-San Andres Pool (62180). The project was designated the Texaco Inc. Vacuum Grayburg-San Andres Pressure Maintenance Project.

(4) The "Unitized Formation" for the Vacuum Grayburg-San Andres Unit, as defined by the Unit agreement which was introduced as Exhibit 3 in this case on August 23, 2007, includes the stratigraphic interval underlying the Unit Area in the Vacuum-Grayburg-San Andres Pool between the depths of 3,902 feet (plus 105 feet sub-sea) and 4,809 feet (minus 802 feet sub-sea) on the Welex Acoustic Velocity Log, run on February 22, 1965 in the Texaco Inc. ("Texaco") State of New Mexico "M" State Well No.8, **(API No. 30-025-21107)**, now the Chevron USA, Inc.'s ("Chevron") Vacuum Glorieta West Unit Well No. 113, located 330 feet from the North line and 1880 feet from the West line (Lot 3/Unit C) of Section 1, Township 18 South, Range 34 East, NMPM, Lea County, New Mexico.

(5) By Order No. R-4442-A, entered on September 18, 2001, the Division granted the application of Texaco to amend Division Order No. R-4442 to **(i)** authorize the implementation of tertiary recovery operations within the Vacuum Grayburg-San Andres Unit Pressure Maintenance Project by the injection of carbon dioxide ("CO_2") and other produced gases into the Grayburg and San Andres formations, **(ii)** authorize the injection of CO_2 and produced gases at a maximum surface injection pressure of 350 psi above the maximum allowed surface water injection pressure, not to exceed 1850 psi, **(iii)** qualify the proposed tertiary recovery project as an Enhanced Oil Recovery ("EOR") Project pursuant to the "Enhanced Oil Recovery Act," and **(iv)** to approve the amendment of the lease line injection agreements between the Central Vacuum Unit and the Vacuum Grayburg-San Andres Unit.

(6) In August 2002, Texaco obtained an extension of this order from the Division Director. However, no action was taken to convert the wells that were the subject of this order to CO_2 injection, and the order expired of its own terms on September 18, 2003.

(7) Following the entry of Order No. R-4442-A, Texaco, and later Chevron, filed and the Division granted, the following three administrative applications with the Division seeking authorization to expand their Vacuum Grayburg-San Andres Unit Enhanced Oil Tertiary Recovery Project, including injection pressure increases for CO_2:

Administrative Order PMX-216, dated October 3, 2001 granted Texaco's application to authorize injection in its:

(i) **Vacuum Grayburg San Andres Unit Well No. 135** (API No. 30-025-35561) located 2535' FNL & 1930' FEL (Unit G), Section 1, Township18 South, Range 34 East, NMPM;

(ii) **Vacuum Grayburg San Andres Unit Well No. 235** (API No. 30-025-35562) located 2610' FNL & 660' FEL (Unit H), Section 1, Township 18 South, Range 34 East, NMPM; and

(iii) **Vacuum Grayburg San Andres Unit Well No. 249** (API No. 30-025-35563) located 1390' FNL & 2530' FWL (Unit F), Section 1, Township 18 South, Range 34 East, NMPM

Administrative Order PMX-217, dated November 13, 2001 granted Texaco's application to authorize injection in its **Vacuum Grayburg San Andres Unit Well No. 133** (API No. 30-025-35686) located 2590' FNL & 1270' FWL (Unit E), Section 1, Township 18 South, Range 34 East, NMPM.

Administrative Order WFX-823, dated October 23, 2006 granted Chevron's application to authorize injection in its **Vacuum Grayburg San Andres Unit Well No. 250** (API No. 30-025-38001) located 1443' FNL & 1286' FEL (Unit H), Section 1, Township 18 South, Range 34 East, NMPM.

(8) Chevron testified that each of these wells has been converted to injection and used for water injection as part of the Vacuum Grayburg-San Andres Pressure Maintenance Project approved by Division Order No R-4442, issued in Case No 4852 on November 27, 1972. Chevron further testified that no CO_2 or produced gas has been injected in any of these 5 wells and that all injection has occurred at or below the pressures approved for water injection in this project.

(9) Chevron requested that the Division confirm in the order entered in this case that each of these orders remains in full force for the injection of water only pursuant to Order No. R-4442 and that CO_2 or produced gas injection and increased injection pressure in any of these wells may only be allowed if approved by subsequently entered orders of the Division.

(10) Since Order No. R-4442 remains in full force and effect and authorizes the addition of water injection wells to the Vacuum Grayburg-San Andres Pressure Maintenance Project by administrative order, the request of Chevron that the Division confirm in the order entered in this case that each of these administrative orders remain in full force for the injection of water only pursuant to Order No. R-4442 and that CO_2 or produced gas injection and increased injection pressure in any of these wells may only be allowed if approved by subsequently entered orders of the Division, should be approved.

(11) The applicant, Chevron, now seeks an order from the Division granting its request for some of the same matters approved for Texaco by Order No R-4442-A. Chevron now seeks:

(a) to amend Division Order No. R-4442 to authorize the implementation of tertiary recovery operations within the Chevron

USA, Inc. Vacuum Grayburg-San Andres Unit Pressure Maintenance Project by the injection of carbon dioxide ("CO_2") and other produced gases into the Grayburg and San Andres formations;

b) authorization to inject CO_2 and produced gases at a maximum surface injection pressure of 350 psi above the maximum allowed surface water injection pressure, not to exceed 1850 psi; and

c) approval of the amendment of the lease line injection agreement between the Central Vacuum Unit and the Vacuum Grayburg-San Andres Unit.

(12) Chevron did present an exhibit and testimony toward qualifying this project for the Recovered Oil Tax Rate; however the request for qualification was not included in this case as advertised and Chevron asked it be considered at a future time.

(13) Current secondary recovery operations within the Vacuum Grayburg-San Andres Unit Area include 25 water injection wells and 47 producing wells. Chevron proposes to utilize the 25 water injection wells identified on Exhibit A to this order as CO_2 and produced gas injectors and to convert the one producing well also identified on Exhibit A to this order into a CO_2 and produced gas injection well.

(14) According to evidence and testimony presented by the applicant, its plan of operation for the implementation of this tertiary recovery project includes:

a) implementing a change in the process used for the displacement of crude oil by initiating water-alternating-gas (WAG) injection;

b) injecting an estimated 140 BCF of CO_2 and other produced gases over the life of the proposed tertiary project, which is estimated to be approximately 50 years (Chevron Exhibit 15);

c) utilizing a total of twenty-six (26) injection wells (all as shown on Exhibit "A" attached hereto) and forty-seven (46) producing wells within the proposed tertiary recovery project; and,

d) injecting at sufficient pressure so as to maintain reservoir pressure at high enough levels to meet miscible pressure requirements in the reservoir.

(15) The applicant proposed that the project area for the tertiary recovery project comprise an area (as shown in Exhibit 11) within the Vacuum Grayburg-San Andres Unit Area. This area represents less than the total area contained within the Vacuum Grayburg-San Andres Unit. According to applicant's testimony, the proposed tertiary recovery project is being limited to only a portion of the Vacuum Grayburg-San

Andres Unit which contains the best hydrocarbon pore volume within the Vacuum Grayburg-San Andres Pool.

(16) Further evidence and testimony presented by the applicant indicates that the amount of recoverable oil attributed to a positive production response from the expanded use of enhanced oil recovery technology for the proposed tertiary recovery project is an estimated 24.5 million stock tank barrels (Chevron Exhibit 15).

(17) Chevron presented testimony to the effect that the initiation of tertiary recovery operations utilizing the methodology proposed should result in the additional recovery set forth in Finding Paragraph No (16) above for a projected cost of approximately $233.6 million which includes field installations and upgrades, well remediation, separation and compression facilities, the purchase of CO_2 and the costs associated with the recycling of injected fluids.

(18) The proposed tertiary recovery project is offset by the following described WAG tertiary carbon dioxide floods within the Vacuum Grayburg-San Andres Pool, approved respectively, by Division Order Nos. R-5530-E and R-10599-B:

a) To the east is the Chevron's Central Vacuum Unit located in portions of Townships 17 and 18 South, Ranges 34 and 35 East, NMPM, Lea County, New Mexico. The authorized surface injection pressure for CO_2 in this project area is 1850 psig.

b) To the north is the McGowan Working Partners State "35" Unit Pressure Maintenance Project underlying the N/2, E/2 SW/4, and SE/4 of Section 35, Township 17 South, Range 34 East, NMPM, State "35" Com Unit Area, Lea County, New Mexico. The authorized surface injection pressure for CO_2 in this project area is 1850 psig.

(19) Pursuant to a Cooperative Water Injection Agreement, dated April 14, 1978, water has been injected into the Grayburg-San Andres formation through various wells located in Townships 17 and 18 South, Ranges 34 and 35 East, NMPM, Lea County, New Mexico. Chevron seeks authorization to amend this agreement to also provide for the injection of CO_2 and produced gases.

(20) To assure that the interest owners in Chevron's Vacuum Grayburg-San Andres Unit and Central Vacuum Unit continue to receive their fair and reasonable share of the reserves produced from each of these units, the proposed amendments dated January 4, 2001 to the Cooperative Water Injection Agreement which were presented as Exhibit No. 2 in this case, should be approved.

(21) The evidence and testimony presented in this case indicates that it is prudent to implement the proposed tertiary recovery project within the Vacuum Grayburg-San Andres Unit at this time, and that such implementation will result in the

recovery of additional oil and gas from the project area which may otherwise not be recovered, thereby preventing waste. The proposed tertiary recovery project should be approved.

(22) The evidence further indicates that the oil and gas recovered as a result of implementing the proposed tertiary recovery project will be allocated to each tract within the Vacuum Grayburg-San Andres Unit on a fair and reasonable basis, thereby protecting correlative rights.

(23) Division Order No. R-4442 which approved the Vacuum Grayburg-San Andres Unit Pressure Maintenance Project did not set a pressure limitation for water injection in the unit area.

(24) The current approved maximum surface injection pressures for each well within the proposed tertiary recovery project area range from approximately 1395 psi to 2300 psi.

(25) Chevron asked for no change in the approved injection pressure for water. However, injection wells intended for gas or WAG injection that currently have no pressure limit for water injection should have a "water injection pressure limit" set at this time of 1500 psi.

(26) Chevron seeks authority to inject CO_2 or a mixture of CO_2 and produced gas at a surface injection pressure which is 350 psi above the current maximum surface injection pressure for water for a given well with said injection pressure not to exceed 1850 psi.

(27) The evidence and testimony presented by Chevron indicates that the proposed maximum surface injection pressure (for CO_2 or CO_2 and a mixture of produced gas) of 1850 psi, or 350 psi above the current maximum surface injection pressure for water, is reasonable and necessary and should not result in the migration of injected fluid from the proposed injection interval.

(28) Chevron presented testimony that it has reviewed the available data on all wells in the Area of Review of this tertiary recovery project area including all injection wells, producing wells and plugged and abandoned wells, and that there is no remedial work required on any well to enable Chevron to safely conduct CO_2 injection operations.

(29) Chevron presented testimony that to ensure the integrity of each wellbore, wells in the Vacuum Grayburg-San Andres Project Area will be monitored like wells in the offsetting CO_2 floods which includes: (i) equipping each injection well with an automation system which monitors pressures in the well and shuts in the well if pressures increase above predetermined levels, (ii) conducting monthly Division-monitored bradenhead surveys on each injection well and annual Division-monitored bradenhead surveys on each producing well, (iii) conducting periodic wellbore integrity tests on each well, and (iv) visually inspecting each well each day.

(30) The CO_2 supply source for this project is McElmo Dome in southwestern Colorado. This CO_2 is naturally occurring in the earth, should be transported and re-cycled as needed for this enhanced oil recovery project and should not be released into the atmosphere.

(31) Chevron is not yet permitted to inject CO_2 derived from industrial operations (anthropogenic CO_2) and should apply to the Division for such permit as needed.

(32) The application should be approved, and the project should be governed by the provisions of Division Rules No. 701 through 708.

IT IS THEREFORE ORDERED THAT:

(1) The applicant, Chevron USA, Inc. ("Chevron") is hereby authorized to institute an enhanced oil tertiary recovery project by means of combined or alternating injection of water, carbon dioxide (CO_2), and produced gas into the Grayburg and San Andres formations, Vacuum-Grayburg-San Andres Pool, in its Vacuum Grayburg San Andres Unit Area located in portions of Township 17 South, Range 34 East, NMPM, Lea County, New Mexico.

Injection is authorized within each of the twenty-six (26) injection wells shown on Exhibit "A" attached hereto through the gross perforated interval in each well that is correlative to the interval between the depths of 3,902 feet (plus 105 feet sub-sea) and 4,809 feet (minus 802 feet sub-sea) on the Welex Acoustic Velocity Log, run on February 22, 1965 in Texaco's State of New Mexico "M" Well No. 8, **(API No. 30-025-21107),** now Chevron's Vacuum Glorieta West Unit Well No. 113, located 330 feet from the North line and 1880 feet from the West line (Lot 3/Unit C) of Section 1, Township 18 South, Range 34 East, NMPM, Lea County, New Mexico.

IT IS FURTHER ORDERED THAT:

(2) Any injection authority granted by Order No. R-4442, issued in Case No. 4852 on November 27, 1972, and injection authority of subsequent administrative orders, not in conflict with the provisions set forth in this order, shall remain in full force and effect.

(3) Each of the following administrative orders remains in full force for the injection of **only water** pursuant to Order No R-4442. CO_2 or produced gas injection and increased injection pressure in any of these wells may only be allowed if approved by subsequent orders of the Division:

Administrative Order PMX-216, dated October 3, 2001 granted Texaco's application to authorize injection in its:

(i) **Vacuum Grayburg San Andres Unit Well No. 135** (API No. 30-025-35561) located 2535' FNL & 1930' FEL (Unit G), Section 1, Township18 South, Range 34 East, NMPM;

(ii) **Vacuum Grayburg San Andres Unit Well No. 235** (API No. 30-025-35562) located 2610' FNL & 660' FEL (Unit H), Section 1, Township 18 South, Range 34 East, NMPM; and

(iii) **Vacuum Grayburg San Andres Unit Well No. 249** (API No. 30-025-35563) located 1390' FNL & 2530' FWL (Unit F), Section 1, Township 18 South, Range 34 East, NMPM

Administrative Order PMX-217, dated November 13, 2001 granted Texaco's application to authorize injection in its **Vacuum Grayburg San Andres Unit Well No. 133** (API No. 30-025-35686) located 2590' FNL & 1270' FWL (Unit E), Section 1, Township 18 South, Range 34 East, NMPM.

Administrative Order WFX-823, dated October 23, 2006 granted Chevron's application to authorize injection in its **Vacuum Grayburg San Andres Unit Well No. 250** (API No. 30-025-38001) located 1443' FNL & 1286' FEL (Unit H), Section 1, Township 18 South, Range 34 East, NMPM.

(4) 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.

(5) For those injection wells within the enhanced oil tertiary recovery project with a current maximum surface injection pressure for water of less than 1500 psi, 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 CO_2 and produced gases at a maximum surface injection pressure of 350 psi above the current maximum surface injection pressure for water, provided however, such CO_2 and produced gas injection may not occur at a surface injection pressure in excess of 1850 psi. 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.

(6) For those injection wells within the enhanced oil tertiary recovery project with a current maximum surface injection pressure for water exceeding 1500 psi, the applicant is hereby authorized to inject water into each of these wells at the current maximum surface injection pressure, and is further authorized to inject CO_2 and produced gases at a maximum surface injection pressure of 1850 psi unless a higher pressure is approved by the Division following a witnessed Step-Rate-Test.

(7) The Division Director shall retain the authority to administratively authorize a pressure limitation in excess of the above pressure limits upon a showing by the operator that such higher pressure will not result in the fracturing of the injection formation or confining strata.

(8) The operator shall immediately notify the Supervisor of the Hobbs District Office of the Division of the failure of the casing in any of the injection wells, the leakage of water, natural gas, CO_2, or oil from or around any producing well, or the leakage of water, natural gas, CO_2, or oil from any plugged and abandoned well within the enhanced oil tertiary recovery project, and shall take such steps as may be necessary to correct such failure or leakage.

(9) The proposed amendments to the Vacuum Grayburg-San Andres Cooperative Water Injection Agreement with the Central Vacuum Unit dated January 4, 2001 are hereby approved.

(10) The injection authority granted herein for the twenty-six WAG injection wells shall terminate one year after the effective date of this order if the operator has not commenced WAG injection operations into one or more of these wells, provided however, the Division, upon written request by the operator, may grant an extension thereof for good cause shown.

(11) The subject tertiary recovery project is hereby designated the "Vacuum Grayburg-San Andres Unit Tertiary Recovery Project" and shall be governed by the provisions of Rules Nos. 701 through 708 of the Oil Conservation Division Rules and Regulations.

(12) Monthly progress reports of the tertiary recovery project herein authorized shall be submitted to the Division in accordance with Rules 706 and 1115 of the Division Rules and Regulations.

(13) The injected and recycled CO_2 and produced gas shall not be released into the atmosphere. Chevron is not yet permitted to inject CO_2 derived from industrial operations (anthropogenic CO_2) and shall apply to the Division for such permit as needed.

(14) This order does not relieve the operator of responsibility should its operations cause any damage or threat of damage to fresh water, human health or the environment, nor does it relieve the operator of responsibility for complying with applicable Division rules or other federal, state or local laws or regulations.

(15) 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

SEAL
Attachment

Exhibit "A"
Case No. 13961 Order No. R-4442-B
Chevron USA, Inc.
Vacuum Grayburg San Andres Unit, Township 18 South, Range 34 East
Injection Well Summary

Existing Injection Wells to be used for CO2 or WAG Injection

Ref. No.	API	Well Name	Unit Lot	Sec	Pressure Limit (Water)	Pressure Limit (CO2)
1	30-025-24332	VGSA Unit 004	M	1	2,150	1,850
2	30-025-24333	VGSA Unit 005	N	1	1,500	1,850
3	30-025-24359	VGSA Unit 014	K	2	1,420	1,770
4	30-025-24328	VGSA Unit 015	J	2	1,500	1,850
5	30-025-24308	VGSA Unit 016	I	2	1,480	1,830
6	30-025-24316	VGSA Unit 017	I	2	1,500	1,850
7	30-025-24317	VGSA Unit 018	K	1	1,930	1,850
8	30-025-24331	VGSA Unit 019	N	1	1,500	1,850
9	30-025-24360	VGSA Unit 020	J	1	1,680	1,850
10	30-025-24314	VGSA Unit 031	J	2	1,500	1,850
11	30-025-24330	VGSA Unit 032	L	1	1,730	1,850
12	30-025-24323	VGSA Unit 033	E	1	P&Aed	P&Aed
13	30-025-24312	VGSA Unit 034	J	1	1,395	1,745
14	30-025-24361	VGSA Unit 035	G	1	1,500	1,850
15	30-025-24364	VGSA Unit 046	H	2	1,765	1,850
16	30-025-24365	VGSA Unit 047	H	2	1,500	1,850
17	30-025-24322	VGSA Unit 048	F	1	2,210	1,850
18	30-025-24329	VGSA Unit 049	F	1	P&Aed	P&Aed
19	30-025-24366	VGSA Unit 050	G	1	P&Aed	P&Aed
20	30-025-27974	VGSA Unit 063	2	2	2,115	1,850
21	30-025-30846	VGSA Unit 146	2	2	1,800	1,850
22	30-025-30798	VGSA Unit 147	H	2	2,030	1,850
23	30-025-30799	VGSA Unit 148	4	1	2,300	1,850
24	30-025-30847	VGSA Unit 149	3	1	1,845	1,850
25	30-025-30917	VGSA Unit 150	G	1	1,810	1,850
Active Producing Well to be Converted to CO2 Injection						
26	30-025-30721	VGSA Unit 122	H	1	1,500	1,210