Oil Well Remediation in Clay and Wayne Counties, IL

Technical Progress Report and Final Report

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ABSTRACT

This is the second progress and final technical report of the remediation of abandoned wells in Clay and Wayne Counties in Illinois.

The wells will be identified as the Routt #3 and #4 and the Bates Hosselton 1 and 2. Both sites have met all legal, financial and environmental requirements to drill and/or pump oil on both leases.

We have also obtained all available information about both leases. All steps were taken to improve access roads, dig the necessary pits, and build the necessary firewalls.

This progress and final technical report will address the remediation efforts as well as our results and conclusions.

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EXECUTIVE SUMMARY

This summary will include the final remediation results of the Routt leases as well as the Bates-Hosselton lease.

All legal requirements were met on both sites, which included satisfying some State violations on the Bates- Hosselton lease. All lease roads were immediately improved by adding gravel and rock, which was then leveled and graded. Necessary firewalls and pits were also dug. Electrical work was completed and problems corrected on the Routt lease, while propane gas was supplied to the Bates-Hosselton lease. Both sites include a water injection well that required Mechanical Integrity Tests. Both sites are in compliance with State requirements.

This report will now focus on the acidization and completion of the Routt lease.

As previously reported, we experienced several weather delays but we were able to acidize the Routt #3. The results of the Routt #3 acidization showed the well pumped 11 barrels of oil for two days, then dropped to 8½ barrels of oil per day. It eventually leveled out at approximately 5 barrels per day. The well continues to pump at a steady rate of 4-5 barrels per day. The well was treated with 1135 liters (300 gallons) of 10% hydrochloric acid and pressured up to 6894.8 kPa (1000 lbs.). We continued to treat at ¼ barrel per minute at 3792.14 kPa (550 psi). The well was then placed on pump. After pumping for 6 days, the well developed a packer leak. All rods and tubes were pulled and the top tension packer removed. Tubing was returned with set down packer at 698.6m (2292 ft.) with a 9.75m (32') joint and seating nipple below packer. All rods and tubing were replaced and the well was put on pump.

We then focused on the Routt #4. A 5.08cm (2") gas gun was utilized on the Routt #4 and the well was acidized with 2270.4 liters (600 gallons) of 10% hydrochloric acid with 20 barrels of flush and chemical wash. The well was treated at 2068.44 kPa (300 psi) at ¼ barrels per minute. The well was left shut in for 4 hours. After being placed on pump it pumped 2.9 barrels. The well steadied out at 2.3 barrels per day and continues to pump that amount daily.

The remainder of this summary will deal with the Bates-Hosselton lease and its remediation. The Bates-Hosselton lease consists of two wells and one water injection well. They are identified as follows: the Bates-Hosselton #1 well, the Bates Hosselton #2 (water injection well) and the Bates Hosselton #3. Work immediately began on the Bates-Hosselton #3. The decision was made to pull and repair tubing and place the well on pump without the benefit or use of gas gun stimulation at this time. After making the necessary repairs, the well was placed on pump and is currently pumping 1.8 barrels per day.

We then turned our attention to the Bates-Hosselton #1. After setting the rig on site, we started pulling 1.91cm (¾") rods. We immediately encountered serious problems. The rods pulled apart at seventy-two (72) sections down. The rods were parted and came out in small sections. It was necessary to weld a collar on the top joint in an effort to pull tubing. After pulling 34 joints, we hit a tight spot, which pulled a section of tubing in two. The fish was at 533.4m (1750') down from the surface. (Fish is a term used to identify the down hole location of the broken or torn rod, tubes, or casing.) We were able to determine that the top part of the fish was 238.05m (781') down hole. After renting the necessary fish tools we re-entered the hole with an 8.89cm (3 ½") overshot fishing tool with a 76.2cm (30") extension. We ran new tubing to 233.78m (767'). We went into the hole with a 1.91cm (¾") rod to fish out remaining rods.

Poor weather conditions and mud once more delayed progress. Additional time was required for rig set up and tear down. Again, an attempt to pull tubing was made. After pulling 6 joints, we again got stuck. We worked the tubing, pulling it off the fish. When we exited the hole, the grapple was partially broken and left in the hole. A new 6.05cm (2 3/8") grapple was lowered and we were able to move the fish, but lost it.

We then tried a 5.87cm (2 5/16") grapple. We were able to pull 38 joints of tubing. When the tool was removed, it came out with the top collar of a broken packer. We then rigged up a retrieving tool to fish 1.6cm (5/8") rods in open casing. In our effort to do so, we built a spear out of 2.54cm (1") rod, putting a 3/2 swedge on it. We set down at 531.88m (1745') with negative results.

Continued efforts to remove the debris in the Bates-Hosselton #1 brought disappointing results. A fishing tool with undersized slips and a 7.62cm (3") skirt was used to bypass the fish. It appears we may have parted casing. In an effort to pump the well, we re-entered the hole with 55 joints of 5.08cm (2") tubing and a 5.08cm x 2.44m (2"x8') perforated mud anchor. We placed a 30.48cm (12") seating nipple to seat the insert pump. We ran 526.39m (1727') of tubing with a 5.08cm x3.81cm x 3.05m (2"x1 ½" x 10') insert pump with a .30m x 1.83m (1'x6') strainer. Our 1.91cm (¾") rods were then placed in the hole and the pumping unit was set. We tried to skim any oil out of the zone but were unable to do so. The well continually pumped water. The well was shut in at this time. The Bates-Hosselton #1 will remain shut in until a decision is made as to it's future.

We immediately began work on the Bates-Hosselton #3. This well is currently pumping at the aux-vase formation between 913.79m–914.7m (2998' to 3001'). It will be necessary to squeeze this formation. Squeezing is a process where the formation is cemented in and later drilled out to a desired down hole formation.

A T-65 drilling unit was pulled onto the lease and remediation of the Bates-Hosselton #3 began. This synopsis is a culmination of several weeks of operation. All tubing and rods were pulled. All tubing was tested to 4136.88 kPa (6000 psi). The tubing and rods were returned to the hole and an AD-1 packer was set at 867.16m (2845'). The hole was then cemented between 911.96m-912.88m (2992' and 2995') using 39 sacks of cement. The zone locked up (it quit taking fluid indicating the zone was cemented in). The well was pressured up to 22063.36 kPa (3200 lbs.). The packer was unseated and the hole washed down. After pulling two joints, the well pressured up. It was then shut down for three hours.

After the removal of the tubing, a 9.84cm (3 7/8") tri-coned drill bit was used to drill out the cement. The cement was encountered at 867.16m (2845') and was drilled to 918.97m (3015'). The bit was run down hole to 941.22m (3088') where the hole was circulated and cleaned. After pulling the bit, the T-65 rig was moved off the lease. A standard spudder was then rigged up. The wire line company re-perforated the McClosky zone. (See Results and Discussion for explanation.) Perforations were at 918.06m (3012') and 918.67m (3014') at the McClosky formation 5 shots per foot and 918.06m-918.67m (3012' – 3014'). We then shot a .61m (2') gas gun at 918.06m-918.67m (3012' – 3014'). We replaced the AD-1 packer and set it at 915.92m (3005'). We then acidized the zone using 1892 liters (500 gallons) of 10% MCA (mud acid). The formation broke down at 9652.72 kPa (1400 psi) and we continued to treat with 2 barrels of acid.

After shutting down to let the acid soak in, the pressure dropped to 5515.84 kPa (800 psi). We finished treatment at 2½ barrels per minute at 10169.83 kPa (1475 psi). We then rigged up, replaced tubing and swabbed the hole. We encountered a good show of oil, a good blow of gas and a little show of water. We then delivered 5676 liters (1500 gallons) with 10% acid. We continued treating at 2½ barrels per minute at 8273.76 kPa (1200 psi). We overflushed with 20 barrels of salt water resulting in a pressure rise to 5860.58 kPa (850psi). We then rigged up and did a tubing swab.

After two pulls we had a good blow of acid. The well gassed and flowed fluid for 15 minutes. It showed excellent color and a strong blow of gas. The fluid level was 396.24m (1300') from surface. We then pulled the packer and tubing. The necessary pumping equipment was set on the hole and the mud anchor was set at 929.03m (3048'). We put 3.29cm (¾") rods in tubing and placed the well on pump.

The first day the Bates-Hosselton pumped 29 barrels of oil and 60 barrels of water. The second day it pumped 45 barrels of oil and 15 barrels of water. The well pumped 30 barrels of oil and 15 barrels of water on day three. Day four the well dropped to 24 barrels of oil and 15 barrels of water. It is currently pumping 20 barrels of oil and 15 barrels of water.

EXPERIMENTAL

The gas gun was used on 3 wells and shot 4 times. We were unable to use the gun on the Bates-Hosselton #1.

As previously reported, we experimented with the gas gun on the Routt #3 by using plastic tubing in an effort to reduce the down hole debris. The tubing was replaced open-ended and the hole circulated to recover any debris in the zone. Recovery efforts were very promising as the plastic tubing was disintegrated and reduced to gravel-like parts. We also experimented on the Bates-Hosselton #3 by using rubber tubing with ends made of hard plastic and a screwed-on cemented weight to facilitate easy down hole movement.

Again, as on the Routt #3, we used some experimental procedures to remove debris from the hole on the Bates-Hosselton. We created a center spear consisting of 2.5cm (1") rod. We welded assorted barbs at different angles to pull rod, and in some cases, damaged tubing from the hole.

RESULTS AND DISCUSSION

The remediation portion of this project is now complete. The following observations, discussions, and results are a culmination of events for the past twelve months.

The drilling superintendent, project geologist and project director have provided all the information contained in the report. In an effort to analyze and discuss the results, the report will address the well sites in the order they were remediated.

The reclamation of the Routt lease proved difficult, however it is considered a success in that most of our objectives were achieved. The clean up, road repairs, electrical overhaul and repair of the saltwater injection well made the lease operational. All legal and environmental concerns were met.

The remediation of the Routt #3 was costly and with concerns. We utilized the gas gun in two zones but did not use the gun in any other formation for fear of breaking the casing. We did not anticipate finding any debris down hole. It proved costly in rig time and labor to remove the rubbish and repair the tubing. In view of the unanticipated costs, it is recommended that anyone rehabbing abandoned well sites have their own rig and labor force to avoid the costly contract charges. We eventually perforated the zone and, utilizing the gas gun, stimulated the formation. After acidization, the well is pumping 4 to 5 barrels daily.

It is important to know the well is pumping beneath a packer because of a hole in the casing. This also presents special problems in that the well cannot be treated with chemicals and it increases its operational costs. It is felt that if we are able to patch the casing and remove the packer we will be able to double or triple our production. The problem can be remedied with the use of a gas-vent packer. It's a packer which would straddle the casing hole and allow annular space to let gas out and chemicals down hole. It is our intention to remedy the problem when funds become available.

The Routt #4 was stimulated with the gas gun and acidized. It is currently pumping 2.3 barrels per day. The gamma ray log indicates there is another zone to explore in the Routt #4. At some point we will attempt to explore this formation.

The reclamation of the Bates-Hosselton #1 and #3 proved just as difficult as the Routts #3 and #4. Much effort was put in the repair of the Bates-Hosselton #1. It is not currently pumping and will remain down until all debris is removed from the hole and the necessary repairs made to make it functional. There is some indication that the casing may be damaged, which complicates further repairs. It should be noted that every attempt will be made to remediate this well because of its geological log readings and the success on the Bates-Hosselton #3. The Bates-Hosselton #1 appears to be at least 35.56cm-45.72cm (14"-18") higher in the same zone and the log shows a 3.05m-3.66m (10'-12') break in that formation. It is our feeling this zone will produce as much as, if not more, oil than the Bates Hosselton #3.

We chose to remediate this lease because we learned, through an interview with the former owner, that he attempted to perforate the same zones that we targeted, but he was unable to break down the zone. After two attempts, he abandoned the site. It was decided that this would be an excellent choice to determine the effectiveness of the gas gun technology.

The Bates-Hosselton #3 was squeezed and drilled to a lower zone. The zone was re-perforated and gas gun stimulation was utilized. It was evident the gas gun technology helped break down the formation as the zone initially pumped 45 barrels of oil and 15 barrels of water. The well is currently pumping 20 barrels of oil daily and giving up 15 barrels of water. It is unknown how long it will continue to pump this amount, but it appears to be leveling out at the time of this report.

In addition to the pumped oil, the well is giving up natural gas, which is currently being utilized to run the pumping unit. The unit was equipped with a test meter to monitor its output for commercial sale and use. It has been determined that the well is not giving up enough gas for commercial use, however there is enough to run the pumping units, eliminating the high cost of propane.

CONCLUSIONS

The project is nearly completed. We have met our objectives and consider the project a success with some considerations.

All sites have been made environmentally safe. They have met all legal requirements and all are operational. We attempted to remediate a total of 6 wells on two separate leases with 2 potential producing wells and one water injection well on each site. Both water injection wells passed their Mechanical Integrity Tests and will be able to handle all water from their own leases as well as surrounding leases, if necessary. We completed 5 of the 6 wells within our allocated time period. The Bates-Hosselton #1 remains inoperative however we will continue with our plans to make it a producer.

The Routt lease is currently pumping 6 barrels of oil daily with one well pumping from under a packer. Future repairs may double the amount of oil being pumped on this lease. The Bates-Hosselton #3 is currently pumping 20 barrels of oil daily while the Bates-Hosselton #1 remains inoperative. If the anticipated repairs are made, the two leases have the potential to pump 15,000 to 20,000 barrels per year.

It is important to understand the success of this project is dependent on site selection, log interpretation, and the condition of well sites. We did not anticipate finding debris down hole on both sites, nor did we take into consideration the age and condition of the casing. Extensive use of the gas gun can have disastrous results if the casing should split. After having stated the above, we feel the use of gas gun stimulation to be an efficient, cost effective method for stimulating oil recovery in naturally fractured oil bearing rock formation.

In short, we have assisted the D.O.E. in meeting its goal to help small producers utilize approaches "that could mean the difference between maintaining production or shutting down an oil field." The technology is easy to replicate, efficient and cost effective. Dakfam will help D.O.E. reach its stated objective to "increase oil production in the United States by finding solutions to problems that inhibit production."