

ARMSTRONG ENERGY CORPORATION

**APPLICATION OF ARMSTRONG ENERGY CORPORATION
FOR A PRESSURE MAINTENANCE PROJECT
(AND QUALIFICATION FOR THE RECOVERED TAX RATE
UNDER THE NEW MEXICO ENHANCED OIL RECOVERY ACT)
NORTHEAST LEA-DELAWARE POOL
LEA COUNTY, NEW MEXICO**

CASE No. 11436

HEARD BEFORE THE OIL CONSERVATION DIVISION

ON

DECEMBER 7, 1995

**BEFORE THE
OIL CONSERVATION DIVISION**

Santa Fe, New Mexico

Case No. 11436 Exhibit No. 6

Submitted by: Armstrong Energy Corporation

Hearing Date: December 7, 1995

**PECOS PETROLEUM ENGINEERING, INC.
ROSWELL, NEW MEXICO**

**APPLICATION OF ARMSTRONG ENERGY CORPORATION
FOR A PRESSURE MAINTENANCE PROJECT (AND QUALIFICATION
FOR THE RECOVERED TAX RATE UNDER
THE NEW MEXICO ENHANCED OIL RECOVERY ACT),
NORTHEAST LEA-DELAWARE POOL,
LEA COUNTY, NEW MEXICO**

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Purpose

Armstrong Energy Corporation (Armstrong) makes application for authority to implement a pressure maintenance project in part of the Northeast Lea-Delaware Pool, and to qualify this project for the **Recovered Oil Tax Rate** pursuant to the **New Mexico Enhanced Oil Recovery Act**, (laws 1992, Chapter 38, Sections 1 through 5).

Type of Project

Armstrong proposes to drill a water injection well, in a structural down dip position, in the SW/SW of section 2, T20S-R34E for pressure maintenance in the Third Sand Interval. The injection interval will be approximately 5930'-5970'. Water will be injected to supplement the natural water influx from the south. This injection will maintain reservoir pressure and displace oil to the updip producing wells.

C-108 Application

Exhibit No. 1 is a copy of Armstrong's C-108, Application for Authorization to Inject. This exhibit presents data on the project and outlines the status of wells within a one-half mile radius of investigation from the proposed injection well.

Injection Well Status

Armstrong proposes to drill a new pressure maintenance well located in the SW/SW, 330' FSL & 990' FWL, of section 2, T20S-R34E. The construction of this well is outlined in **Exhibit No. 1, Item III** in the C-108 Application.

Area of Review

Exhibit No. 1, Item V-A is a map showing all wells located within a Two-Mile Radius of investigation from the proposed injection well. **Item V-B** shows the one-half mile radius of investigation from the proposed well. All wells within the one-half mile radius of investigation have been reviewed to determine their status and construction.

The proposed injection well and the four producing wells that will be affected by injection are located in the SW/4 (160 acres) of section 2. The 160 acre tract is contained in a State lease, No. LG-2750. Leases surrounding this 160 acres are State to the north and east and Federal to the west and south.

Wells in the Area of Review

Pages **VI-A through VI-Q** of **Exhibit No. 1** contains data on all wells within the on-half mile area

of review that penetrate the injection interval. The wells are:

<u>Page</u>	<u>Well</u>	<u>Unit</u>	<u>Location</u>	<u>Status</u>
VI-A	Mobile Lea State #1	K	Section 2-T20S-R34E	Producing
VI-B	Mobile Lea State #2	L	Section 2-T20S-R34E	Producing
VI-C	Mobile Lea State #3	M	Section 2-T20S-R34E	Producing
VI-D	Mobile Lea State #4	N	Section 2-T20S-R34E	Producing
VI-E	Mobile Lea State #5	E	Section 2-T20S-R34E	Producing
VI-F	Mobile State #1	J	Section 2-T20S-R34E	Producing
VI-G	Mobile State #2	N	Section 2-T20S-R34E	P/A
VI-H	Federal "A" #1	P	Section 3-T20S-R34E	P/A - NDE
VI-I	Mark Federal #3	O	Section 3-T20S-R34E	Producing
VI-J	Mark Federal #4	P	Section 3-T20S-R34E	Producing
VI-K	Mark Federal #8	I	Section 3-T20S-R34E	Producing
VI-L	Federal "10" #2	B	Section 10-T20S-R34E	P/A
VI-M	North Lea Federal #3	H	Section 10-T20S-R34E	Producing
VI-N	North Lea Federal #9	H	Section 10-T20S-R34E	Producing
VI-O	North Lea Federal #10	A	Section 10-T20S-R34E	Producing
VI-P	Federal #5	D	Section 11-T20S-R34E	Producing
VI-Q	Federal #1	F	Section 11-T20S-R34E	Producing

Plugged and Abandoned Wells

Plugged and abandoned wells within the one-half mile area of review are listed as follows:

<u>Page</u>	<u>Well</u>	<u>Unit</u>	<u>Location</u>	<u>Status</u>
VI-G	Mobile State #2	N	Section 2-T20S-R34E	P/A
VI-H	Federal "A" #1	P	Section 3-T20S-R34E	P/A - NDE
VI-L	Federal "10" #2	B	Section 10-T20S-R34E	P/A

All wells are plugged in such a manner to contain fluids to the Delaware interval.

Injection Well Construction

The well Armstrong proposes to drill for injection is depicted in **Exhibit No. 1, Item III**. This will be a new well designed for injection.

Injection Zone

Injection will be into the Third Sand Interval of the Cherry Canyon, from 5930'-5970', 40'. The Third Sand has a gross thickness of 100'. The Cherry Canyon is the middle member of the Delaware Mountain sequence. These wells are in the Northeast Lea-Delaware Pool.

Other Productive Zones

Other oil and gas producing zones in the area include:

Cherry Canyon-First Sand	5456'-5676'
Bone Springs	9476'-10258'
Morrow	13034'-13462'
Devonian	14360'

Water Source and Injection Plan

Water used for injection will come from a closed system collecting water from producing Delaware wells in section 2, T20S-R34E. Average injection volume is estimated at 400 BWPD. The maximum daily injection rate is estimated at 500 BWPD. This daily injection volume is based on the productivity of the producing zone, which was estimated at .4544 bbls./psi. With an initial BHP of 2539 psi, this zone was capable of production in excess of 1000 BOPD. Calculations show the permeability to oil was 12.7 md. With a ΔP of approximately 1000 psi, the injection rate should be 400 to 500 BWPD. The average injection pressure is expected to be 500 PSI, 0.084 psi/Ft. The maximum pressure is estimated at 750 psi, 0.126 psi/ft. If the necessity to raise the injection pressure above 0.2 PSI/ft. is needed, a step rate test will be performed to determine reservoir parting pressure.

Water Analysis

The water to be injected is produced Delaware water. A water analysis is included in **Exhibit No. 1, Item VII**. Since this water is from the same formation as the injection interval, no compatibility problems are anticipated.

Fresh Water Zones

There are very limited fresh water sources in the area. The closest fresh water well is located one and one-half miles west in the SE/SE of section 4. This well was drilled to a depth of 200 ft. and produced from the Chinlee Formation. There are no fresh water zones below the injection interval. A water analysis is included in **Exhibit No. 1, Item XI**. This water is being piped to this site from another source to the north. This well is presently capped.

Hydrologic Isolation

After examining all available geological and engineering data, we find no evidence of open faults or any other hydrologic connection between the injection zone and any underground source of drinking water.

Recovery

The drilling of this pressure maintenance well is part of the reservoir management plan to maximize recovery from this reservoir. To date production has been designed to maximize recovery from the Third Sand Reservoir using solution gas drive. The reservoir pressure has been reduced to allow gas expansion and production of oil from the updip area (attic oil) of the reservoir. The reservoir surrounding the Mobil Lea State wells has entered the last phase of the solution gas drive mechanism, as evidenced by the declining gas-oil ratios, since July 1995. **Exhibit No. 2, A through J** are individual well production curves and **K** is a Third Sand total production curve.

Cumulative Production through August 1995 from each well is:

<u>Well</u>	<u>Oil</u>	<u>Gas</u>	<u>Water</u>	<u>Avg. GOR</u>	<u>Present GOR</u>
Mobil Lea State #1	139,289	132,462	11,061	951	2,239
Mobil Lea State #2	122,677	147,995	10,700	1,206	1,863
Mobil Lea State #3	76,961	99,253	15,396	1,289	2,364
Mobil Lea State #4	68,231	99,292	5,091	1,290	1,801
West Pearl State #1	43,468	30,281	6,357	697	1,333
West Pearl State #2	21,090	24,030	21,649	1,139	1,068
Total	471,696	521,832	70,254	1,106	
North Lea Federal #6	122,844	43,669	131,941	355	545
North Lea Federal #10	53,502	44,622	73,232	834	1,670
Mark Federal #4	39,001	24,030	4,097	616	1,032
Mark Federal #8	1,837	2,920	12,152	1,589	2,020
Total	217,184	115,241	221,422	530	
Pool Total	688,880	637,073	291,676	925	

To supplement the water influx and maintain reservoir pressure in the downdip part of the reservoir, water will need to be injected. The North Lea Federal #6 is the closest well to the oil-water contact and has evidenced the greatest effect of water influx. Exhibit No. 2-I shows the GOR has remained low, production has been relatively constant and oil recovery is high. Calculations show recoveries in the areas of the reservoir swept by the water drive may be as high as 50% of the oil-in-place. The total primary recovery from this reservoir is estimated at 900,000 to 1,000,000 BO, 16.5% to 18.3% of the original-oil-in-place.

Using the North Lea #6 as an analogy calculations indicate that if the recovery around the Mobil Lea State wells is increased from 18% to 33% an additional 300,000 BO will be recovered. Reserves were estimated using the reservoir model in **Exhibit No. 3-A and 3-B.**

<u>PRIMARY</u>				<u>ESTIMATED</u>	<u>OIL</u>	<u>% PRIMARY</u>
<u>ARMSTRONG</u>	<u>WELL</u>			<u>RECOVERABLE</u>	<u>PRODUCTION</u>	<u>RECOVERY</u>
<u>POR.-FT-BLKS</u>	<u>#</u>	<u>OOIP</u>	<u>R.F.</u>	<u>RESERVES</u>	<u>THRU 8/95</u>	<u>TO DATE</u>
316.5	1	1,210,102	0.18	220,019	139,269	63.30%
268.7	2	1,027,344	0.18	186,790	122,677	65.68%
172.5	3	659,343	0.18	119,881	76,961	64.20%
142.5	4	544,833	0.18	99,060	68,231	68.88%

**APPLICATION FOR QUALIFICATION OF THE
PROJECT FOR THE RECOVERED TAX RATE**

Status

The current status of this project is, application is being made to provide authorization to drill an injection well in January 1996. Water injection would commence as soon after the drilling and completion of this well as possible.

Producing Wells

The producing wells that will be affected by this injection well are:

<u>Page</u>	<u>Well</u>	<u>Unit</u>	<u>Location</u>	<u>Status</u>
VI-A	Mobile Lea State #1	K	Section 2-T20S-R34E	Producing
VI-B	Mobile Lea State #2	L	Section 2-T20S-R34E	Producing
VI-C	Mobile Lea State #3	M	Section 2-T20S-R34E	Producing
VI-D	Mobile Lea State #4	N	Section 2-T20S-R34E	Producing

Injection Well Location

The proposed injection well will be located in the SW/SW, 330' FSL & 990" FWL of section 2, T20S-R34E, Lea County, New Mexico.

Project Capital Costs

The estimated capital cost to implement this project is \$328,675 to drill and complete the injection well. The cost of the injection facility is estimated at \$32,500. Total project cost is estimated at \$361,175.

Project Economics

The projected incremental production from this project is 306,000 BO over 16.6 years. Based on an oil price of \$17.54 per barrel, a 100% W.I. and a 80% N.R.I., future net revenues are estimated at \$3,184,000, discounted future net revenue at 10% is \$1,892,000. An economic projection is presented in **Exhibit No. 4**.

Project Expansion

If successful, additional reserves could be recovered by adding more injection wells along the eastern downdip edge of the zone. The second proposed injection well location would be in the NE/SW of section 2.

Project Production

