ROCKY MOUNTAIN OILFIELD TESTING CENTER

PROJECT TEST RESULTS

# LOW COST REFRACTURING

JANUARY 23, 1998

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RMOTC Test Report
Number 96PT14

# Low Cost Refracturing

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## Introduction

There are relatively few stimulation options available to owners of marginal or stripper wells. These wells are commonly restricted in their production rates because of formation or wellbore damage near the wellbore. Current services available to remove this damage are compared to the small gains possible from old, marginal wells.

Over time, several things can occur that cause the flow of oil into the wellbore to be restricted. First, carbonate or sulfate scale can accumulate around the well or in the perforations. The accumulated scale will block oil from flowing into the well. Also, other materials such as clay, asphalt~ or paraffin can accumulate and cause the same type of flow restriction. Finally, a well might have been hydraulically fractured in the past but that treatment has failed over time. Common problems include crushed proppant used to hold the fracture open, proppant flow back into the well, or formation closure over the proppant and imbedinent into the surrounding rock formations.

Current technology is highly advanced. Important parameters can be measured in real-time during a fracture treatment and tools are available to predict the firture behavior of the treatment as it progresses. Pump rate, pressure, proppant concentration, and other parameters can be measured and recorded on disk for R=e analysis.

Fracture treatments commonly require at least five pieces of equipment, including at least one pump truck, one blender, a proppant carrier, a supply truck and monitoring van. Large treatments may have dozens of trucks hooked in parallel.Since many different pieces of truck-mounted equipment are used, communications equipment allows each operator to communicate with the other members of the team during the treatment. This also allows the engineer or technician to give the crew instructions from within a monitoring van.

Unfortunately, this level of sophistication carries a cost that is difficult for the owner of old, marginal wells to bear. The cost for a small fracture treatment can start at $10,000 for a shallow well. In an optimistic case, this cost may result in a payout of six months (5 additional barrels of oil per day at $12/bbI net). In many cases, the cost of treatment may not be justified at all.

Owners of stripper or marginal wells do not necessarily require or even want the level of technology that is available from service companies. This concept is designed around the assumption that re-fracturing treatments will involve pumping small quantities of fracturing fluid at relatively low injection rates and pressures. Technology is brought to a level that is appropriate for the geologic conditions and economic realities of this market.

This report documents the field testing of a low cost method of perforating hydraulic fracture treatments on new or existing oil wells. The primary focus of the RMOTC test was to verify the mechanical design and reliability of the pumping equipment. Second, RMOTC evaluated the ability of the equipment to perform a treatment of sufficient size and quality to be an effective stimulation alternative. Finally, well performance was evaluated in order to determine if the treatments were actually effective in our candidate wells.

## Operation

Rock Creek Enterprises has developed a method for performing small fracture treatments using a single pump truck and two persons. A water storage tank or water truck is all that is required for support.This down-sized method may enable marginal well operators to fracture (or re-treat) existing wells economically. A two person crew is able to batch mix 1,000 gallons of fracturing fluid based on a borate cross-linked, guar polymer. The fluid can be pumped at rates of 3-4 barrels per minute and at pressures up to 5,000 psi. An enzyme is used to break up the polymer after the treatment is completed. This type of fluid composition is commonly used in shallow, low temperature formations. Approximately 1,200 pounds of fracture proppant can also be carried and pumped during the treatment.

This borate cross-linked, enzyme breaker fluid has been used successfully at NPR-3 in the past~ with the fluid either being mixed "on-the-fly" and or batch-mixed. Due to the low reservoir temperature of the Shannon at such a shallow depth (60'F), there have been several previous failures to break the polymer after treatment with both enzyme and oxidizing (persulfate) breakers. Lab tests at reservoir temperature are required in order to determine the correct breaker concentrations.

Instrumentation is minimal. A circular chart recording pressure gauge is used to record treating pressure. A turbine meter is used to measure liquid pumping rate. The truck does not measure sand concentration or bulk fluid density. The "dirty" fluid injection rate (fluid injection rate adjusted for proppant volume) is also not available during the test. Since a constant rate auger is used to add proppant to the treating fluid, the "dirty" injection rate can be calculated after the treatment, based on the assumption that proppant injection was constant, even if the turbine meter recorded a changing liquid rate.

## Anticipated Benefits

The typical customer for this type of well treatment is an owner of old, shallow oil wells. These wells show signs of wellbore damage or they may never have been effectively fractured. The wells might carry high static fluid levels, but they pump off quickly and have low production rates. This low cost alternative will allow an owner to economically fracture (or re-fracture) wells in order to improve production. Current technology would be too expensive to be justified and the treatments would not be performed in that case.

## Test Program

Eight treatments were performed on wells at the US Naval Petroleum Reserve No. 3 located at the Teapot Dome oilfield. Wells are typical of the low volume, stripper operations intended to benefit from this process. The Shannon sand is a shallow, underpressured sandstone that occurs in two benches at depths from between 400 feet to 500 feet subsurface. The Second Wall Creek (Second Frontier) is another producing horizon located approximately 3,000 feet deep. Candidate wells included a mix of new completions of varying economic potential and older wells that we believed would benefit from re-fracturing.

Before field testing, construction drawings of the equipment were reviewed to determine that good design practices were used and that proper materials were selected for the fabrication. In addition, it was decided that the fast treatment would consist exclusively of a hydrostatic test and a clear water breakdown. This allowed the major systems to be tested without the risk of a chemical leak or spill.

As stated in the introduction, the goals and acceptance criteria of the test were:

1. Verify the mechanical design and reliability of the pumping equipment.

   - The equipment design contains expected safety features such as pressure relief valves and sufficient pressure rating for all components. OSHA requirements for equipment guarding, etc. will be enforced.

   - The equipment passes a hydrostatic pressure test greater than the treating pressures anticipated during the testing program.

2. Evaluate the ability of the equipment to perform a treatment of sufficient size and quality to be an effective stimulation alternative.

   - The equipment is capable of mixing and hydrating a quality polymer slurry containing 36 lb. guar polymer per thousand gallons of water, borate cross-linking agent, an enzyme breaker, and any other additives required for the treatment.

   - The fracturing fluid must cleanly break at reservoir conditions within the designed time.

3. Evaluate well performance in order to determine if the treatments were actually effective in our candidate wells.

   - Wells should show evidence of a successful stimulation treatment, comparable to offset well performance.

**TEST RESULTS:**

<u>Treatment 1, 2 & 3 - Well 28-1 X 11 (New Completion)</u>

The first fracture treatment performed by RMOTC was conducted on May 22, 1996. The Lower Shannon perforations from 553-573' were broken down with water only in order to verify the mechanical reliability of the truck and other equipment. Surface equipment was pressure tested successfully to 3,400 psi. The perforations were then broken down at 800 psi and 3-4 bbl./min. A total of 58 bbl. of water was pumped in three stages in order to simulate a 30 bbl. pad, a 24 bbl. treatment and a 4 bbl. flush. The treatment was executed at an average injection rate of 3.5 bbl./min. and 300 psi.

The second treatment was performed on May 23, 1996. The same perforations were treated with a 15 bbl. water pad followed by 24 bbl. of borate cross-linked slurry containing I lb./gallon 12/20 sand. No breakdown pressure was observed. Average pressure during treatment was 300 psi at 3 bpm.

The third treatment of the series was conducted on the Upper Shannon perforations from 478-498' on May 13, 1996. A 30 bbl. water pad was pumped, followed by 24 bbl. of cross-linked polymer containing proppant.

Unfortunately, the wellsite supervisor neglected to record treatment information during the test and as discussed previously, this process does not provide for automated data recording.

The well's Initial Potential (IP) was tested on 8/l/96 with 9. BOPD, 6.4, BWPD. Productivity is comparable with offset wells fractured conventionally.

Treatment 4 and 5: 45-1 X 14 (new completion)

This well was never completed due to poor reservoir quality and doubt that a commercial success would be achieved. The attractiveness of the Rock Creek Enterprises concept convinced us to attempt a completion. The Lower Shannon perforations from 908-928 were fractured on June 4, 1996. A 30 bbl. pad of water was followed by 24 bbI of slurry containing 1,000 lbs. of 20/40 sand. The perforations broke down at 1600 psi and the treatment was performed at 3.5 BPM and 250 psi. No ISIP was observed.

The Upper Shannon perforations were treated on June 13, 1996. The treatment screened out almost immediately and little proppant was placed in the fracture.

Swab testing after the treatment yielded little fluid inflow. No oil was recovered and only 5 bbl. of the load fluid was returned. Re well was temporarily abandoned.

Treatment 6: Well 81 SX 10 (Re-fracture)

The sixth treatment was conducted on July 17, 1997. Since both benches of the Shannon were already producing, both sets of perforations were treated together. A 30 bbl. pad of water was pumped at 3.9 bpm, followed by 24 bbl of sand slurry containing I 100 lb. of 20/40 sand (2 lb./gallon). Average pump rate was 3.8 bpm at 200 psi. No Initial Shut-in Pressure OSIP) was observed.

Production rate before treatment was approximately 3.3 BOPD and 40 BWPD. Production after treatment on 8/3/96 was 5.3 BOPD and 80.4 BWPD. A review of the production decline curve shows that the treatment yielded a small amount of incremental oil. This evaluation is complicated by the fact that a natural gas "huff & puff' project (cyclic gas injection) was underway in a nearby portion of the field. We cannot rule out the possibility that the change in production rate is due to gas injection.

Treatment 7 - 82 SX 10 (Re-fracture)

Both sets of existing Shannon perforations; 314-366 and 392-424, were treated on July 18, 1996.

A 30 bbl pad of water was followed by 24 bbl. slurry containing 1100# of 20/40 sand. No breakdown pressure was observed and the treatment was pumped at 3.9 BPM and 175 psi.

No change in production rate was initially observed. Both the oil and total fluid production rates continued to follow the previous decline trends. After an apparent period of "cleanup", production began increasing and a small incremental step in the decline curve is now observed.

Treatment 8: 15 AX I I (Re-fracture - 2nd Wall Creek)

The final treatment of the series was performed on 15 AX 11 on August 13, 1996. The 2nd Wall creek perforations at 3030-3044 feet were treated with a 50 bbl water pad followed by 24 bbl. of slurry containing 1200# of 20/40 sand. No breakdown pressure was observed and the treatment was performed at 3.6 bbl./min. at 100 psi. No ISIP was recorded because the well immediately went on a vacuum.

Production increased from 2.6 BOPD, 4.8 BWPD before the treatment, to 5.6 BOPD, 8.3 B)ATD after treatment. Both total fluid and crude oil demonstrated incremental increases upon decline curve analysis.

**TECHNICAL OBSERVATIONS:**

Criteria 1. Verify the mechanical design and reliability of the pumping equipment.

- The equipment design contains expected safety features such as pressure relief valves and sufficient pressure rating for all components. OSHA requirements for equipment guarding, etc. will be enforced.

- The equipment passes a hydrostatic pressure test greater than the treating pressures anticipated during the testing program.

The equipment proved itself to be mechanically reliable and passed a hydrostatic pressure test to 3,600 psi. The truck and associated equipment were also inspected by the project Safety Specialist and found to be in compliance with OSHA requirements.

The need to record treatment data manually will require some adjustment for operators. We discovered that wellsite supervisors assume that the data is being recorded and tend to take fewer notes during the treatment than they desire afterward. Any future enhancement of Rock Creek's services should include additional cost-effective data acquisition equipment.

Criteria 2. Evaluate the ability of the equipment to perform a treatment of sufficient size and quality to be an effective stimulation alternative.

- The equipment is capable of mixing and hydrating a quality polymer slurry containing 36 lb. guar polymer per thousand gallons of water, borate cross-linking agent, an enzyme breaker, and any other additives required for the treatment.

- The fracturing fluid must break at reservoir conditions within the designed time.

The equipment and crew were able to generate a crosslinked polymer slurry with enough control to carry sand into an induced fracture and break it afterward. The crew of the well servicing rig informally reported that one treatment (of eight) may not have broken sufficiently after the treatment. It should be noted and understood that the viscosity of the returned polymer gel was not checked after treatment and that this type of treatment may leave more damaging residue behind than other treatments that are closely controlled.

3. Evaluate well performance in order to determine if the treatments were actually effective in our candidate wells.

- Wells should show evidence of a successful stimulation treatment, comparable to offset well performance.

As far as production improvement is concerned, the results display a fairly common assortment of outcomes. Some wells showed economic improvement. One showed no change, indicating that the treatment was possibly unnecessary. One well increased water production, demonstrating the unpredictability of waterflood behavior. One well was an admittedly high-risk completion. In general, most wells demonstrated than an effective fracture treatment was obtained using Rock Creek Enterprises equipment.

In no case was there indication that the treatment may have damaged the well. This was a concern going into the program, given the relative lack of sophistication of blending the guar polymer and enzyme breakers.

## ACKNOWLEDGEMENTS

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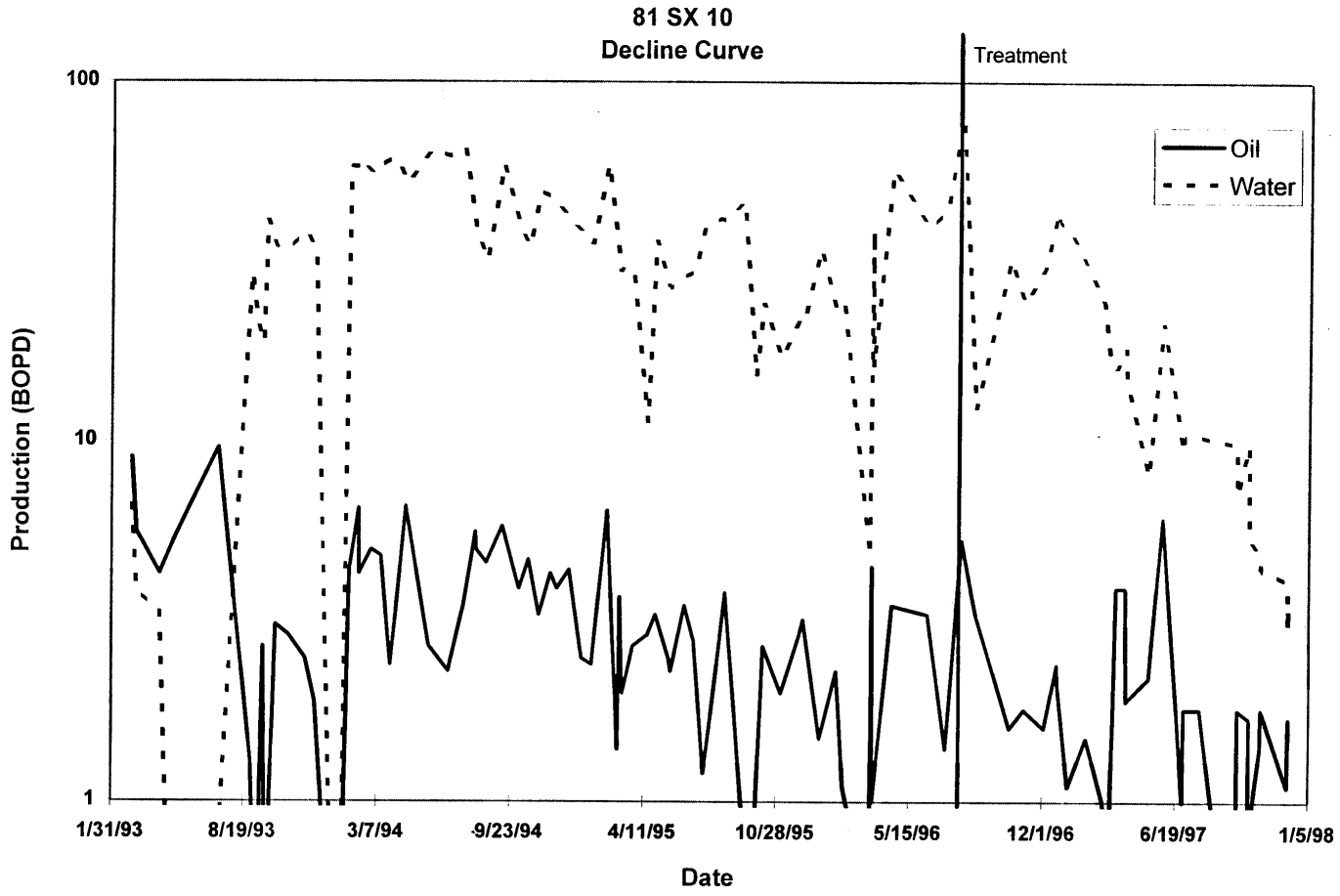
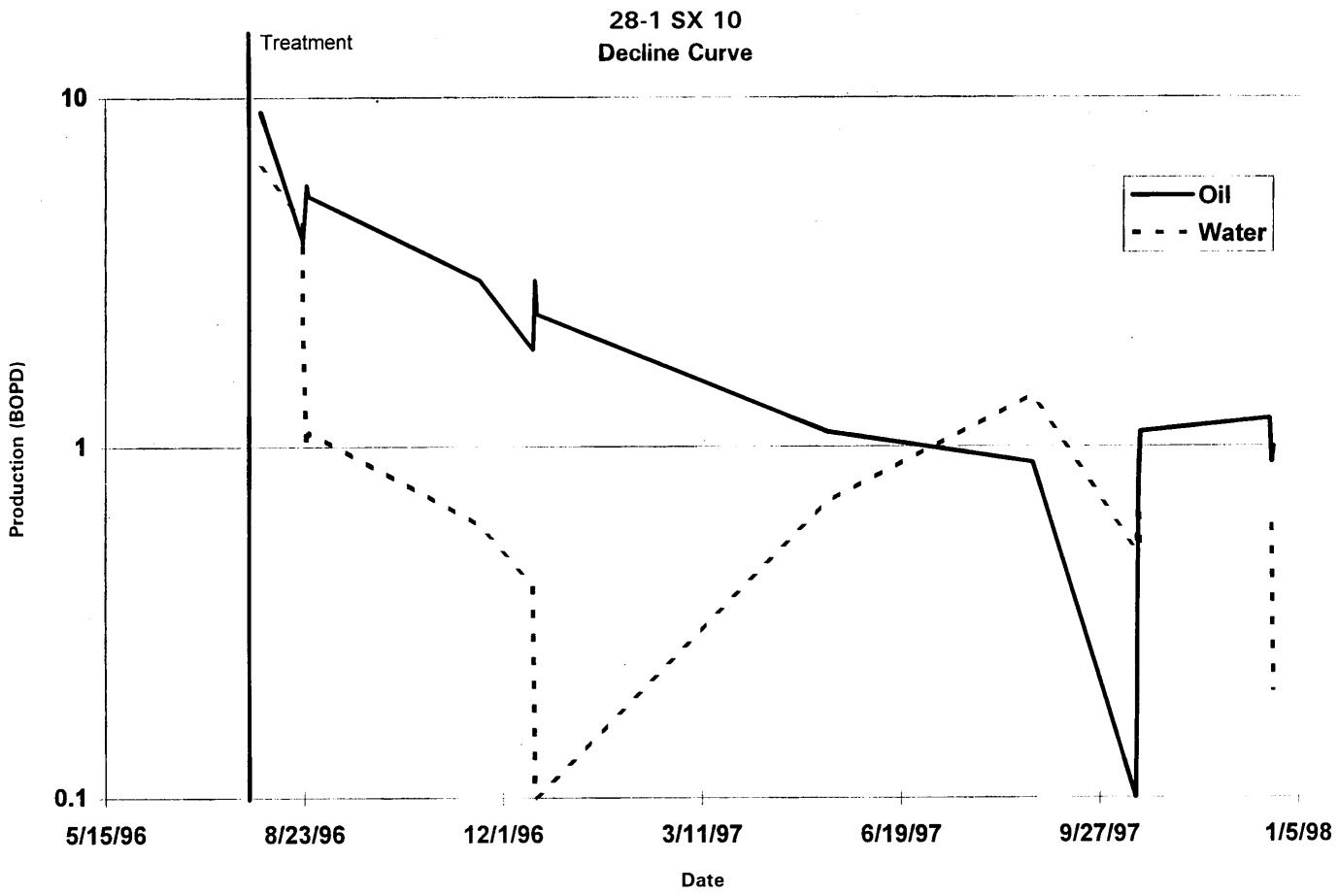
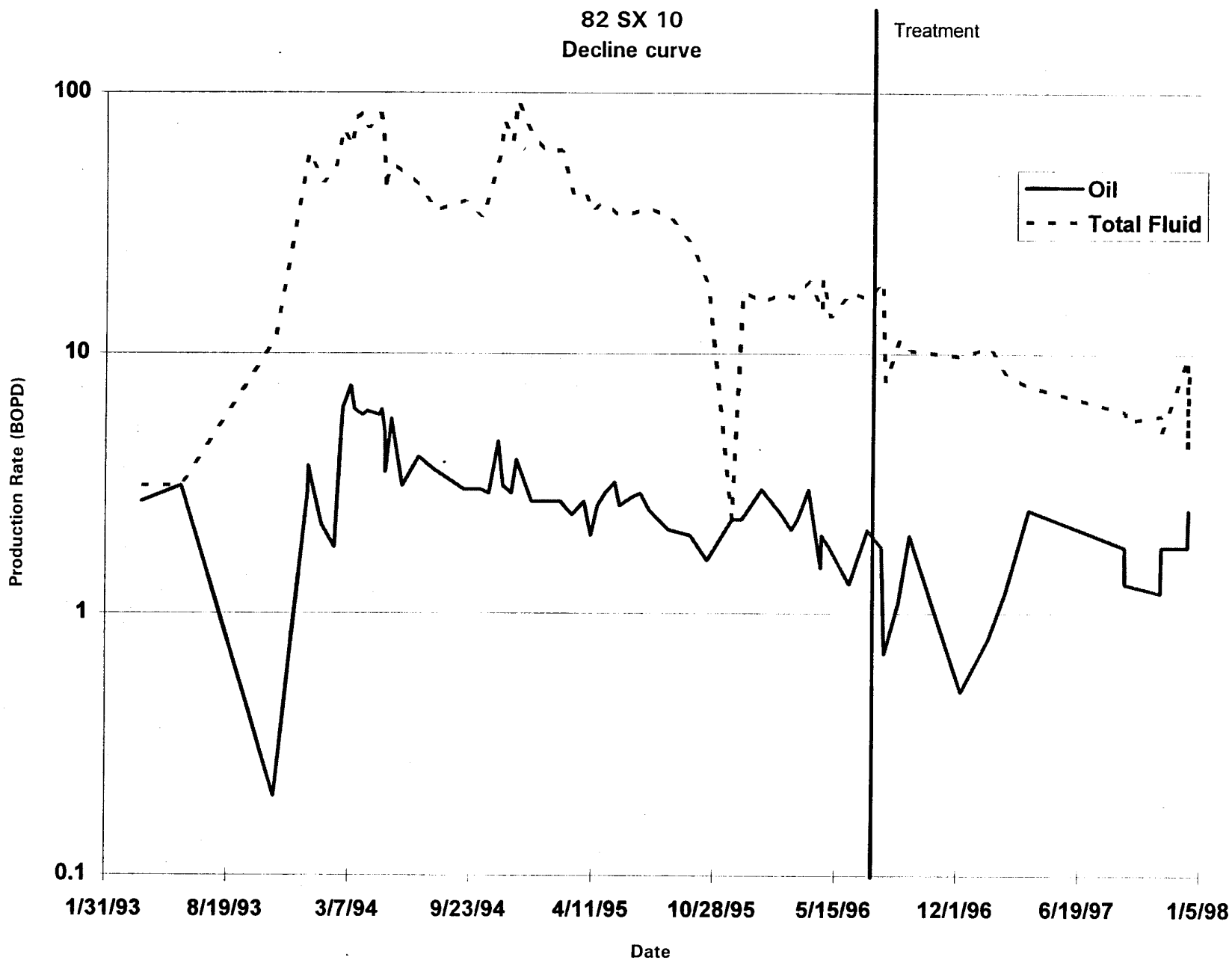
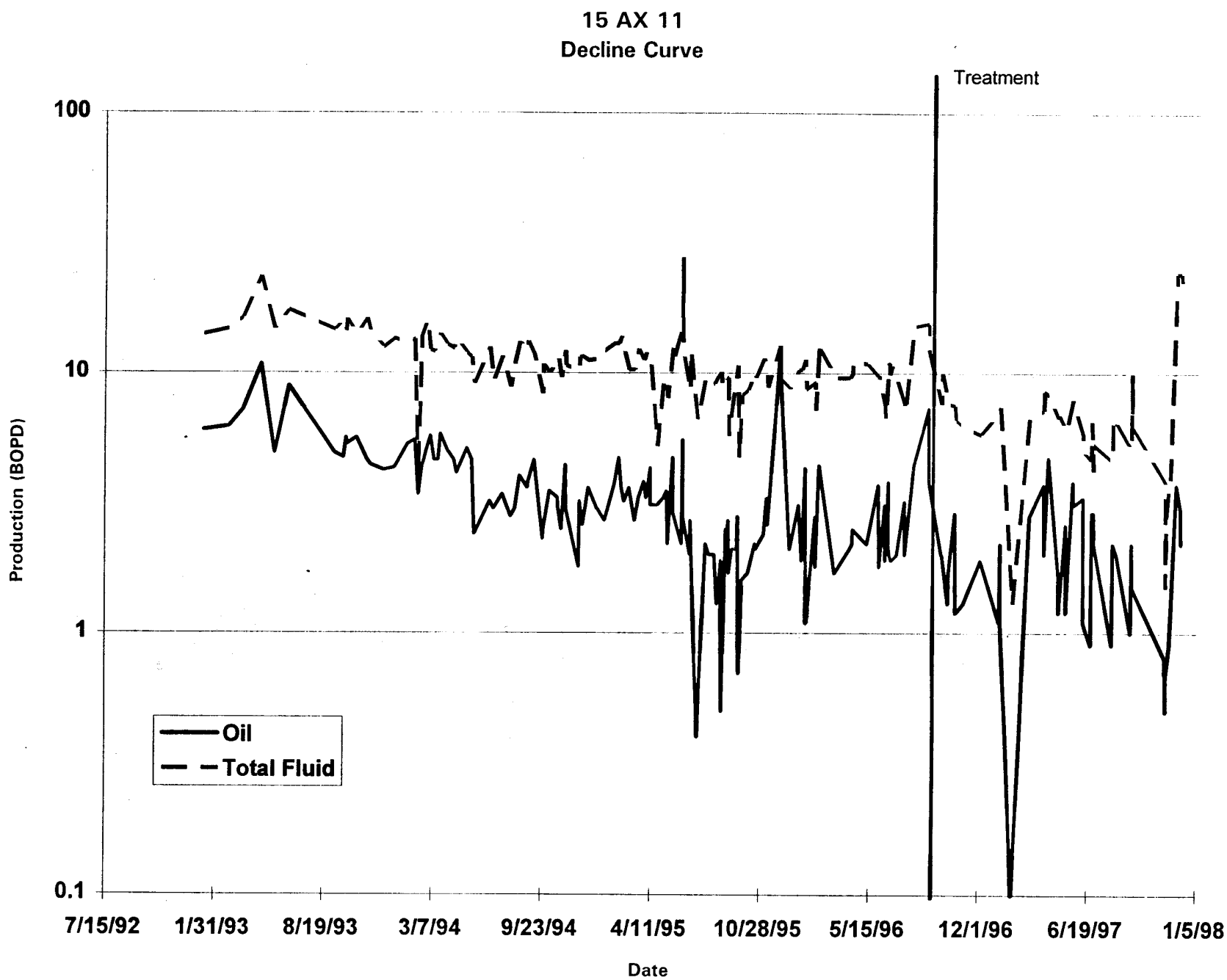

81 SX 10
Decline Curve
Treatment
Oil
Water
Production (BOPD)
100
10
1
1/31/93
8/19/93
3/7/94
9/23/94
4/11/95
10/28/95
5/15/96
12/1/96
6/19/97
1/5/98
Date


28-1 SX 10
Decline Curve
Treatment
10
1
0.1
Production (BOPD)
Oil
Water
5/15/96
8/23/96
12/1/96
3/11/97
6/19/97
9/27/97
1/5/98
Date


82 SX 10
Decline curve
Treatment
Oil
Total Fluid
Production Rate (BOPD)
100
10
1
0.1
1/31/93
8/19/93
3/7/94
9/23/94
4/11/95
10/28/95
5/15/96
12/1/96
6/19/97
1/5/98
Date


15 AX 11
Decline Curve
Treatment
100
10
1
0.1
Production (BOPD)
Oil
Total Fluid
7/15/92
1/31/93
8/19/93
3/7/94
9/23/94
4/11/95
10/28/95
5/15/96
12/1/96
6/19/97
1/5/98
Date

| 28-1 SX 10 Production History | | | |
|---|---|---|---|
| | | | |
| Date | Oil | Water | Total Fluid |
| | | | |
| 8/1/96 | 9.1 | 6.4 | 15.5 |
| 8/22/96 | 3.9 | 4.4 | 8.3 |
| 8/22/96 | 3.8 | 2.3 | 6.1 |
| 8/24/96 | 5.6 | 1 | 6.6 |
| 8/25/96 | 5.2 | 1.1 | 6.3 |
| 11/19/96 | 3 | 0.6 | 3.6 |
| 12/16/96 | 1.9 | 0.4 | 2.3 |
| 12/17/96 | 3 | 0.1 | 3.1 |
| 12/18/96 | 2.4 | 0.1 | 2.5 |
| 5/13/97 | 1.1 | 0.7 | 1.8 |
| 8/24/97 | 0.9 | 1.4 | 2.3 |
| 10/15/97 | 0.1 | 0.5 | 0.6 |
| 10/16/97 | 0.8 | 0.8 | 1.6 |
| 10/17/97 | 1.1 | 0.5 | 1.6 |
| 12/21/97 | 1.2 | 0 | 1.2 |
| 12/22/97 | 0.9 | 0.6 | 1.5 |
| 12/23/97 | 1 | 0.2 | 1.2 |

| 81 SX 10 Production History | | | |
|---|---|---|---|
| | | | |
| Date | Oil | Water | Total Fluid |
| | | | |
| 3/3/93 | 9 | 6.7 | 15.7 |
| 3/10/93 | 5.6 | 3.8 | 9.4 |
| 4/14/93 | 4.3 | 3.4 | 7.7 |
| 5/7/93 | 5.4 | 0.2 | 5.6 |
| 7/12/93 | 9.6 | 0.7 | 10.3 |
| 8/30/93 | 1.3 | 29.5 | 30.8 |
| 9/8/93 | 0.4 | 21.4 | 21.8 |
| 9/17/93 | 2.7 | 18.7 | 21.4 |
| 9/22/93 | 0.5 | 41.5 | 42 |
| 10/6/93 | 3.1 | 34.6 | 37.7 |
| 10/26/93 | 2.9 | 34.9 | 37.8 |
| 11/20/93 | 2.5 | 38.3 | 40.8 |
| 12/4/93 | 1.9 | 33.7 | 35.6 |
| 1/10/94 | 0.2 | 0.1 | 0.3 |
| 1/24/94 | 4.4 | 58.1 | 62.5 |
| 2/7/94 | 6.5 | 58 | 64.5 |
| 2/8/94 | 4.3 | 60.2 | 64.5 |
| 2/26/94 | 5 | 55.4 | 60.4 |
| 3/13/94 | 4.8 | 59.1 | 63.9 |
| 3/27/94 | 2.4 | 61 | 63.4 |
| 4/4/94 | 3.3 | 60.3 | 63.6 |
| 4/19/94 | 6.6 | 52 | 58.6 |
| 5/24/94 | 2.7 | 64.2 | 66.9 |
| 6/22/94 | 2.3 | 62.1 | 64.4 |
| 7/15/94 | 3.5 | 65.2 | 68.7 |
| 8/2/94 | 5.6 | 38.3 | 43.9 |
| 8/3/94 | 5 | 38.2 | 43.2 |
| 8/18/94 | 4.6 | 32 | 36.6 |
| 9/11/94 | 5.8 | 59.2 | 65 |
| 10/6/94 | 3.9 | 39.5 | 43.4 |
| 10/20/94 | 4.7 | 34.9 | 39.6 |
| 11/5/94 | 3.3 | 49.5 | 52.8 |
| 11/22/94 | 4.3 | 48 | 52.3 |
| 12/2/94 | 3.9 | 45.7 | 49.6 |
| 12/20/94 | 4.4 | 41.4 | 45.8 |
| 1/8/95 | 2.5 | 38.1 | 40.6 |
| 1/23/95 | 2.4 | 35.4 | 37.8 |
| 2/15/95 | 6.4 | 59.2 | 65.6 |
| 3/3/95 | 1.4 | 33.7 | 35.1 |
| 3/6/95 | 3.7 | 29.7 | 33.4 |
| 3/10/95 | 2 | 30.8 | 32.8 |
| 3/26/95 | 2.7 | 29.5 | 32.2 |
| 4/17/95 | 2.9 | 11.2 | 14.1 |
| 4/29/95 | 3.3 | 36.5 | 39.8 |
| 5/19/95 | 2.5 | 26.9 | 29.4 |
| 5/22/95 | 2.3 | 26.9 | 29.2 |
| 6/12/95 | 3.5 | 29 | 32.5 |
| 6/26/95 | 2.8 | 29.7 | 32.5 |
| 7/11/95 | 1.2 | 39.8 | 41 |
| 8/4/95 | 2.8 | 41.8 | 44.6 |

| 81 SX 10 Production History | | | |
|---|---|---|---|
| | | | |
| Date | Oil | Water | Total Fluid |
| | | | |
| 8/12/95 | 3.8 | 41.3 | 45.1 |
| 9/8/95 | 0.9 | 46.8 | 47.7 |
| 9/27/95 | 0.9 | 15.1 | 16 |
| 10/8/95 | 2.7 | 24.4 | 27.1 |
| 11/4/95 | 2 | 17.1 | 19.1 |
| 12/1/95 | 2.9 | 22.1 | 25 |
| 12/7/95 | 3.2 | 21.7 | 24.9 |
| 1/1/96 | 1.5 | 34.6 | 36.1 |
| 1/26/96 | 2.3 | 23 | 25.3 |
| 2/6/96 | 1.1 | 24.1 | 25.2 |
| 3/17/96 | 0.5 | 4.8 | 5.3 |
| 3/20/96 | 4.5 | 39.2 | 43.7 |
| 3/21/96 | 1 | 16.1 | 17.1 |
| 4/19/96 | 3.5 | 57.4 | 60.9 |
| 6/12/96 | 3.3 | 39.7 | 43 |
| 7/9/96 | 1.4 | 44 | 45.4 |
| 8/2/96 | 5.3 | 80.4 | 85.7 |
| 8/23/96 | 3.3 | 12.3 | 15.6 |
| 10/13/96 | 1.6 | 32.4 | 34 |
| 11/3/96 | 1.8 | 24.4 | 26.2 |
| 12/3/96 | 1.6 | 30.6 | 32.2 |
| 12/22/96 | 2.4 | 44.1 | 46.5 |
| 12/23/96 | 2.1 | 41.3 | 43.4 |
| 1/8/97 | 1.1 | 39 | 40.1 |
| 2/4/97 | 1.5 | 31.1 | 32.6 |
| 3/2/97 | 1 | 24.4 | 25.4 |
| 3/11/97 | 0.7 | 16.9 | 17.6 |
| 3/21/97 | 3.9 | 15.9 | 19.8 |
| 4/4/97 | 3.9 | 18.3 | 22.2 |
| 4/5/97 | 1.9 | 14.8 | 16.7 |
| 5/9/97 | 2.2 | 8 | 10.2 |
| 5/30/97 | 6.1 | 21.5 | 27.6 |
| 6/30/97 | 1 | 9.4 | 10.4 |
| 7/1/97 | 1.8 | 10.3 | 12.1 |
| 7/25/97 | 1.8 | 10.3 | 12.1 |
| 9/19/97 | 0.3 | 9.8 | 10.1 |
| 9/20/97 | 1.8 | 7.1 | 8.9 |
| 10/7/97 | 1.7 | 9.8 | 11.5 |
| 10/8/97 | 0.8 | 5.4 | 6.2 |
| 10/24/97 | 1.4 | 4.8 | 6.2 |
| 10/25/97 | 1.8 | 4.4 | 6.2 |
| 12/4/97 | 1.1 | 4.1 | 5.2 |
| 12/5/97 | 1.7 | 3 | 4.7 |
| 12/6/97 | 1.5 | 3.6 | 5.1 |

| 82 SX 10 Production History | | | |
|---|---|---|---|
| | | | |
| Date | Oil | Water | Total Fluid |
| | | | |
| 3/31/93 | 2.7 | 0.4 | 3.1 |
| 6/4/93 | 3.1 | 0 | 3.1 |
| 11/5/93 | 0.2 | 11.2 | 11.4 |
| 12/29/93 | 2.9 | 56.5 | 59.4 |
| 12/30/93 | 3.7 | 55.1 | 58.8 |
| 1/21/94 | 2.2 | 42.9 | 45.1 |
| 2/11/94 | 1.8 | 50.6 | 52.4 |
| 2/23/94 | 5.8 | 67 | 72.8 |
| 2/24/94 | 6.2 | 66.1 | 72.3 |
| 3/9/94 | 7.5 | 54.8 | 62.3 |
| 3/15/94 | 6.1 | 74.2 | 80.3 |
| 3/28/94 | 5.8 | 78 | 83.8 |
| 4/5/94 | 6 | 67.1 | 73.1 |
| 4/25/94 | 5.8 | 78 | 83.8 |
| 4/29/94 | 6.1 | 68.3 | 74.4 |
| 5/4/94 | 5 | 37.2 | 42.2 |
| 5/5/94 | 3.5 | 43.6 | 47.1 |
| 5/15/94 | 5.6 | 47.6 | 53.2 |
| 6/2/94 | 3.1 | 46.8 | 49.9 |
| 6/29/94 | 4 | 40.4 | 44.4 |
| 7/23/94 | 3.6 | 31.8 | 35.4 |
| 9/12/94 | 3 | 35.7 | 38.7 |
| 10/10/94 | 3 | 30.1 | 33.1 |
| 10/23/94 | 2.9 | 38.9 | 41.8 |
| 11/7/94 | 4.6 | 52.2 | 56.8 |
| 11/15/94 | 3.1 | 75.2 | 78.3 |
| 11/29/94 | 2.9 | 62.3 | 65.2 |
| 12/7/94 | 3.9 | 89.6 | 93.5 |
| 1/1/95 | 2.7 | 64.9 | 67.6 |
| 1/25/95 | 2.7 | 57.1 | 59.8 |
| 2/17/95 | 2.7 | 57.9 | 60.6 |
| 3/8/95 | 2.4 | 38.3 | 40.7 |
| 3/28/95 | 2.7 | 38.8 | 41.5 |
| 4/8/95 | 2 | 33 | 35 |
| 4/19/95 | 2.6 | 34.7 | 37.3 |
| 5/1/95 | 2.9 | 34.7 | 37.6 |
| 5/17/95 | 3.2 | 31.4 | 34.6 |
| 5/25/95 | 2.6 | 31.3 | 33.9 |
| 6/14/95 | 2.8 | 31.9 | 34.7 |
| 6/28/95 | 2.9 | 32.6 | 35.5 |
| 7/13/95 | 2.5 | 33.4 | 35.9 |
| 8/14/95 | 2.1 | 31.5 | 33.6 |
| 9/19/95 | 2 | 24.2 | 26.2 |
| 10/17/95 | 1.6 | 16.7 | 18.3 |
| 11/26/95 | 2.3 | 0 | 2.3 |
| 12/12/95 | 2.3 | 15 | 17.3 |
| 1/14/96 | 3 | 12.9 | 15.9 |
| 2/16/96 | 2.4 | 14.7 | 17.1 |
| 3/3/96 | 2.1 | 14.4 | 16.5 |
| 3/13/96 | 2.3 | 15.1 | 17.4 |

| 82 SX 10 Production History | | | |
|---|---|---|---|
| | | | |
| Date | Oil | Water | Total Fluid |
| | | | |
| 3/31/96 | 3 | 16.1 | 19.1 |
| 4/20/96 | 1.5 | 13 | 14.5 |
| 4/21/96 | 2 | 17.5 | 19.5 |
| 5/4/96 | 1.8 | 12 | 13.8 |
| 6/6/96 | 1.3 | 16 | 17.3 |
| 7/6/96 | 2.1 | 14.2 | 16.3 |
| 7/29/96 | 1.8 | 17.4 | 19.2 |
| 8/3/96 | 0.7 | 7.1 | 7.8 |
| 8/26/96 | 1.1 | 10.3 | 11.4 |
| 9/13/96 | 2 | 8.3 | 10.3 |
| 12/7/96 | 0.5 | 9.3 | 9.8 |
| 1/21/97 | 0.8 | 9.9 | 10.7 |
| 2/17/97 | 1.2 | 7.1 | 8.3 |
| 3/27/97 | 2.5 | 5 | 7.5 |
| 9/1/97 | 1.8 | 4.2 | 6 |
| 9/2/97 | 1.3 | 4.2 | 5.5 |
| 10/30/97 | 1.2 | 4.6 | 5.8 |
| 10/31/97 | 1.8 | 3.2 | 5 |
| 12/12/97 | 1.8 | 8 | 9.8 |
| 12/13/97 | 1.8 | 2.5 | 4.3 |
| 12/14/97 | 2.2 | 5.8 | 8 |
| 12/15/97 | 2.5 | 5.9 | 8.4 |

| 15 AX 11 Production History | | | | |
|---|---|---|---|---|
| Date | Oil | Water | Total Fluid | Gas |
| 1/11/93 | 6 | 8.1 | 14.1 | 278 |
| 2/26/93 | 6.2 | 8.6 | 14.8 | 268.1 |
| 3/24/93 | 7.2 | 9.2 | 16.4 | 273 |
| 4/26/93 | 10.8 | 12.8 | 23.6 | 50 |
| 5/21/93 | 4.9 | 9.9 | 14.8 | 189 |
| 6/16/93 | 8.9 | 8.6 | 17.5 | 90.3 |
| 9/8/93 | 4.9 | 9.8 | 14.7 | 258 |
| 9/24/93 | 4.7 | 11.3 | 16 | 263.3 |
| 9/29/93 | 5.6 | 8.9 | 14.5 | 251 |
| 9/30/93 | 5.3 | 10.9 | 16.2 | 226.4 |
| 10/18/93 | 5.6 | 8.5 | 14.1 | 50 |
| 11/6/93 | 4.6 | 11.7 | 16.3 | 228 |
| 11/13/93 | 4.4 | 9.9 | 14.3 | 215.5 |
| 12/7/93 | 4.2 | 8.4 | 12.6 | 227 |
| 12/26/93 | 4.3 | 9.3 | 13.6 | 193 |
| 1/19/94 | 5.3 | 7.8 | 13.1 | 189 |
| 2/1/94 | 5.5 | 8 | 13.5 | 212 |
| 2/8/94 | 3.4 | 0.4 | 3.8 | 203 |
| 2/14/94 | 4.3 | 9.6 | 13.9 | 263 |
| 2/24/94 | 5.2 | 10.8 | 16 | 205.8 |
| 3/2/94 | 5.7 | 6.6 | 12.3 | 231 |
| 3/9/94 | 4.6 | 7.5 | 12.1 | 218 |
| 3/16/94 | 4.6 | 8.4 | 13 | 227 |
| 3/20/94 | 5.8 | 8.4 | 14.2 | 230.3 |
| 4/2/94 | 5 | 7.9 | 12.9 | 250.9 |
| 4/14/94 | 4.6 | 7.9 | 12.5 | 190 |
| 4/19/94 | 4.1 | 9.5 | 13.6 | 153 |
| 5/8/94 | 5.1 | 6.9 | 12 | 50 |
| 5/17/94 | 4.6 | 6.9 | 11.5 | 240 |
| 5/22/94 | 2.4 | 6.7 | 9.1 | 251 |
| 6/19/94 | 3.2 | 9.4 | 12.6 | 50 |
| 6/26/94 | 3 | 6.3 | 9.3 | 227 |
| 7/12/94 | 3.4 | 8.2 | 11.6 | 286 |
| 7/28/94 | 2.8 | 6 | 8.8 | 216.7 |
| 8/4/94 | 3 | 8 | 11 | 210 |
| 8/13/94 | 4 | 9.2 | 13.2 | 28 |
| 8/27/94 | 3.6 | 8.6 | 12.2 | 266 |
| 8/28/94 | 3.8 | 9.5 | 13.3 | 252 |
| 9/8/94 | 4.6 | 7.2 | 11.8 | 247 |
| 9/24/94 | 2.3 | 6 | 8.3 | 257.5 |
| 9/25/94 | 2.5 | 8.3 | 10.8 | 261.5 |
| 10/6/94 | 3.5 | 6.5 | 10 | 255 |
| 10/21/94 | 3.3 | 7.9 | 11.2 | 244 |
| 10/22/94 | 3 | 8.5 | 11.5 | 244 |
| 10/28/94 | 2.5 | 7.1 | 9.6 | 258.4 |
| 11/4/94 | 4.4 | 7.8 | 12.2 | 251 |
| 11/5/94 | 3 | 7.7 | 10.7 | 258 |
| 11/29/94 | 1.8 | 8.4 | 10.2 | 145.4 |
| 11/30/94 | 3.2 | 8.3 | 11.5 | 137.5 |
| 12/6/94 | 2.6 | 9 | 11.6 | 255 |
| 12/16/94 | 3.6 | 7.6 | 11.2 | 249.1 |
| 1/1/95 | 3 | 8.3 | 11.3 | 258 |
| 1/2/95 | 3 | 8.6 | 11.6 | 287 |
| 1/15/95 | 2.7 | 9.5 | 12.2 | 313 |
| 2/2/95 | 3.7 | 9.3 | 13 | 276 |
| 2/10/95 | 4.7 | 8.3 | 13 | 310 |
| 2/15/95 | 3.6 | 10.3 | 13.9 | 327 |
| 2/20/95 | 3.2 | 9.1 | 12.3 | 362 |
| 3/1/95 | 3.6 | 6.7 | 10.3 | 277 |

| 15 AX 11 Production History | | | | |
|---|---|---|---|---|
| | | | | |
| Date | Oil | Water | Total Fluid | Gas |
| 3/11/95 | 2.7 | 7.6 | 10.3 | 254 |
| 3/18/95 | 3.3 | 9.1 | 12.4 | 302.5 |
| 3/28/95 | 3.8 | 7.4 | 11.2 | 50 |
| 4/1/95 | 3.3 | 8.7 | 12 | 280 |
| 4/9/95 | 4.3 | 7.3 | 11.6 | 284.5 |
| 4/9/95 | 3.1 | 8.3 | 11.4 | 297 |
| 4/22/95 | 3.1 | 2.1 | 5.2 | 214 |
| 5/3/95 | 3.3 | 6.3 | 9.6 | 50 |
| 5/9/95 | 3.5 | 5.3 | 8.8 | 50 |
| 5/11/95 | 2.2 | 5.8 | 8 | 278 |
| 5/20/95 | 4.7 | 7.8 | 12.5 | 50 |
| 5/21/95 | 2.9 | 8.3 | 11.2 | 121.5 |
| 6/6/95 | 2.2 | 12.7 | 14.9 | 261 |
| 6/7/95 | 5.5 | 22.4 | 27.9 | 249 |
| 6/8/95 | 2.8 | 9.5 | 12.3 | 221.4 |
| 6/21/95 | 2 | 6.5 | 8.5 | 478.5 |
| 6/22/95 | 2.7 | 9.5 | 12.2 | 478.5 |
| 7/5/95 | 0.4 | 6.2 | 6.6 | 50 |
| 7/20/95 | 2.2 | 7.5 | 9.7 | 424 |
| 7/26/95 | 2 | 7.4 | 9.4 | 50 |
| 8/5/95 | 2 | 7.1 | 9.1 | 175.6 |
| 8/10/95 | 1.3 | 8.3 | 9.6 | 375.4 |
| 8/17/95 | 1.9 | 8.2 | 10.1 | 50 |
| 8/18/95 | 0.5 | 8.5 | 9 | 50 |
| 8/26/95 | 2.5 | 6.3 | 8.8 | 262 |
| 8/27/95 | 2.1 | 7.4 | 9.5 | 261 |
| 8/30/95 | 2.7 | 6.9 | 9.6 | 255 |
| 8/31/95 | 1.7 | 4 | 5.7 | 212 |
| 9/6/95 | 2.1 | 5.2 | 7.3 | 50 |
| 9/15/95 | 2.1 | 8.1 | 10.2 | 218 |
| 9/16/95 | 2.8 | 7.9 | 10.7 | 229 |
| 9/19/95 | 0.7 | 4 | 4.7 | 184 |
| 9/24/95 | 1.6 | 6.6 | 8.2 | 220.5 |
| 10/5/95 | 1.7 | 6.9 | 8.6 | 195 |
| 10/18/95 | 2.2 | 7.9 | 10.1 | 221 |
| 10/19/95 | 2.1 | 7.5 | 9.6 | 204 |
| 11/3/95 | 2.4 | 9 | 11.4 | 217 |
| 11/8/95 | 3.3 | 7 | 10.3 | 50 |
| 11/10/95 | 2.6 | 6.2 | 8.8 | 213 |
| 12/2/95 | 12.4 | 0.4 | 12.8 | 50 |
| 12/3/95 | 9.4 | 0.1 | 9.5 | 235 |
| 12/20/95 | 2.1 | 6.6 | 8.7 | 239 |
| 1/5/96 | 3.1 | 7.2 | 10.3 | 232 |
| 1/11/96 | 1.9 | 8.4 | 10.3 | 247 |
| 1/17/96 | 4.3 | 7 | 11.3 | 242 |
| 1/19/96 | 1.1 | 7.6 | 8.7 | 161 |
| 2/4/96 | 2.8 | 6.4 | 9.2 | 257 |
| 2/5/96 | 1.8 | 5.4 | 7.2 | 227 |
| 2/10/96 | 4 | 8.1 | 12.1 | 262 |
| 2/11/96 | 4.4 | 8.1 | 12.5 | 268 |
| 3/2/96 | 2.3 | 8.2 | 10.5 | 222 |
| 3/11/96 | 1.7 | 7.9 | 9.6 | 224 |
| 4/7/96 | 2.1 | 7.5 | 9.6 | 207 |
| 4/12/96 | 2.2 | 7.8 | 10 | 210 |
| 4/13/96 | 2.5 | 8.6 | 11.1 | 217 |
| 5/9/96 | 2.2 | 8.7 | 10.9 | 50 |
| 5/30/96 | 3.7 | 6 | 9.7 | 228 |
| 5/31/96 | 2.4 | 7.4 | 9.8 | 228 |
| 6/1/96 | 1.8 | 7.6 | 9.4 | 50 |
| 6/11/96 | 3.1 | 4.5 | 7.6 | 183 |

| 15 AX 11 Production History | | | | |
|---|---|---|---|---|
| | | | | |
| Date | Oil | Water | Total Fluid | Gas |
| 6/12/96 | 1.9 | 4.8 | 6.7 | 183 |
| 6/18/96 | 3.8 | 7.2 | 11 | 196 |
| 6/18/96 | 2.1 | 8.8 | 10.9 | 50 |
| 6/19/96 | 2.1 | 8.8 | 10.9 | 195 |
| 6/20/96 | 2 | 7.9 | 9.9 | 199 |
| 6/23/96 | 1.9 | 8.8 | 10.7 | 206 |
| 7/3/96 | 2 | 7.4 | 9.4 | 195 |
| 7/17/96 | 3.2 | 4.4 | 7.6 | 194 |
| 7/18/96 | 2 | 5.1 | 7.1 | 192 |
| 8/3/96 | 4.4 | 10.8 | 15.2 | 200 |
| 8/30/96 | 7.3 | 8.3 | 15.6 | 217 |
| 8/31/96 | 3.8 | 8.3 | 12.1 | 217 |
| 9/23/96 | 2 | 5.6 | 7.6 | 80 |
| 9/24/96 | 2 | 8 | 10 | 80 |
| 10/5/96 | 1.3 | 6.5 | 7.8 | 133 |
| 10/6/96 | 1.7 | 5.9 | 7.6 | 50 |
| 10/17/96 | 2.9 | 4.6 | 7.5 | 50 |
| 10/19/96 | 1.2 | 5.4 | 6.6 | 50 |
| 11/2/96 | 1.3 | 4.9 | 6.2 | 152 |
| 12/3/96 | 1.9 | 3.9 | 5.8 | 132 |
| 1/7/97 | 1.1 | 6 | 7.1 | 147 |
| 1/8/97 | 2.2 | 5.2 | 7.4 | 150 |
| 1/9/97 | 1.1 | 5.9 | 7 | 150 |
| 2/1/97 | 0.1 | 1.2 | 1.3 | 120 |
| 3/2/97 | 2.8 | 3.9 | 6.7 | 128 |
| 3/28/97 | 3.7 | 3.5 | 7.2 | 143 |
| 3/29/97 | 2 | 6.5 | 8.5 | 155 |
| 4/5/97 | 4.7 | 3.6 | 8.3 | 143 |
| 4/24/97 | 1.7 | 5 | 6.7 | 130 |
| 4/25/97 | 1.2 | 5.7 | 6.9 | 161 |
| 5/7/97 | 2.6 | 3.5 | 6.1 | 154 |
| 5/8/97 | 1.2 | 4.8 | 6 | 155 |
| 5/20/97 | 3.8 | 4.1 | 7.9 | 204 |
| 5/21/97 | 3.1 | 4.6 | 7.7 | 180 |
| 6/8/97 | 3.3 | 2.5 | 5.8 | 192 |
| 6/9/97 | 1.1 | 3.9 | 5 | 50 |
| 6/23/97 | 0.9 | 3.7 | 4.6 | 50 |
| 6/24/97 | 2.9 | 3.6 | 6.5 | 206 |
| 6/27/97 | 2.9 | 1.3 | 4.2 | 196 |
| 6/28/97 | 2.2 | 3.1 | 5.3 | 190 |
| 8/1/97 | 0.9 | 3.7 | 4.6 | 190 |
| 8/2/97 | 2.2 | 4.6 | 6.8 | 0 |
| 8/9/97 | 2 | 4.4 | 6.4 | 0 |
| 9/5/97 | 1 | 4.1 | 5.1 | 202 |
| 9/6/97 | 2.2 | 7.8 | 10 | 205 |
| 9/7/97 | 1.5 | 4.7 | 6.2 | 205 |
| 11/7/97 | 0.8 | 3 | 3.8 | 215 |
| 11/8/97 | 0.5 | 1 | 1.5 | 0 |
| 11/9/97 | 0.7 | 2.1 | 2.8 | 0 |
| 11/15/97 | 0.9 | 3.1 | 4 | 127 |
| 11/16/97 | 1 | 2.9 | 3.9 | 0 |
| 11/26/97 | 3.7 | 20.7 | 24.4 | 191 |
| 12/4/97 | 3 | 21.4 | 24.4 | 181 |
| 12/5/97 | 2.2 | 20.5 | 22.7 | 183 |