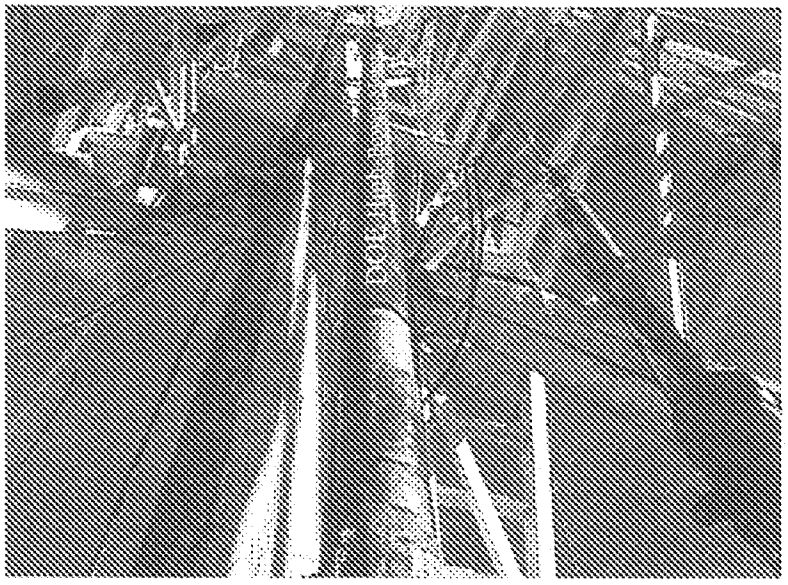
DOE High-Power Slim-Hole Drilling System



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September 1999
TR99-32

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DOE HIGH-POWER SLIM-HOLE DRILLING SYSTEM

EXECUTIVE SUMMARY

Introduction

This project used a systems approach to improve slim-hole drilling performance. A high power mud motor, having a double-length power section, and hybrid PDC/TSP drill bit were developed to deliver maximum horsepower to the rock while providing a long life down hole. This high-power slim-hole drilling system drills much faster than conventional slim-hole motor and bit combinations and holds significant potential to reduce slim-hole drilling costs.

The oil and gas industries have been faced with downward price pressures since the 1980s. These pressures are not expected to be relieved in the near future. To maintain profitability, companies have had to find ways to reduce the costs of producing oil and gas. Drilling is one of the more costly operations in the production process.

One method to reduce costs of drilling is to use smaller more mobile equipment. Slim holes have been drilled in the past using this principle. These wells can save money not only from the use of smaller drilling equipment, but also from reduced tubular costs. Stepping down even one casing size results in significant savings. However, slim holes have not found wide spread use for three reasons. First, until recently, the price of oil has been high so there were no forces to move the industry in this direction. Second, small roller bits and motors were not very reliable and they drilled slowly, removing much of the economic benefit. The third and final reason was the misconception that large holes were needed every where to deliver the desired production.

Several factors have changed that will encourage the use of slim holes. The industry now favors any method of reducing the costs of producing oil and gas. In addition, the industry now understands that large holes are not always needed. Gas, in particular, can have high production rates in smaller holes. New materials now make it possible to manufacture improved bits and motors that drill for long periods at high rates. All that remains is to gather all the elements together and demonstrate the savings of slim hole drilling.

Technical Approach

This project used new and improved materials along with advanced designs to improve the performance of two key down hole components. The components are the drill bit and the mud motor that drives the bit. By combining thermally stable cutters (TSP) with the more conventional poly crystalline compact (PDC) cutters a new hybrid bit was produced that extends the range of rock hardnesses that can be drilled. This new bit is run

on a motor that produces twice the torque and thus twice the power of conventional motors. This allows more weight to be applied to the bit which in turn allows the rock to be drilled faster.

Mud motors convert hydraulic power in the drill mud (pressure and flow) to mechanical power (rotary speed and torque). To increase the power output of a motor the speed or torque must be increased and a corresponding increase in flow or pressure. An analysis of this energy system shows that the best way to achieve higher power is to increase torque and pressure.

The torque output of a motor is proportional to the pressure drop across the motor. The only way to increase the pressure drop is to increase the per stage pressure drop or increase the number of stages. Materials used to manufacture the stator of a mud motor limit the increase in per stage pressure drop so the best way to increase motor power is to increase the number of stages.

Two conventional 3-3/8 in. stator sections were welded together using a proprietary process, and a special rotor machined to form a single long power section. This power section was combined with a modified bearing pack. The modified bearing pack used high strength metal-to-metal radial bearings, stronger roller thrust bearings, and a titanium flex shaft to improving the strength of a conventional bearing pack. The titanium flex shaft replaces the conventional flex coupling used to transmit the rotary power from the power section to the bearing pack shaft.

The increased power of the DOE high-power motor must be utilized by the bit to drill rock. Current PDC bits are a great improvement over small roller bits. The small bearings in these slim-hole roller bits fail quickly and thus can not drill very far. The PDC bits can drill soft to medium hard formations and last a long time. However, in hard abrasive formations or softer formations with hard stringers these bits fail. If slim hole drilling is to succeed this limitation must be overcome. TSP cutters are much more wear resistant that PDC cutters so they can drill hard abrasive rock. Their size however, makes them subject to bit balling in soft sticky formation like shales. Combining the two cutter types produces a bit that can drill quickly through soft formations but not wear out when drilling hard abrasive formations. This bit extends the range of rock types that can be drill and thus can eliminate the need to make trips for bit changes.

Testing

Following design and manufacture, the high-power slim-hole drilling system was subjected to laboratory dynamometer and drilling tests. The dynamometer tests were used to measure the performance of the high power motor for comparison to conventional designs. The data from these tests were used to plot performance curves that were later used in drilling and field tests. Life test were also conducted on the dynamometer to identify reliability problems so they could be corrected before field testing. The drilling tests evaluated the hybrid bit and high-power motor as a system. These data provided correct

Slim hole drilling can save significant dollars through reduced rig and equipment size along with reduce tubular costs. The DOE high-power slim-hole system overcomes the problems that occurred in the past with conventional motors and bits making slim holes much more competitive and practical to drill in today's market. The hybrid bit and high-power motor should be commercialized. This will require a marketing effort to make bit and motor companies realize the benefits that can be achieved with slim hole drilling.

1. INTRODUCTION

1.1 Background

The oil and gas industry has undergone significant restructuring over the last two decades in response to downward price pressures. This has included an intense effort to reduce drilling costs. A study conducted by Maurer Engineering on deep gas wells[1] found that drilling rate and bit life have the greatest impact on overall well costs. For an average deep well (> 15,000 ft.), 48 percent of the rig time is spent rotating the bit and 22% tripping the drill pipe to replace or change out components of the bottomhole assembly (Figure 1.1). This indicates that the primary focus of research and development should be on increasing penetration life and extending BHA component life. As shown in Table 1.1, doubling the penetration rate will reduce well costs by 13%.

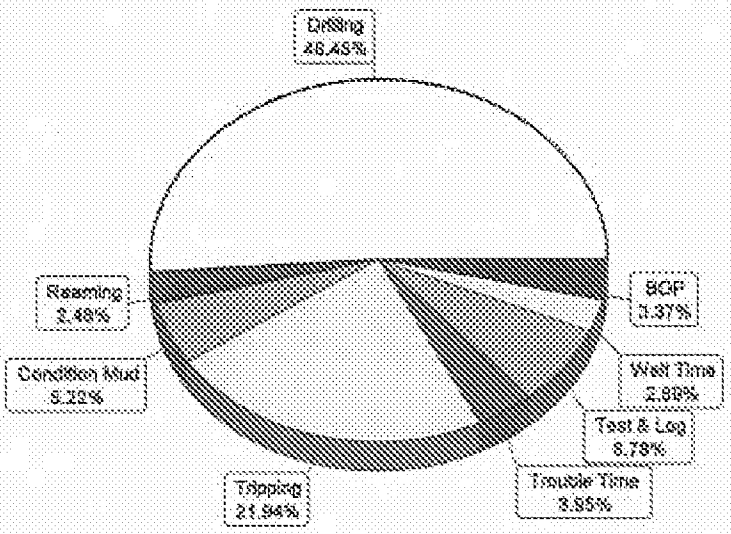


Figure 1.1. Time Study Of Wells > 14,000 Feet Deep[1]

In addition to increasing drilling rate and BHA component life, past experience has shown that use of slim holes can provide further savings by reducing the size and therefore the costs of the drilling rig and the tubular goods (casing and production tubing) used to complete the well. During the 1950s and 1960s, over 3000 slim holes were drilled worldwide[2]. These slim holes lowered well costs by 27 to 75% in many areas. Although significant savings were realized, the industry nevertheless largely abandoned slim holes in favor of larger diameter wells in the 1970s and 1980s. The primary reasons for this were: 1) the shorter life obtained by small diameter roller bits compared to larger bits due to bearing deficiencies; 2) high oil prices which increased the desire to maximize production rates; and 3) the general misconception that large holes were needed. In light

of today's economic climate, many companies are now re-examining the use of slim hole drilling because improved small diameter motors equipped with advanced shear bit technology have reduced costs by 30 to 40%[3] .

Table 1.1 Cost Reductions Due to a Factor of 2 Change[1]

DRILLING PARAMETER	PERCENTAGE COST REDUCTION
Penetration Rate	13.0
Rig Day Rate	10.0
Casing Materials	9.0
Bit Life	7.5
Casing Time	5.5
"Other" Time	4.0
Trip Time	3.0

There are three basic types of slim-hole drilling systems (**Figure 1.2**):

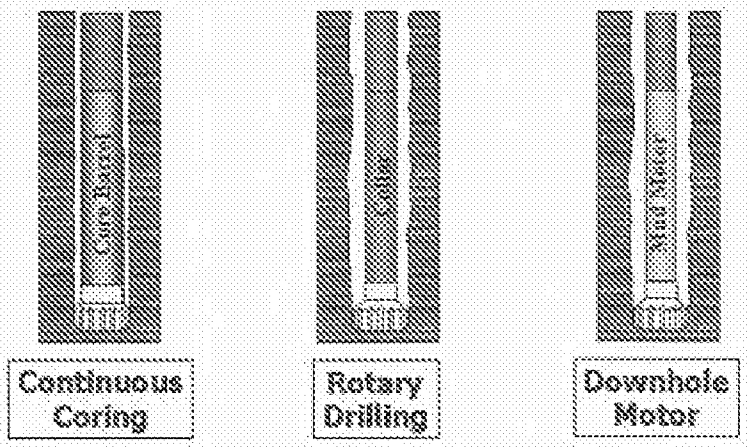


Figure 1.2. Basic Slim-hole Drilling Systems

Continuous Coring systems use slim-hole mining core barrels to continuously core entire wells or substantial sections of wells. Although wireline retrievable core barrels are used to increase overall drilling speed, the overall process is usually slower than conventional drilling. As a result, the method is used in new drilling areas where geologists need cores to define geology. Depth has not been a limiting factor, as specialty slim-hole

coring rigs have been built capable of drilling to 14,000 feet.

Rotary slim-hole rigs rotate PDC and natural diamond bits at speeds of 300 to 800 rpm. Special small diameter strings have been designed for these rotary slim-hole rigs. Typical drill pipe is 3.5 x 2.92 in. for drilling with bits 8½ to 4¾ in. and 2.25 x 1.89 in. for bits 4¾ to 3 inches.

Twist-offs of the small-diameter drill pipe have been a problem with the rotary system. Special controls are required to control the torque on the drill pipe and maintain correct weight on bit.

Downhole Motor systems utilize slim-hole motors to rotate TSP, PDC, natural diamond, and roller-cone bits at speeds of 300 to 2000 rpm. These motors drill at high rates and eliminate drill-string twist-offs by eliminating drill-string rotation.

Downhole motors add an additional expense to the drilling operation that must be offset by improved drilling performance. If improved performance is not observed, then cost performance calculations are difficult because motor cost is being compared to the intangible of "will a drill-string failure occur."

1.2 OBJECTIVES

The overall objective of this project is to implement new high-power slim-hole motors and drill bits into slim-hole gas well drilling applications. The development of these motors and bits is critical to overcome problems such as twist-offs and slow drilling rates associated with existing rotary slim-hole systems as well as the short motor and drill bit lives of current state-of-the-art tools.

Conventional motors drill most formations 2 to 3 times faster than rotary or continuous coring systems due to greater power transfer to the drill bit. New high-power motors and hybrid TSP/PDC bits under study and development at Maurer Engineering Inc. (MEI) drill 3 to 5 times faster than conventional motors. These new slim-hole motors and bits should reduce drilling costs by 30 to 50 percent in many areas by increasing drilling rates and by reducing casing costs.

Other DOE sponsored work on improved TSP diamond cutters has shown that bits built with these cutters could save 15 percent on overall well costs and 7.5 percent on drilling costs[8]. These dramatic costs due to increased production rate and bit life would be further increased if used with the high-power motor.

1.3 SCOPE OF WORK

To achieve the objectives stated above, Maurer Engineering will utilize the results of the GRI project including the design of the high-power motors and bits. Field test sites will

be selected, and motors and bits will then be designed and manufactured for these sites. During Phase I, the motors and bits were extensively laboratory tested at MEI's Drilling Research Center, including motor tests on a dynamometer test stand and drilling tests on a motor drilling test stand.

Additional high-power slim-hole motors and bits were manufactured and field tested during Phase II. The bits were tailored to the formations to be drilled at the Amoco Catoosa shallow well test site and at other deeper gas well sites. The drilling data from these field tests were analyzed in detail using MEI computer programs. A detailed final report has now been prepared to allow service companies and operators to implement this technology into their gas well drilling operations.

Phase I-Task Summary

Task 1. Design High-Power Motor
Task 2. Fabrication of SH High-Power Motor
Task 3. Conduct High-Power Motor Dynamometer Tests
Task 4. Design Large Cutter TSP Bit
Task 5. Fabrication of TSD Drill Bit
Task 6. Laboratory Testing of the SH High-Power Drilling System

Phase II-Task Summary

Task 7. Test Plan and Required Information for the National Environmental Policy Act
Task 8. Plan/Conduct Shallow Field Tests
Task 9. Slim-Hole Drilling System Redesign
Task 10. Manufacture Field Grade Motor/Bits
Task 11. Dynamometer Test Field Motors
Task 12. Conduct Laboratory Drilling Tests
Task 13. Conduct Field Drilling Tests

2. HIGH-POWER HYBRID DRILL BITS

This chapter describes the development of the hybrid PDC/TSP slim-hole drill bits. Being drag bits, PDC/TSP bits do not have bearings to prematurely wear out like those found in smaller diameter roller bits. However, without the new design features incorporated into the hybrid bit to last longer and drill harder, more abrasive formations, the economic benefits of higher power slim-hole motors could not be effectively realized.

2.1 Polycrystalline Diamond & Thermally Stable Cutters

Polycrystalline diamond cutter (PDC) bits work well on motors in soft to medium hard rocks (up to 15,000 psi compressive strength). The PDC cutters consist of a thin layer of small synthetic diamond bonded to a tungsten-carbide substrate as shown in **Figure 2.1**.

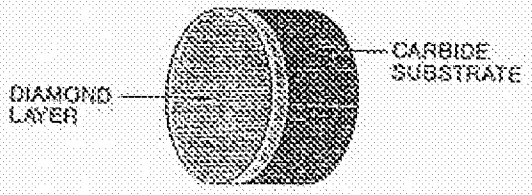


Figure 2.1. PDC Cutter

Early PDCs had a weak bond between the diamond layer and the carbide substrate. Although sufficient for most rotary drilling applications, these early cutters suffered from diamond layer de-bonding (cutter failure) when used on motors because of the higher rotary speeds. Improved bonding techniques have allowed PDC bits to gain increased use on downhole motors.

Two types of PDC bits are commonly used today. Steel body bits have pressed-in tungsten-carbide studs with PDC cutters attached. Matrix bits have PDCs brazed directly to the bit body (**Figure 2.2**). Steel-body bits are less expensive to manufacture than matrix bits, but often suffer erosion problems when used with abrasive drilling muds or on long bit runs. Hard metal coatings have been used to solve this problem, but add to the bit's cost and manufacturing complexity. Matrix bits are manufactured by infiltrating a molten cobalt/nickel binder (1100°C) into tungsten-carbide powder, making them very erosion resistant and ideal for high- performance drilling motors.

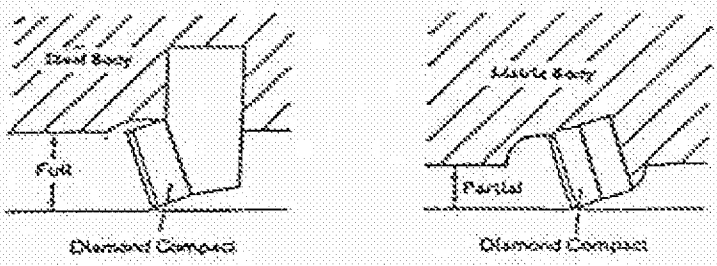


Figure 2.2. PDC Cutter Mounting Techniques

PDC cutters have been very successful in drilling medium-strength rocks such as shale, but they wear out rapidly when drilling hard rock. The major cause of premature wear in hard rock is the thermal limitations of PDC material as shown in **Figure 2.3**.

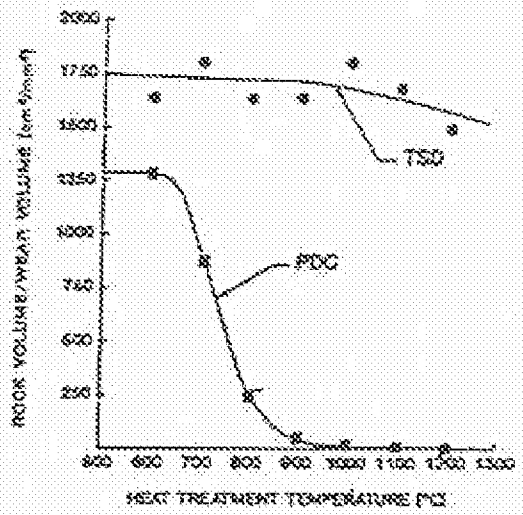


Figure 2.3. Effect of Temperature on Granite Drilling Tests.[3]

PDC cutters fail at high temperatures because the cobalt binder holding the diamonds together expands more rapidly than the diamond carbon lattice, thereby causing the PDC cutters to thermally fracture (**Figure 2.4**).

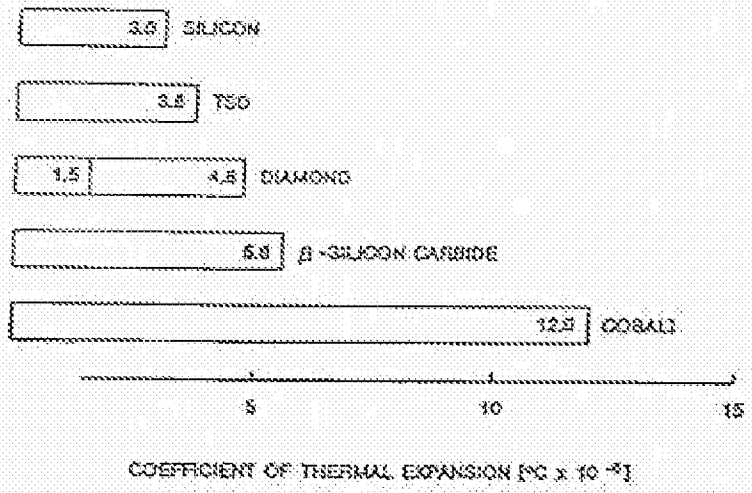


Figure 2.4. Coefficient of expansion for diamond and cobalt.[4]

General Electric (Geoset) and De Beers (SYNDAX 3) have developed thermally stable diamond cutters (TSP) in which the cobalt binder is removed to allow them to operate at much higher temperatures (**Figure 2.3**). The high-temperature capability of these TSP cutters allows them to be cast directly into matrix bits as shown in **Figures 2.5** and **2.6**.

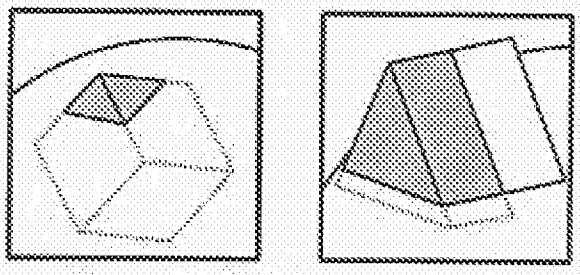


Figure 2.5. TSP Cutters In Matrix

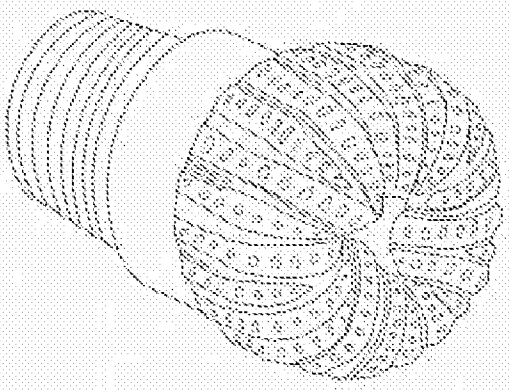


Figure 2.6. TSP Bit

TSP matrix bits are ideally suited for high performance motor drilling. Wear tests run at Sandia National Laboratories show that TSPs are more wear resistant that PDCs. In the Sandia tests, cutters held in an instrumented holder are used to mill off the top of a Sierra White granite rock. The wear of the cutter is then plotted against the volume of rock removed (**Figure 2.7**). The data show that TSP is approximately seven times more wear resistant that PDC. **Figure 2.8** shows that these bits can drill in excess of 90 meters (300 ft) before wearing out in granite, an igneous rock that is much harder than the sedimentary rocks normally encountered in oil or gas wells.

The key to the successful use of hybrid bits is to match the torque/speed characteristics of bits to downhole motors, thereby optimizing use of motor power by maximizing drilling rate and bit life. This can be done using computer programs that predict

bit and motor performance or with empirical data from laboratory and/or field drilling.

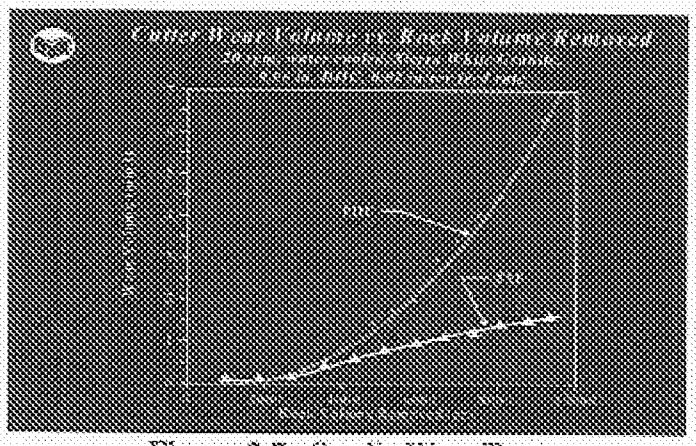


Figure 2.7. Sandia Wear Test.

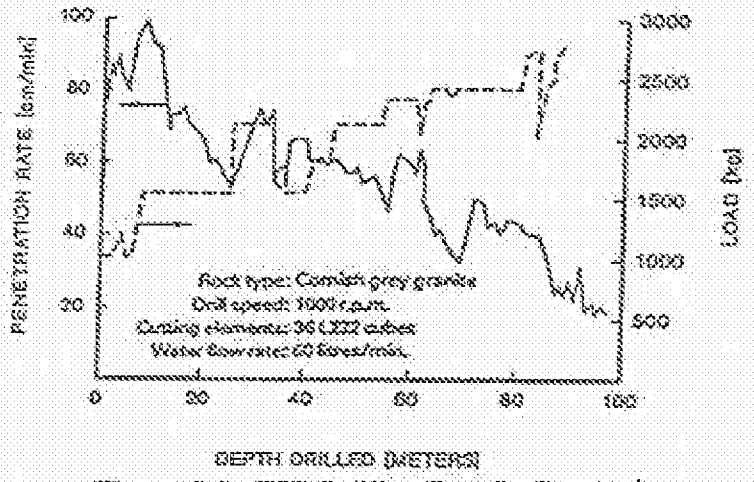


Figure 2.8. TSP Drilling Data In Granite.[4]

Many large manufacturers of bits have developed very sophisticated computer software that can accurately predict the forces generated on cutters and bits as they drill through different formations. These programs are used to predict the resultant loads on bits so that anti-whirl pads can be correctly placed on bit bodies. These same programs can be used to make bit designs that match the torque and speed characteristics of motors.

Motor manufacturers use computer programs to calculate the torque and speed characteristics of different designs. Recent work has focused on Finite Element programs to optimize the rotor/stator shapes and the rubber compounds for different applications. These data are used to match the motor and bit.

Laboratory and field test data can also be used to match motors and bits either to

confirm computer output or as an alternative. This can often be more precise because of manufacturing or material variations. MEI considers it essential to confirm predicted motor performance by testing motors on a dynamometer test stand. Significant differences have been observed between predicted and measured performance.

Confirmation of bit performance is very important primarily because prediction of formation characteristics is very difficult. Small changes in depth, water content, or surrounding stress fields can significantly alter rock behavior.

The motors and bits developed in this project made use of a combination of computer software predictions and empirical data from laboratory drilling and dynamometer tests.

2.2 TSP Drill Bit Design Factors

MEI previously conducted a multi-phase study to improve TSP bits for deep gas drilling. This work showed that the primary design parameters that control drilling rate and bit life are 1) cutter orientation, 2) cutter size, and 3) density or number of cutters on the bit (**Figure 2.9**). Test results show that large cutters set with an exposed sharp edge or point drill the fastest. Bits with a high density of cutters have the longest life because the redundant cutters reduce the work load and thus reduce the wear and breakage.

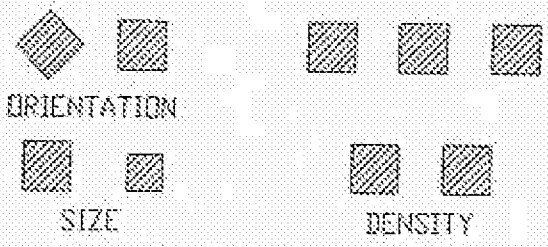


Figure 2.9. TSP Cutter Variables

Thirteen different TSP bits (**Table 2.1**) were tested on the Drilling Research Center (DRC) drilling test stand shown in **Figure 2.10**.

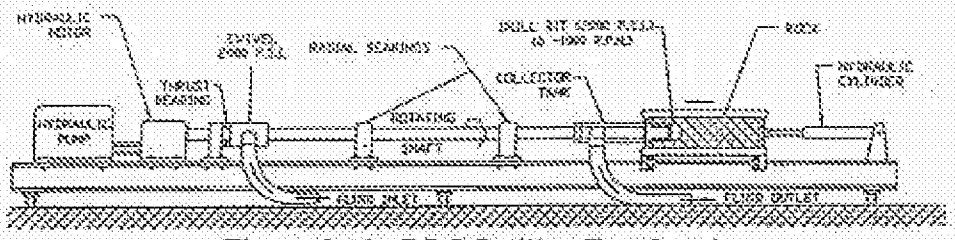


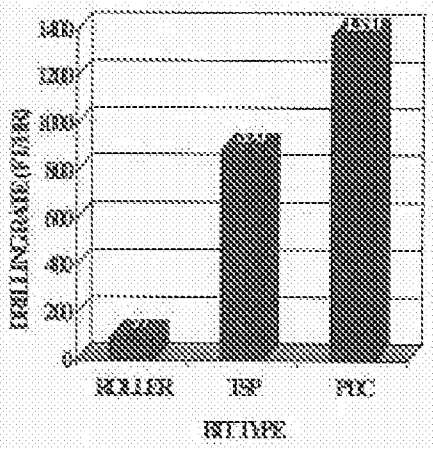
Figure 2.10. DRC Drilling Test Stand.

TABLE 2.1. Test Bits TSP Bit Study

	Bit No.	TSP Shape	TSP Density	TSP Setting	TSP Size mm
Phase I	1	Cube	Heavy	Corner	3 x 3 x 3
	2	Cube	Light	Corner	3 x 3 x 3
	3	Cube	Heavy	Face	3 x 3 x 3
	4	Cube	Light	Face	3 x 3 x 3
	5	Cube	Heavy	Corner	5 x 5 x 5
	6	Cube	Light	Corner	5 x 5 x 5
	7	PDC	Light	N/A	13 mm
	8	Roller Tooth	N/A	N/A	N/A
	9	Roller Carbide	N/A	N/A	N/A
Phase II	10	Cube	Heavy	Corner	5 x 5 x 5
	11	Rectangular	Heavy	Corner	7 x 7 x 5
	12	Hexagonal	Heavy	Corner	3 x 3 x 2.5
	13	Round	Heavy	Face	5 x 5 x 5

These laboratory tests showed that PDC and TSP bits operating at motor speeds of 800 rpm drilled at rates of 1380 and 890 ft/hr (421 and 271 m/hr), respectively, compared to 97 ft/hr (30 m/hr) for roller bits operating at 100 rpm (**Figure 2.11**). Although the PDC bits drilled faster than TSP bits, PDC bits are not as well suited for use on high-power motors because of thermal limitations of these cutters.

The tests also showed that large TSP cutters (5mm x 5mm x 5mm) drill very fast and eliminated cutter breakage - a problem encountered on earlier tests with smaller dimension cutters(3mmx3mm x 3mm) (**Figure 2.12**).



Bit Diameter	3 in.
Bit Weight	7,000 lbs.
Bit Pressure	200 psi
Rotary Speed	0-800 rpm
Rock	Leuders Limestone
Flow Rate	60 gpm
Drilling Fluid	Water

Figure 2.11. Effect Of Bit Type On Drilling Rate (Leuders Limestone).

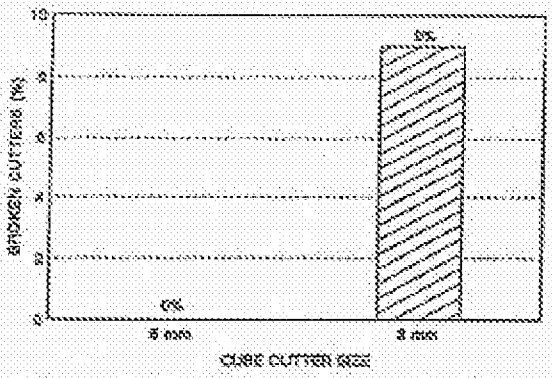


Figure 2.12. Effect of Cutter Breakage (Leuders Limestone)

Based on the above results, MEI selected the four large TSP cutters shown in **Figure 2.13** (dimensions in millimeters) for testing in Phase II.

To our knowledge, the 7mm x7mm x5 mm *rectangular* cutter is the largest TSP cutter ever tested in a drill bit. Early TSP bits used 2-mm cube cutters that were much smaller than the 8 mm and 13 mm round PDC cutters commonly used on oil-field bits. The large TSP cutters being tested approach the size of PDC cutters as shown in **Figure 2.14.**

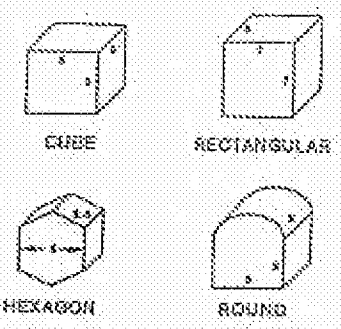


Figure 2.13. TSP Cutter Tested.

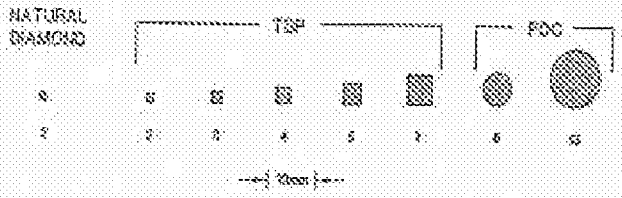


Figure 2.14. Diamond Sizes.

The four large TSP cutter designs shown in **Figure 2.13** were incorporated into 7.6 cm (3-in.) diameter test bits (**Figure 2.15**). These test bits were tested on a 2⅜-in. SlimDril motor using the Drilling Research Center (DRC) motor drilling test stand shown in **Figure 2.16.**

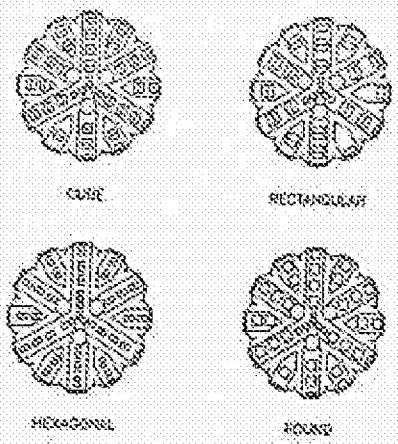


Figure 2.15. TSP Test Bits.

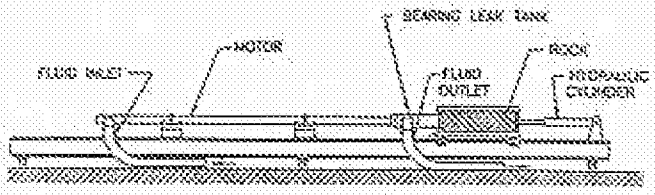


Figure 2.16. DRC Motor Drilling Test Stand.

At 70 gpm (265 l/min), the 2⅝-in. motor delivered 56 hp at 2340 rpm. This is an overpowered condition for the 2⅝-in motor.

The experimental TSP bits drilled at maximum rates of 200 to 550 ft/hr (61 to 168 m/hr) as shown in **Figure 2.17.**

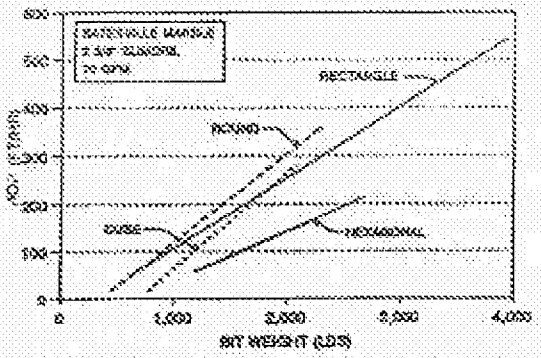


Figure 2.17. Rop vs. Bit Weight For TSP Bits.

The rectangular cutter bit drilled the fastest [550 ft/hr (168 m/hr)], due to the large cutter size. The round cutter bit drilled at rates up to 350 ft/hr (107 m/hr), showing that round cutters also have significant potential. The round cutters eliminate sharp edges and corners that earlier tests showed were initiation points for failures.

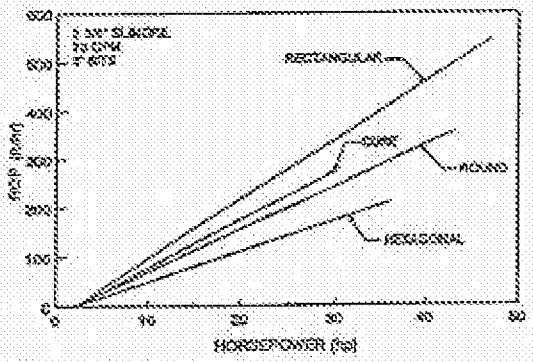


Figure 2.18. Drilling Rate vs. Power.

Drilling rates of the TSP bits increased linearly with motor power output, showing that higher power motors are highly beneficial (**Figure 2.18**).

At the higher power levels (20 to 45 hp), the TSP bits drilled at rates of 200 to 550 ft/hr (61 to 168 m/hr) in Batesville marble (uniaxial compression strength = 15,000 psi). Field drilling rates in this type of rock would typically be about 50 to 100 ft/hr (15 to 30 m/hr) with roller bits operating at 80 to 120 rpm. These tests show that high-power bits can be manufactured using TSP cutters and matrix style bit bodies.

2.3 BIT CLEANING TESTS

There are two fundamental elements to drilling. The rock must first be broken and then flushed from the hole with the drilling fluid (**Figure 2.19**).

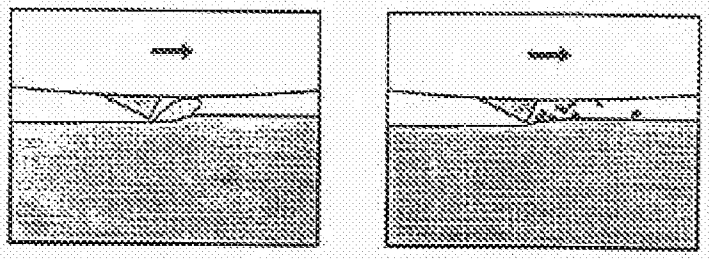


Figure 2.19. Two Elements of Drilling

Conventional diamond bits have small fluid passages for cleaning, thus restricting the free flow of cuttings. If cutters are set up on blades, there is more area for the drilling fluid and cuttings to flow out from under the bit (**Figure 2.20**).

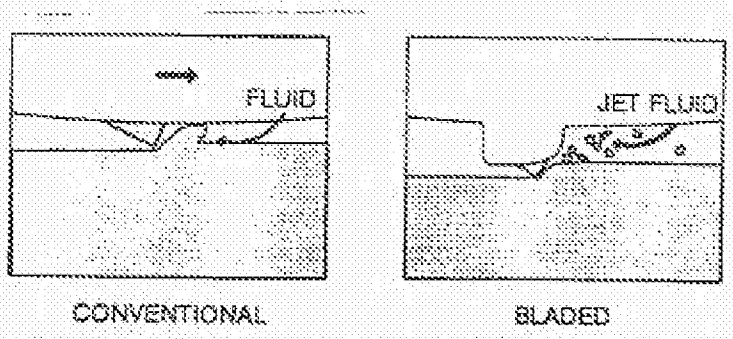


Figure 2.20. Conventional and Bladed Bit Designs.

Bits with enhanced cleaning designs are shown in **Figure 2.21** and **2.22**. **Figure 2.21** is a bit with side rakes on the cutters to help push the cuttings away from the center of the bit to the annulus. **Figure 2.22** shows a bit set with the cutters on blades and fluid nozzles so hydraulic horsepower on the bit can be better controlled.

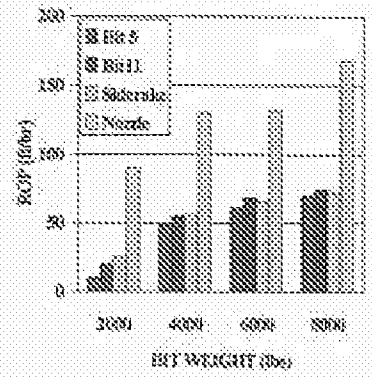


Figure 2.23. Improved Cleaning Bit Test Results

The major bit manufacturers are now making PDC bits using new smaller 8-mm cutters. These new smaller cutters are possible now because the brazed joint between the diamond compact and the carbide stud that is mounted into the bit has been improved. The new brazes have higher strengths (100 to 150 Ksi shear) requiring less braze area to hold at drilling loads. The 8-mm PDCs allow bit designs in smaller sizes with more redundant cutters. This reduces the work and wear on individual cutters, making them last longer. These new PDC bits are also candidates for use on the DOE higher power motors in soft to medium hard formations. TSP cutters will still perform better in harder formations where increased heat from the drilling process can damage the PDC material.

2.4 TSP Bit Field Test Results

Six field tests were conducted using large cutter TSP bits. These tests are listed in the Table 2.2, below, and a discussion of each test follows.

Table 2.2. TSP Bit Field Tests

Test No.	Bit Size	Cutter Size (mm)	Location
1	7-7/8	5x5x5	Wyoming
2	5-1/2	5 round	California
3	4-1/2	5 round	Mississippi
4	4-1/2	5 round	Mississippi
5	5-7/8	7x7x5	East Texas
6	5-7/8	7x7x6	East Texas

Test 1. In the first test the drilling contractor was typically drilling the wells using two bits. In the upper section of the hole a PDC bit was used to drill soft shales at rates of 70 to 100 ft/hr, down to the cap rock, of the Mesa Verde formation, at approximately 6,000 to 7,000 ft (**Figure 2.24**). At this point the PDC bit would be pulled and replaced with a roller bit, because past experience had shown that drilling into the cap rock with the PDC bit would result in total failure of the cutters. Roller bits typically drilled this section at 10 to 30 ft/hr. The contractor wanting to make the entire run with a single bit. The production in this area is from sandstone layers in the Mesa Verde formation. The sandstone layers are separated by shale, however it is the sandstone that damages the PDC bit.

A 7-7/8 in. large cutter TSP bit was manufactured for this test to see if the TSP cutters could drill the hard abrasive sandstone in the Mesa Verde formation. The bit used 5 mm cube TSP cutters sharp set. This bit running on at 110 rpm on a Sperry Sun multilobe motor and a rotary table speed of 60 rpm drilled the hard sandstone cap rock (6904' to 6920') at 18 ft/hr. This is a good rate, however when the bit entered the shale below the cap the penetration rate decreased to 8.25 ft/hr and the bit was pulled. The bit did not drill the shale well because the small TSP cutters allowed the bit to ball up. This test showed that TSPs can drill hard abrasive formations, but in a typical diamond bit configuration the TSPs can not clean sticky formations. A new mounting method is needed to increase the exposer and open space between the bit and formation so that shale and other sticky formations can be drilled.

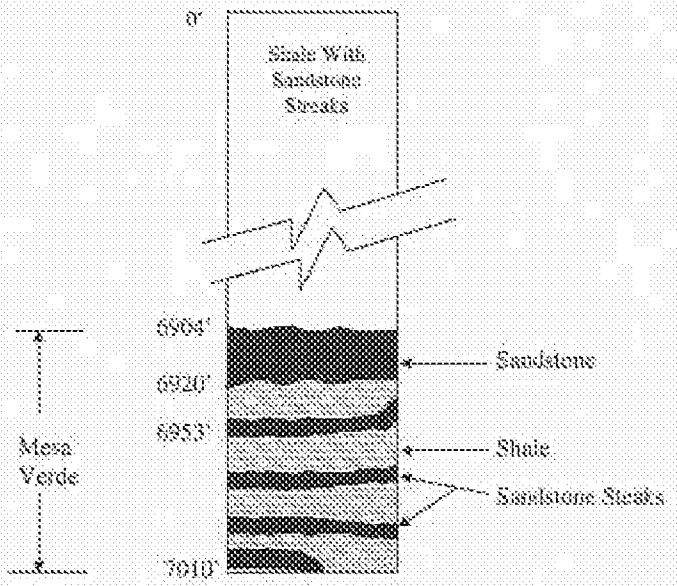


Figure 2.24. Wyoming Test Well Geology

Test 2. The second test was in hard abrasive sandstone in a horizontal well in California. PDC bits could not drill the formation because the sandstone caused excessive wear of the cutters. Prior to running TSP bits, natural diamond bits were used but these too suffered from slow penetration rates and excessive wear. The TSP bit increased

maximum drilling rates from 4.9 fph to 11.5 fph a 234% improvement. The average drilling rate increased from 3.0 fph to 4.5 fph a 150% increase. The TSP bottom hole assembly (BHA) with the TSP bit was pulled early due to differential sticking. The bit had minimal wear and was rerun on another well.

Test 3. This test compared large TSPs to small TSPs. The curved section of a horizontal well in Mississippi was drilled with a TSP bit made using 3mm cube cutters sharp set. The bit drilled 223 ft at 5.8 fph through an abrasive sandstone formation, and was completely used up. Concerned with slow penetration rates and high bit wear the operator wanted to try a different bit. A TSP manufactured with 5.3 mm round cutters was prepared for the job. During the BHA change a portion of the hole was lost a section of the curve had to be redrilled. In this section of the well there is a direct comparison between the large and small TSP cutter bits. The large cutter bit drilled from 10,441 to 10, 561, a total of 120 ft at 7.3 fph. The bit manufactured with 3 mm cutters drilled from 10,721 to 10,544, a distance of 223 ft at 5.8 fph. The bit with large cutters drilled 26% faster through the curved section of the well. The bit went on to drill a total 1215 ft at an average rate of 12.5 fph. This shows that large cutters drill faster and wear less than small cutters.

Test 4. This test consisted of 5 different bits. Four of the five were large cutter TSP bitsmanufactured using 5 mm cube cutters. The test results are summarized in **Table 2.3.** The first bit was run on junk so it is not included in calculations for penetration rate. The second bit was manufactured with 3 mm cubes and drilled 32 ft at 1.18 fph. The next 3 bit runs were made with bits using 5 mm round cutters. These bits drilled a total of 461 ft at rates of 2 to 4.67 fph.

Table 2.3 Test 4 Bit Run Summary

Bit Run	Bit S.N.	Type	No. of Runs	Total Footage	Average ROP	Formation	Mud Wt.	Flow	ROP Increase
1	9530	HT-25C	1	23	9	Cement	10.5	100	NA
2	NA	HT-23	2	32	1.18	Marine Shale	10.5	100	_
3	9560	HT-25C	5	318	2.87	Marine Shale & Tuscaloosa Sand	10.5	100 to 115	2.4
4	9557	HT-25C	1	139	4.67	Tuscaloosa Sand	10.5	115	4.0
5	9561	HT-25C	1	18	2.60	Tuscaloosa Sand	10.7	107	1.7

Offset data for straight wells in the same formation show that roller bits drill much faster than TSP bits in directional wells. However, the roller bits suffered severe wear and the directional drilling contractor felt that the TSP bits were needed to provide the

directional control to stay in the thin producing formation.

Test 5. This test is the best example of the benefits of large cutter TSP bits. A 5-7/8 in. bit manufactured with the largest (7mm x 7mm x 5 mm) TSP cutters was used to drill in the Bossier formation, a very hard shale in East Texas. Run on rotary this bit drilled 1600 ft at 10 to 12 fph. Replacing two natural diamond bits, this bit drill twice as far as an average diamond bit, and 600 more feet than the maximum (1000 ft) ever drilled by a natural diamond bit. Penetration rates were comparable for both bit types.

Test 6. This bit was identical to the bit used in test 5. However, this run was on a high speed motor. The bit performed well at the beginning of the run, but quickly slowed down, and was pulled after drilling only 400 ft. The bit was severely damaged with many cutters broken. The large cutters even though broken still presented a significant cutting structure so the bit was rerun on rotary in another well. In this well the damaged bit was able to drill an additional 600 ft at 10 fph. The total footage drilled was 1000 ft, equal to the best natural diamond bit run.

This test showed that large cutter TSP bits are very rugged and even damaged can drill long distances at high rates. The fracturing of the cutters during the motor run shows that TSP are very brittle and therefor need smooth running conditions and anti whirl protection. TSP bit designs should enhance the toughness of the cutters to achieve the best results.

Attempts were made to have the operator try this bit on a slow speed motor. However, hot hole conditions caused failures of multi lobe mud motors in previous attempts and the operator was unwilling to try these motors again so no further testing was done. The bits needed to be run on motors for directional control in this formation.

These tests showed that large cutter TSP bits can drill fast and have long life in hard abrasive formations. They also showed that in soft sticky formations the TSP bits tend to ball up, and due to their brittleness they can be fractured easily if exposed to bit whirl or impact loads.

These data prompted a design study to determine a way to get the benefits of PDC style bits and the wear resistance of TSPs. The ideal solution is to have a TSP that looks and mounts just like a PDC. This unfortunately can not be done because the TSP material can not be brazed with sufficient strength for drilling applications. Current research is underway to develop brazing techniques that will work with TSPs, but their commercial availability is still in the future. To overcome this road block the hybrid bit was designed. This bit uses both PDC and TSP cutters and has the attributes of each bit type. The development and field tests of the hybrid bit are described below.

2.6 Hybrid Bit Design

The hybrid bit is designed to capture the drilling qualities of both PDC and TSP bits. It starts out as a bladed PDC bit (**Figure 2.25**). This configuration allows the bit to drill many soft to medium formations at high rates. It includes four nozzles two replaceable and two fixed. The PDC can be either rotated or replaced to rebuild the bit after it has been run. The matrix body of the bit will resist erosion even from abrasive muds.

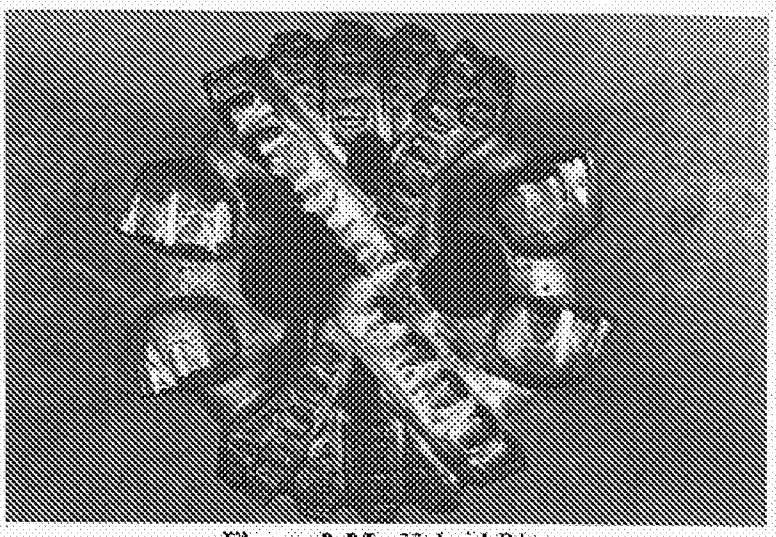


Figure 2.25. Hybrid Bit.

To enhance the bit's ability to drill harder formations, large TSP cutters have been set at the same height and behind the PDC cutters. Since the face of the bit must wear down evenly these TSP cutters protect the PDC cutters from damage (excessive wear).

Similar concepts to this have been used in the past. Natural diamond pads or carbide inserts have been place behind PDC cutters on other bits to act as shock pads during drilling. The TSP cutters on the hybrid bit not only absorb shock but they also help drill the formation.

The nozzles on the bit are designed to provide cleaning even in sticky formations that may tend to ball the bit. The two adjustable nozzles can be selected to provide the jet impact force necessary to keep the bit face clean in any conditions.

The TSP cutters have been set up on pads. This has the effect of increasing their exposure to the formation for better cleaning and to provide maximum penetration rates.

2.6 Hybrid Bit Field Performances and Commercialization

A hybrid bit was used during the first shake down tests of the high power motor at the Catoosa test site. The bit performed well in many different drilling conditions. Most of the drilling during this first test was not taxing to the hybrid bit. However, one formation known as "The Wall" has a reputation for destroying PDC bits. Typically PDC bits hit this formation and quit drilling when many of the PDC become damaged. The hybrid bit was able to drill 40 ft into the "The Wall". The test was only stopped at this time because test monies had run out, not due to bit or motor failure.

Figure 2.26 shows the hybrid bit used in the first test. The PDC cutters show considerable wear, testimony to the hardness and abrasiveness of "The Wall". However, the bit was still in good condition and could have continued drilling. The TSP cutters on the bit showed minimal wear. This bit was rebuilt after the test and used again.

Figure 2.26. Hybrid Bit After Drilling "The Wall"

The hybrid bit has been successfully used in many commercial applications. **Table 2.4** is a summary of these runs. Over 17,000 feet of hole has been drilled using the hybrid bit.

Table 2.4 Commercial Hybrid Bit Runs

Size	Formation	Footage	ROP
6-1/8	Sprayberry	997	35.5
6-1/8	Sprayberry	2275	38.4
6-1/8	Sprayberry	1830	22.5
6-1/8	Devonian Dolomite	1784	17.6
4-3/4	Red River Dolomite	1509	26
4-3/4	Cherry Canyon	1847	21.4
4-3/4	ABO Dolomite	366	8.5
4-3/4	Cherry Canyon	1331	29
4-3/4	Sprayberry	1511	58.5
4-3/4	Sand, Shale Limestone	830	50.9
4-3/4	Cherry Canyon	1557	15.2
4-3/4	Desert Creek	2098	15.3
Total		**17,915**	**21.97**

These data show that the hybrid bit can drill rapidly and have long life in a variety of formations. Three case histories given below show how the hybrid bit compares to other bit types.

Case 1

San Juan County, Utah; a 4-3/4 in. hybrid bit drill 2098 ft in hard limestone and hale formations in 137.25 hours for an average penetration rate of 15.28 fph. The bit drilled 2 horizontal legs and was only 1/3 worn. **Figure 2.27** shows the footage drilled for the hybrid bit and bits in two offset wells.

The hybrid bit was able to replace two rock bits and eliminate a trip and risk of lost cones in the hole. The bit was suitable for additional use and was more controllable in directional drilling making it much better and more cost effective that the roller bits in this application.

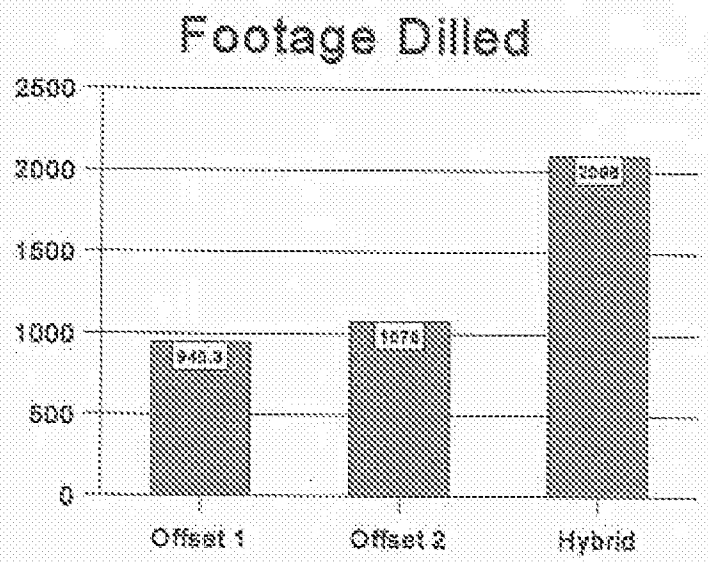


Figure 2.27. Comparison To Offset Wells.

Case 2

Borden County, Texas: A 6-1/8 in. hybrid bit was used to drill 3 horizontal legs in the Sprayberry formation. A total of 5002 ft were drilled in the three wells in 166.1 hours for an average penetration rate of 30.1 fph. **Figures 2.28 and 2.29** show a comparison for rate of penetration and footage drilled between the hybrid bit and offset well data.

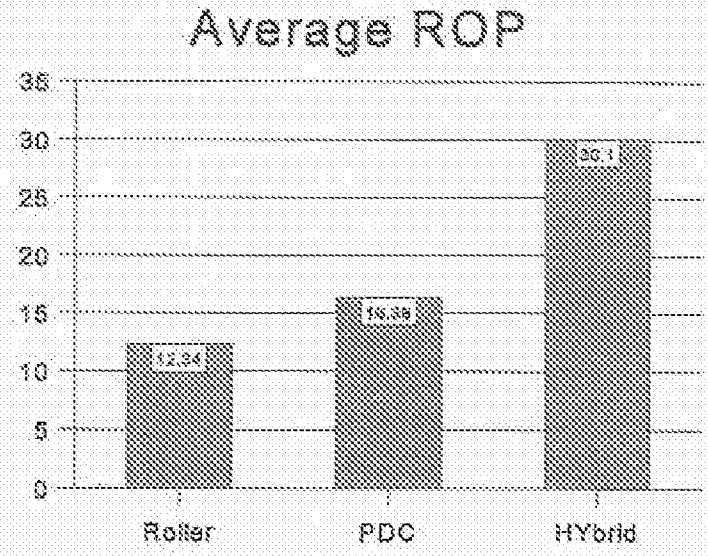


Figure 2.28. Comparison of ROP To Offset Wells

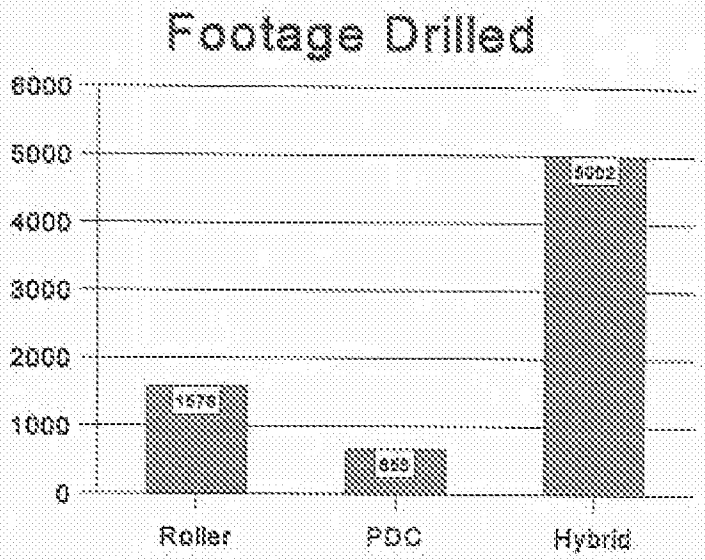


Figure 2.29. Comparison of Footage Drilled to Offset Wells.

The bit was able to replace several rock bits and was repairable and reusable at the conclusion of the run. It had higher penetration rates and longer life than the other bits. It eliminated several trips and was very controllable in directional drilling.

Case 3

Winkler County, Texas: A 4-3/4 in hybrid bit drilled 1331 ft of Cherry Canyon Sand in 45.75 hours at an average penetration rate of 29.09 fph. **Figure 2.30** is a comparison

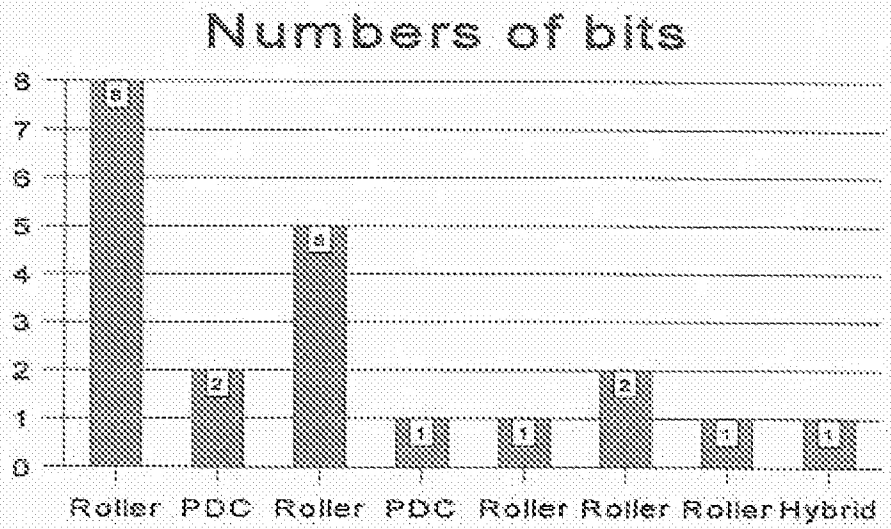


Figure 2.30. Comparison Of Numbers Of Bits.

of the number of bits used to drill offset wells. These data show that the hybrid bit replaced several roller bits and eliminated many trips.

Figure 2.31 shows a comparison of the average footage drilled for each bit. The hybrid was able to drill further than all but one PDC bit. It eliminated several trips and replaced many roller bits.

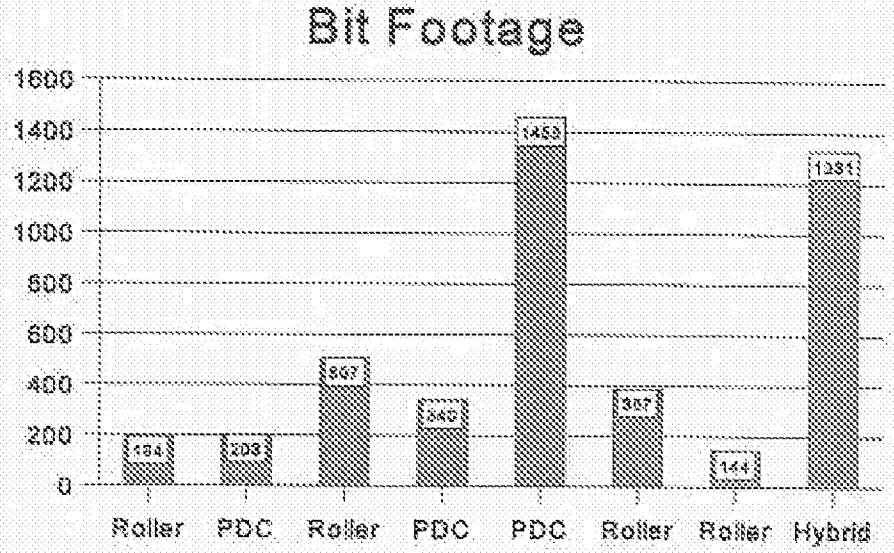


Figure 2.31. Bit Footage Drilled.

The hybrid bit was able to drill the formation faster than the other bits (**Figure 2.32**).

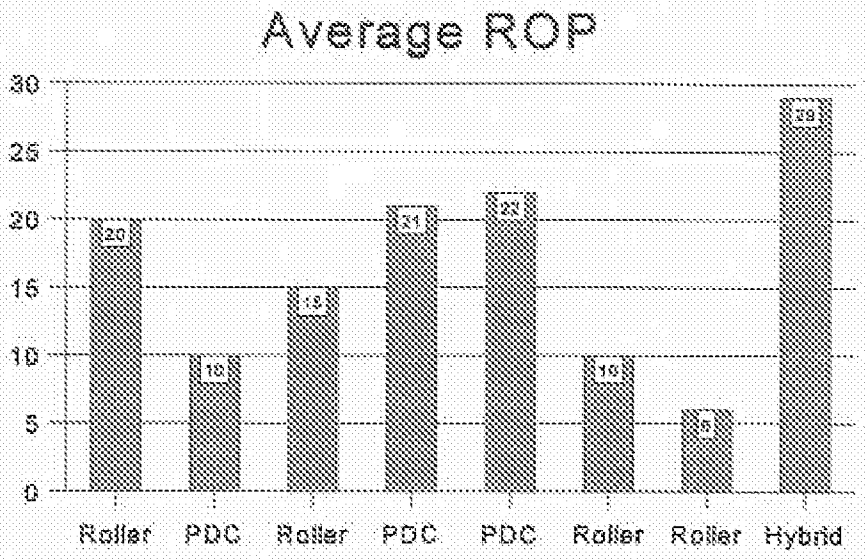


Figure 2.32. Average Bit ROP

The Hybrid bit was also able to reduce vibrations in this application. This saved costs by preventing damage to the steering tools and eliminating trips to replace the broken steering tools. This is a significant finding since these costs can be very high.

The Hybrid bit as shown in these case histories is an excellent design that combines many of the attributes of PDC and TSP bits into a single bit. The bit delivers high penetration rates while being able to drill through hard or abrasive formations or stringers. It reduces bit vibrations is very controllable making it an excellent bit for straight hole and directional jobs. The bits characteristics make a good selection when running under difficult conditions such as when used with high power or extended length motors.

Commercial Status

The hybrid bit was produced commercially by Phoenix Energy Systems. When Phoenix Energy was purchased by National Oil Well the bit division, Walker McDonald, was sold to Varel Manufacturing Co. They do not produce diamond bits so the hybrid is not currently available. MEI is trying to form a new bit company can manufacture the hybrid bit or transfer the technology to an existing bit company that can add the hybrid design to their current line.

3. HIGH POWER SLIM-HOLE MOTOR

3.1 Basic Motor Design

Down hole mud motors consist of three major subassemblies. These are the power section, flex coupling and the bearing pack (Figure 3.1). The power section converts a portion of the drilling fluid's hydraulic energy (in the form of pressure and flow rate) into mechanical energy (rotary speed and torque). The power section is based on pump designs developed by the French scientist Moineau. It is comprised of a steel rotor that turns inside of a rubber lined stator. As the rotor turns inside the stator, fluid packets progress from the top of the motor to the bottom. The Moineau power sections rotate eccentrically. The function of the flex coupling is to convert the eccentric rotation to pure rotation and couple this motion to the drive shaft/bearing pack assembly. The bearing packs absorbs loads such as the hydraulic down thrust produced by the pressure differential across the tool and the loads generated at the bit while drilling.

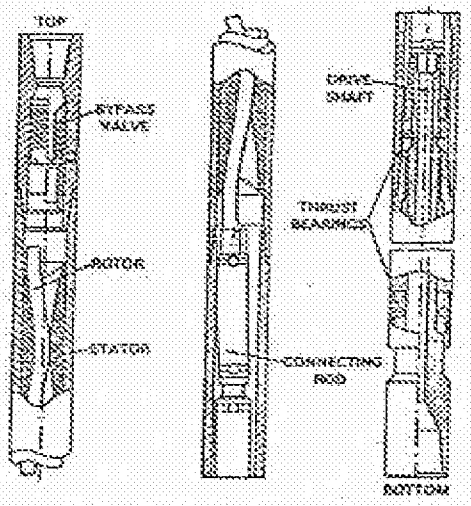


Figure 3.1. Basic Moineau Motor Design.

To produce a high-power slim-hole motor each of the major subassemblies must be improved. Specifically, the power sections must be modified to produce more power while the flex coupling and bearing pack must be redesigned to handle the increased power reliably.

3.2 Power Section Modifications

As previously stated, Moineau motor power sections convert hydraulic power to mechanical power. The hydraulic power is derived from the drilling fluid pumped done the

drill string and is proportional to the quantity of fluid being pumped and the pressure drop across the tool. Mathematically, hydraulic horsepower is

$$HP = \frac{P \times Q}{K} \tag{3.1}$$

where P is the pressure drop, Q is the flow rate and K is a constant. The mechanical power, represented by rotary motion is

$$HP = \frac{T \times N}{K} \tag{3.2}$$

where T is the torque, N is the rotary speed and K is a constant. These two equations show that the speed of rotation is proportional to the mud flow rate and that the torque is proportional to the pressure drop in the drilling mud. To increase the power output of a motor it is necessary to increase rotary speed and/or torque. This must be accompanied by an increase in the flow rate and/or the pressure drop.

$$\begin{aligned} N &\propto Q \\ T &\propto P \end{aligned} \tag{3.3}$$

There are many ways to alter the torque and speed of a Moineau motor. The rotor and stator cross sections are contoured. The stator contours have one more "lobe" than the rotor, as shown in **Figure 3.2.** As the number of lobes in a motor increases, the motor torque increases and the rotary speed decreases.

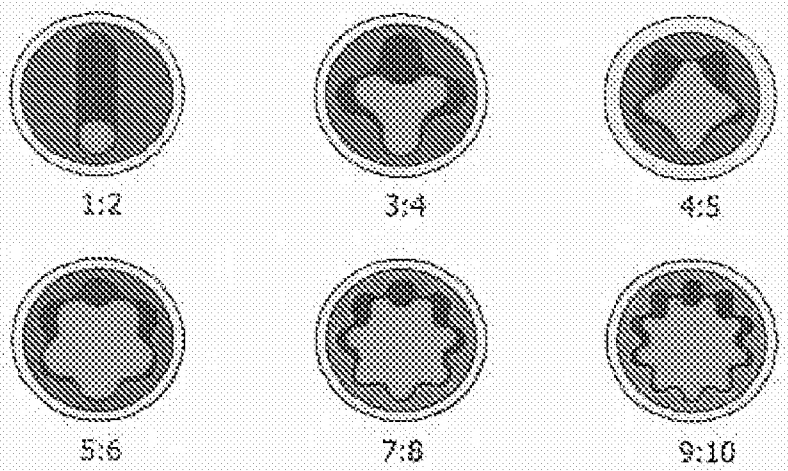


Figure 3.2. Different Lobe Configurations

can be accomplished by doubling the number of stages in a tool and thus doubling the pressure drop across the tool. In **Figure 3.4,** doubling the pressure drop from 900 psi to 1800 psi increases the torque from 75 to 150 ft-lbs.

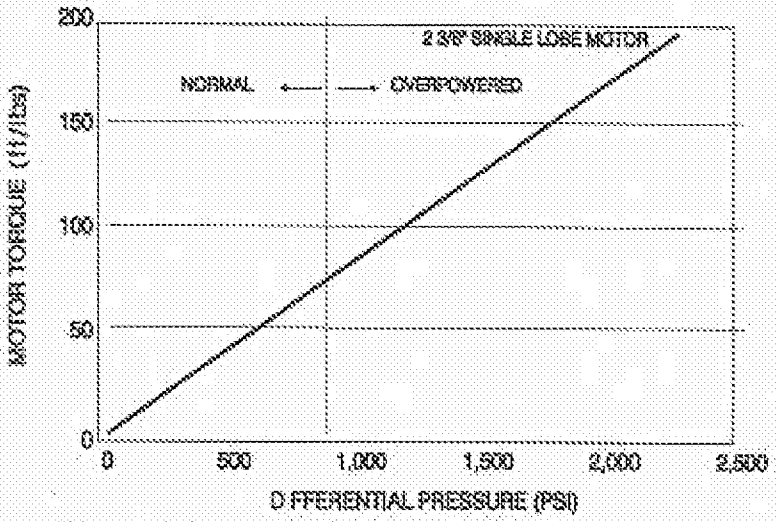


Figure 3.4. Torque for Normal And Overpowered Conditions.

Increasing the flow rate through the motor increases the rotary speed. This increases the power. **Figure 3.5** shows the speed vs. flow for a single lobe motor run in normal and over powered conditions, as the speed increases the power output increases linearly. However, this causes the rubber to flex more due to the increased speed. This flexing caused heat build up in the rubber that can eventually cause damage and failure. Therefore, increasing the flow rate through the motor is not a very good way to increase motor power.

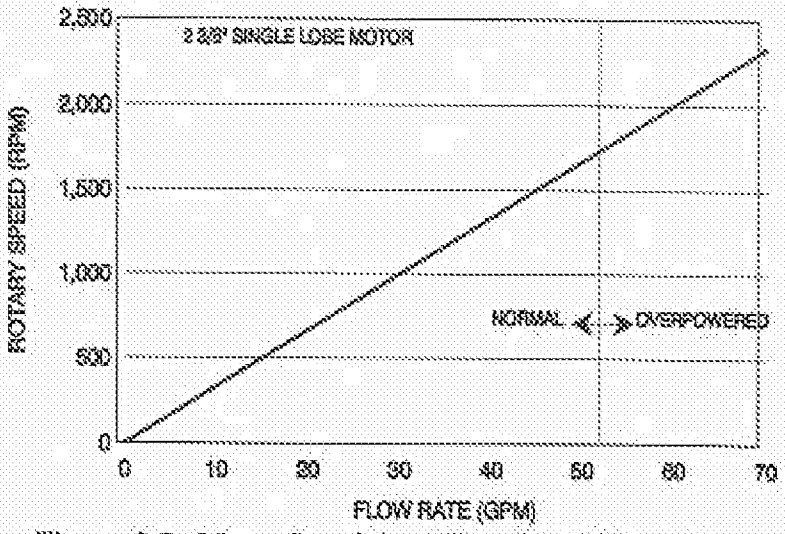


Figure 3.5. Motor Speed As A Function Of Flow Rate.

The high-power slim-hole DOE power section was manufactured from two R & M Energy System's 4:5 multilobe stators. These stators are welded together in a proprietary process that achieves a secure joint between the power sections without damaging the rubber in the stator. **Figure 3.6** shows the standard performance curves for this power section while **Table 3.1** lists the specifications.

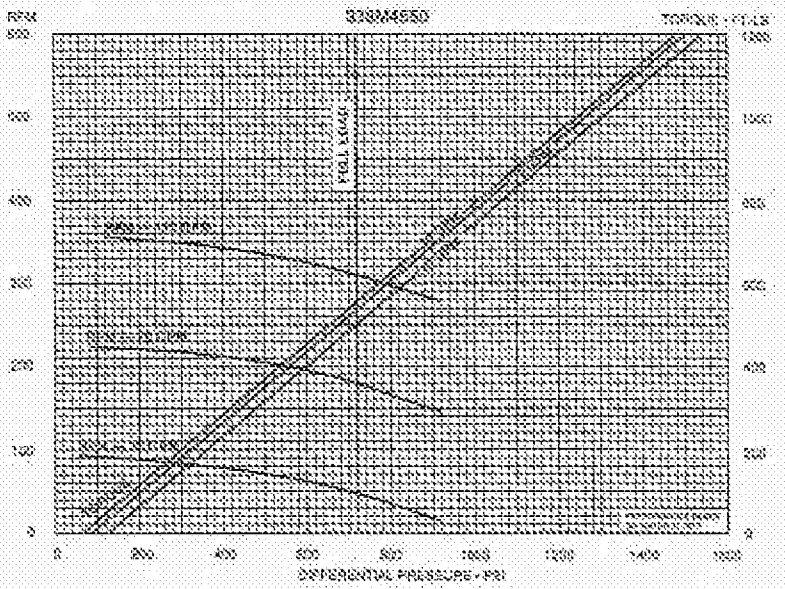


Figure 3.6. R & M 3-3/8 In. Performance Curves.

Table 3.1. Moyno™ Motor Specifications

ROTOR SPECIFICATIONS & DIMENSIONS		STATOR SPECIFICATIONS & DIMENSIONS	
Number of Lobes	4	Number of Lobes	5
Number of Stages	5.0	Nominal Tube OD	3.38 in.
Contour Length	107.0 in.	Nominal Tube ID	2.75 in.
Overall Length	111.0 in.	Overall Length	118.0 in.
Contour OD	1.940 in.	Length from End of	6.0 in. Each End
Head OD	1.75 in.	Contour OD	2.260 in.
Thread Form	1¾-6 Stub Acme	Inside Diameter	1.600 in.
Eccentricity	0.165 in.	Material	4142 Heat Treated Hot Finished
Material	4140 Heat Treated Bar		Tubing with Nitrile Insert
Weight	84 lbs	Weight	115 lbs

A special rotor was machined by R & M Energy Systems for use in the high-power motor. Its length is the maximum that R & M can manufacture on their rotor cutting machine. If necessary, two conventional rotors can been welded together to form a long rotor. Manufacturing limitations did not dictate maximum rotor length. The objective was to double the length so the power could be doubled.

Welded rotors work as well as single-piece rotors if care is taken to get a proper weld. The most significant problem is phasing the rotors correctly and then machining the weld to the final rotor form. Much of this work must be done by hand. **Figure 3.7** shows the double length rotor and stator along with a conventional stator.

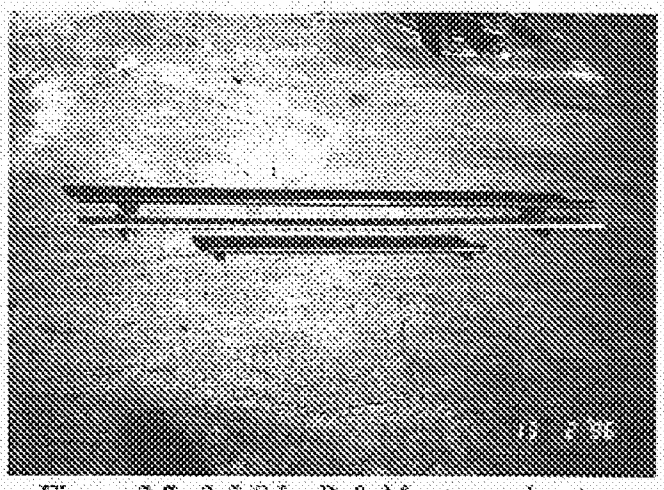


Figure 3.7. 3-3/8 In. R & M rotor and stators

3.3 Flex Coupling Design

The flex coupling is required because the power section does not rotate concentrically. The rotor orbits about a center offset from the stator's center line (**Figure 3.8**). The distance between the two centers is called the motor's eccentricity.

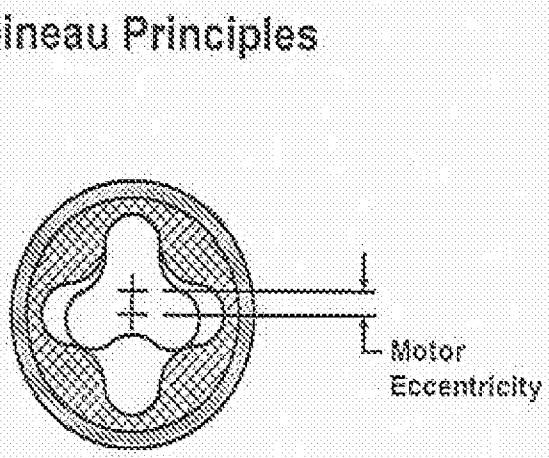


Figure 3.8. Multilobe Cross Section Showing Eccentricity

The flex coupling has always been a weak component in Moineau oil-field motors. The standard SlimDril motor uses a flame cut flex coupling. The flame-cutting operation damages the heat treatment of the steel, reducing its strength. To avoid this problem, a high-pressure water-jet cutting process (30,000 psi) was tried for the DOE motor. Some success has been achieved with this process in larger flex couplings, but the small size of the 3⅝-in. coupling led to problems that could not be overcome. The small diameter of this coupling allowed the water jet to pass across the inside of the coupling and damage the inside diameter opposite the cut as shown in **Figure 3.9.**

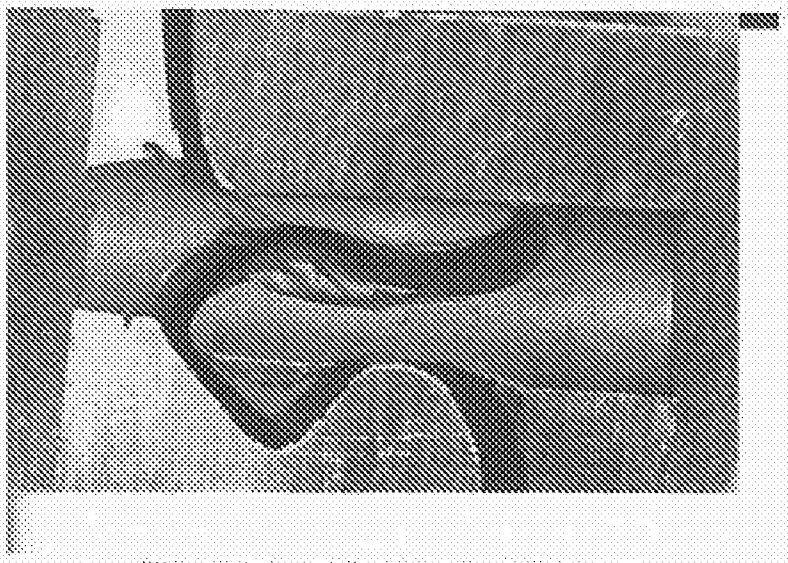


Figure 3.9. High-Pressure Jet Damage

Several different methods of cutting the flex coupling with the water jet were tested. These included varying pressure and placing a sacrificial bar inside the coupling to absorb the energy of the water jet before it could cut the opposite side of the coupling. However, cutting could not be accomplished without damage. Therefore, a conventional coupling was manufactured. The flame cut coupling was designed to maximize diameter while still allowing a bend in the motor of 2 to 2.5 degrees. Maximizing coupling diameter also maximizes coupling strength. This flex coupling failed under the high torques developed by the DOE motor during laboratory testing on the DRC dynamometer test stand (Figure 3.10). More details on these tests are presented later in this report.

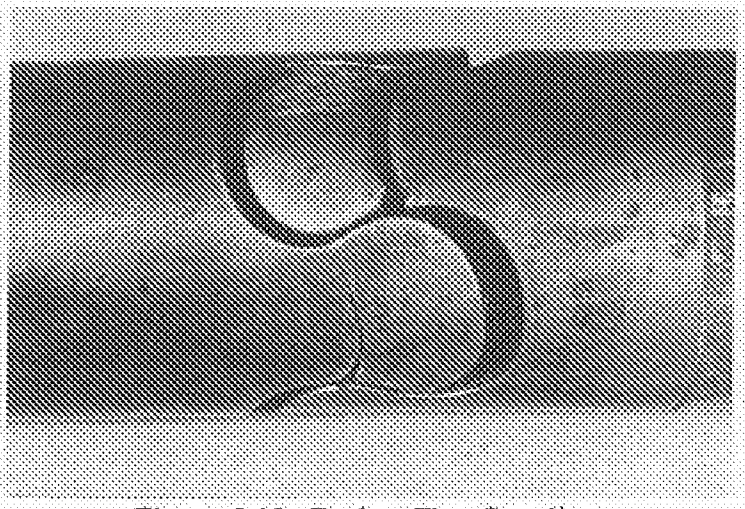


Figure 3.10. Broken Flex Coupling.

As an alternate to the conventional flex coupling, a titanium flex shaft was designed and fabricated that uses natural elasticity to accommodate the Moineau motor eccentricity. **Figure 3.11** is a drawing of a flex shaft.

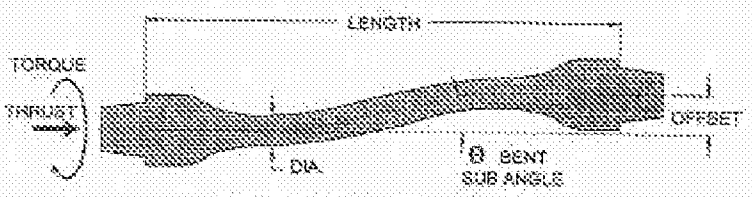


Figure 3.11. Flex Shaft

The stress in a flex shaft is a function of the material properties, length, diameter, and offset. A low modulus material like titanium or beryllium copper minimizes length. The flex shaft designed for the DOE motor is made with titanium, which has a modulus of 15 x 10^6 psi—half that of steel. Flex shafts have been used in Moineau pumps, but the increased length has made them unpopular for mud motors. Since the high-power motor is already double length, the slight increase in length for a flex shaft is insignificant.

R & M Energy Systems ran a finite element analysis to help design the DOE flex shaft. The flex shaft specifications (**Table 3.2**) were derived from data supplied in the R & M power section specification sheet, extrapolated data, and calculations.

TABLE 3.2. Flex Shaft Specifications

Motor Size:	3⅜, 4/5, High-Power Moineau
Eccentricity	0.165 in.
Max Torque	1600 ft-lbs
Max Down Thrust	5900 lbs
Coupling Length Min: Max:	 17.125 in. 36 in.
Coupling Diameter: OD: ID:	 2 in. As required
Material:	Titanium, Beryllium Copper, Aluminum
Minimum Life:	1000 hrs.
Max Motor Bend:	2½°
Bit Sizes:	3⅝ to 6½ in.

The flex shaft must accommodate offsets from two sources: 1) rotor eccentricity and the 2) bent housing. The eccentricity is established by the power section design and is given on the R & M data sheet. The maximum bent housing the motor can use must be determined by layout drawings that show the clearance between the flex shaft and the flex shaft housing. **Figure 3.12 (A & B)** show a typical layout of this section.

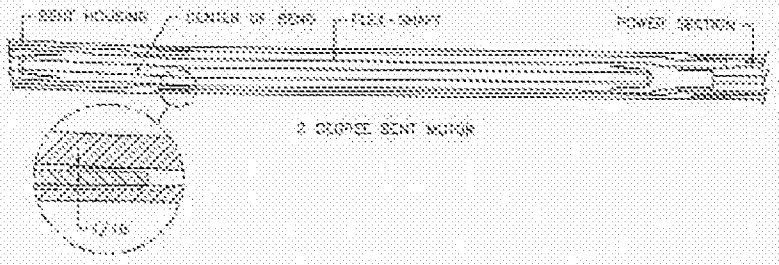


Figure 3.12A. Clearance with Bent Sub.

The designer must use judgement in determining the maximum bent sub that can

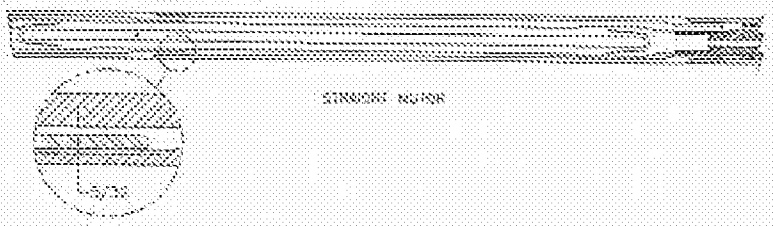


Figure 3.12B. Clearance in straight Motor.

be used. As the bend increases, the housing wall thickness must be decreased or the flex shaft diameter decreased. The optimum point is found through experience. The DOE high-power motor can support a 2.5° bent housing before the flex shaft begins to interfere with the housing.

The maximum torque for the flex shaft was calculated by doubling the operating torque listed in the R & M data for a standard motor and applying a safety factor of 1.5. In a similar manner, the down thrust was calculated by doubling the listed operating pressure drop and applying a safety factor of 1.4. This particular safety factor for down thrust was selected because it specified a load that could be safely carried by two thrust bearings.

The flex shaft length was selected to be equal to the conventional flex coupling length, up to a maximum of 36 in. Lengths over 36 in. were not considered due to concern that the coupling would become unstable and "whip" as it rotated. The final length was selected so that stress in the shaft will be kept below the fatigue endurance limit. The

maximum shaft OD was selected in the layout drawing shown in **Figure 3.12 (A & B)**.

A flex shaft life of 1000 hours was selected so that it could replace 10 conventional flex couplings lasting 100 hrs each. The 100 hr life is a typical for a conventional coupling run in typical, but not severe, conditions.

Under this criteria, the flex shaft cost can be 10 times as much as the conventional coupling cost and still be at break-even. **Table 3.3** gives the results of R & M's analysis while **Table 3.4** shows results from an MEI analytical design program. Both analyses yielded similar results for the dimensions of the flex shaft. The stresses are below the 40,000 psi endurance limit for titanium. This means the shaft should not fatigue, regardless of the number of cycles. If these calculations prove to be correct, and there is no reason to believe otherwise, the life of the flex shaft will be determined by something other than fatigue. The shaft theoretically has infinite life with no maintenance required.

TABLE 3.3. Moyno Oil-Field Products Flex-Shaft Calculations

SHAFT LENGTH (INCH)	O.D (INCH)	I.D. (INCH)	MATERIAL	MAX STRESS (PSI)	VON MISES STRESS
30	1.5	0	STEEL	119,000	110,304
30	1.5	0.75	STEEL	130,000	115,000
30	1.5	0	TITANIUM	64,000	62,424
30	1.5	0.75	TITANIUM	72,000	62,114
36	1.5	0.75	STEEL	84,000	83,117
36	1.5	0.75	TITANIUM	48,000	46,039

TABLE 3.4. MEI Titanium Flex-Shaft Calculations

Flex Shaft Calculation		
Eccentricity	0.165 in.	
Shaft OD	2 in.	
Shaft ID	0 in.	
Motor bend	2.5 deg.	
Titanium (E=17500000 psi)		
Shaft length	Bending stress (psi)	
(in.)	Straight motor	Motor bend
17	59824	104253
25	27596	57438
36	13244	33447
Copper (E=15000000 psi)		
Shaft length	Bending stress (psi)	
(in.)	Straight motor	Motor bend
17	52160	89277
25	23636	49118
36	11334	28517
Aluminum (E=11000000 psi)		
Shaft length	Bending stress (psi)	
(in.)	Straight motor	Motor bend
17	37558	65311
25	17300	35892
36	8278	20806

During the first run of the high-power motor the lower sections of the stator was damaged. It was determined that the damage was caused because the flex shaft was too stiff. Further analysis was conducted on the shaft and the titanium material. It was determined that the endurance limit on the titanium selected could be increased from 40,000 psi to 60,000 psi. This allow the shaft diameter to be reduced to 1.5 in. while retaining the same infinite cycle fatigue life. This change was made and the motor with the new shaft retested. The smaller shaft worked and no subsequent damage to the stator has occurred.

3.4 Bearing Pack Design

The bearing pack reacts all internally and externally applied motor loads. There are

two types of bearing packs in use: 1) oil-filled sealed bearing packs and 2) mud-lubricated leaking bearing packs. Sealed bearing packs must be pressure compensated to respond to oil volume increases as they become heated. They are considerably more expensive than mud lubricated packs and have a very short life in the event the seals fail during operation.

Mud lubricated bearing packs are designed to divert a portion (approximately 10%) of the drilling fluid volume through the pack to cool and lubricate the bearings. The remainder of the fluid is routed through the center of the bearing pack shaft directly to the drill bit. Figure 3.13 shows a schematic of a mud lubricated pack. A flow restrictor is used to set the amount of flow across the bearings and to compensate for the pressure drop across the drill bit.

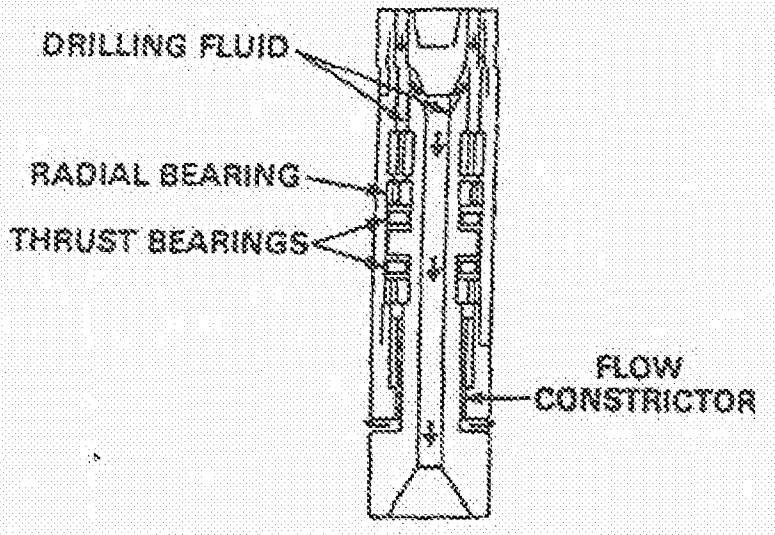


Figure 3.13 Leaking Bearing Pack

The thrust and radial bearings in mud lubricated bearing packs are expendable items and are often used up after a single run. There are two sources of thrust loads in a Moineau motor. The first is a result of the pressure drop across the power section, which pushes down on the rotor. Thrust bearings must absorb this down thrust load to keep the rotor in place. The other thrust loading comes from the bit load. This force pushes up on the bearing pack shaft countering the down thrust from the rotor. Bearings that absorb the down thrust are sometimes called "off bottom" bearings since these have maximum load when the bit is off bottom. When the bit weight exceeds the rotor down thrust then the "on bottom" bearings become loaded. Depending on the type of bearing pack and the bearings used, stacked bearings are often needed because of the high loads. When stacked bearings are used a load distribution system is needed to divide the load equally between the bearings. Failure of the load distribution system can cause bearings to fail prematurely.

Radial loads to motors come from normal drilling forces, purposeful side loads for directional drilling, and loads transferred through the flex coupling to the bearing pack. In mud lubricated bearing packs the radial bearings are often rubber marine bearings. These work well in the mud environment, but have low load limitations. Two radial bearings are typically used one at the top of the bearing pack and one at the bottom with the thrust bearings sandwiched between.

The small size of components in slim-hole motos make it challenging to develop a long life bearing pack. To handle the increased power, the thrust bearings and the load distribution system were modified to withstand higher thrust loads. Higher thrust loads come from two sources: 1) since the motor has twice the number of stages, the pressure drop and the down thrust are doubled, and 2) the increased torque of the high-power motor allows higher bit weights. In an ideal situation, the down thrust equals the bit thrust and the bearings carry no load. However, in reality, this is rarely achieved and the thrust bearings must carry substantial loads.

The down thrust on the bearing pack can be calculated by multiplying the operating pressure drop across the motor times the projected area of the rotor. This projected area can be calculated from the rotor contour outside diameter listed in **Table 3.1** (1.941 in.). At 1500 psi differential pressure, the down thrust for this DOE high-power motor will be 4400 lbs. This bearing pack has been constructed so that two bearings share the down thrust load and four bearings share the up-thrust or bit loads. If needed, additional bearings can be added to extend tool life.

Rubber radial marine bearings used in the conventional bearing packs have been replaced with metal-on-metal bearings in the high-power motor to increase the radial load capacity and life. The radial bearings are made using a proprietary process where a coating of tungsten carbide is fused to the surface of a steel sleeve. The powdered tungsten carbide is first made into a blanket as shown in **Figure 3.14**.

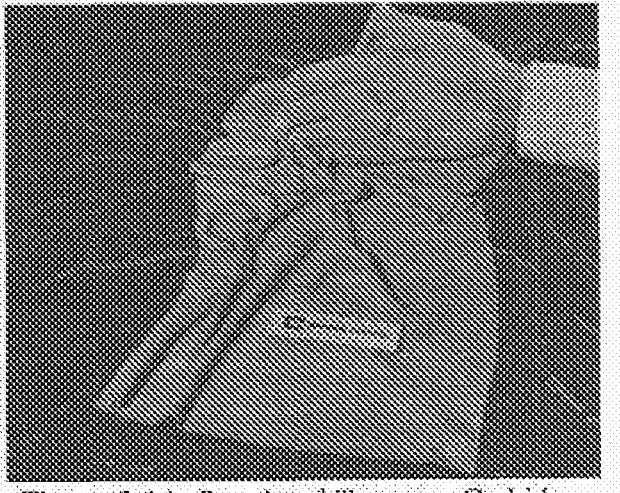


Figure 3.14. Powdered Tungsten Carbide Blanket.

This blanket material is then cut into a shape that matches the part to be covered. The blanket is glued into place with a layer of braze material between the blanket and part. The assembly is placed into a furnace to melt the braze and fuse the tungsten carbide to the part. The result is a final assembly that is very uniform and close to size. Final grinding finishes the part. The radial bearings are manufactured in two parts: 1) an inner and 2) outer sleeve as shown in **Figure 3.15**.

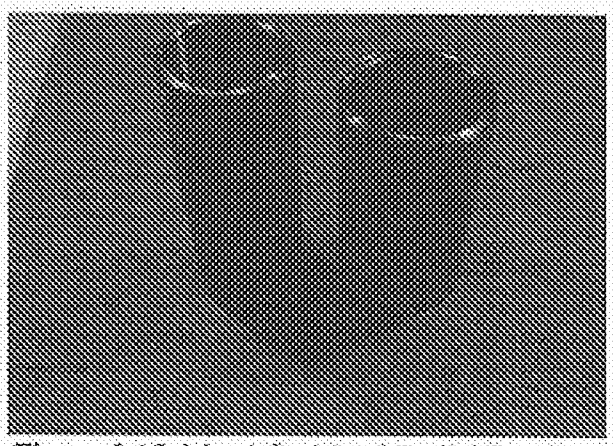


Figure 3.15 Metal On Metal Radial Bearings

These bearings wear well, because the surface is tungsten carbide, and are tough, because the core part is made from steel. They are becoming the industry standard because of their increased life and load carrying ability. The metal-on-metal bearings are also shorter than conventional rubber marine bearings, reducing bearing pack length. The metal-on-metal bearings are much more expensive then the marine bearings. Two sets (upper and lower) for the DOE high-power motor cost $3500.

3.5 DOE High-Power Slim-Hole Motor

The above components are combined to for the slim-hole high-power motor. The specifications for this tool are shown in **Table 3.5**. Performance data used in the table comes from tests described in Chapter **4. Laboratory Testing**.

Table 3.5. DOE High-Power Motor
General Specifications

	ENGLISH	METRIC
Outside Diameter	3⅜ inch	85.7 mm
Overall Length	25.3 Ft	7716 mm
Weight	495 lb	225 kg
Top Connection	2⅜ API Reg	-
Make-Up Torque	3080 Ft-Lbs	4078 N-m
Bit Connection	2⅜ API Reg	-
Make-Up Torque	3000 Ft-Lbs	4070 N-m
Bit Size Range	4⅛ to 6 inches	-
Max WOB	19,000 Lbs	8620 kg
Max Bit Pressure Drop	500 psi	34.5 bar
Flow Rate	30 — 110 gpm	114 — 415 l/min
Free-Running Shaft Speed	125 — 400 rpm	125 — 400 rpm
Differential Pressure @ Max. Operating Torque	2000 psi	140 bar
Max Operating Torque	1100 Ft-Lbs	1490 N-m
Max Power Output	75 hp	56 kW
Max Stall Torque @ Max Flow Rate w/H_2O	1700 Ft-Lbs	2300 N-m
Max Allowable Overpull for Retrieving Motor	22,500 Lbs	10,200 kg
Absolute Max Overpull	35,000 Lbs	15,875 kg
Configuration	4:5	4:5
Number of Stages	9.5	9.5

4. LABORATORY TESTING

4.1 Test Format and Objectives

The high-power, slim-hole motor was subjected to three types of laboratory tests. The first series of tests consisted of establishing the actual power output and efficiency of the motor for subsequent comparison to conventional motors. These tests were conducted on the Drilling Research Center dynamometer test stand (**Figures 4.1 and 4.2**). This test stand uses a water-cooled brake to apply torque resistance to the output of the motor. As torque is applied to the motor, a computer data acquisition system measures the following parameters:

1. Motor Input Pressure
2. Motor Output Pressure
3. Flow
4. Motor Speed
5. Motor Output Torque

During a performance test, the flow through the motor is fixed at a given rate and the torque on the dynamometer is gradually increased under computer control. As the torque

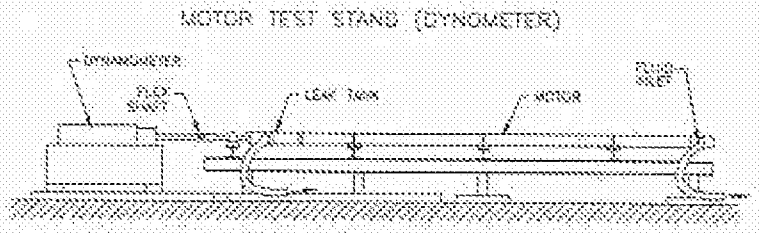


Figure 4.1. Motor Dynamometer Test Stand

increases, so does the pressure drop across the motor. As torque is increased, the motor's speed decreases until the motor stalls.

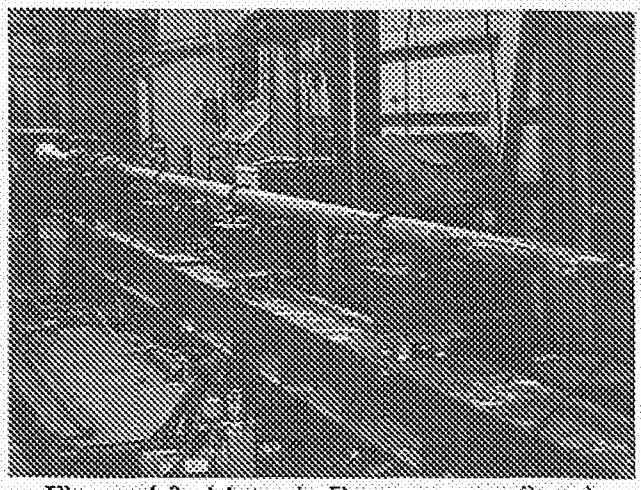


Figure 4.2. Motor in Dynamometer Stand.

The performance tests were run at 30, 70, and 110 gpm. These flow rates match the data published by R & M Energy Systems and allow direct performance comparisons with manufacturer's data. **Appendix A** contains the printed Data.

The second series of tests were focused on reliability and were specifically structured to identify any design weaknesses/high wear rate items which needed to be fixed prior to field testing. In reliability testing, the motor is run in a loaded condition for several hours while the computerized data acquisition system periodically monitors system parameters. The system parameters were monitored so that if they varied from the set conditions an alarm would sound to alert the operator to either make adjustments to the pump if input hydraulics were deviating from the desired settings or to examine the motor if its output speed or torque changed in any statistically significant way.

Two life tests were conducted: one for 20 hours and another for 10 hours. During these tests, conditions were held at a constant 70 gpm and 1200 psi motor differential pressure. The motor produced 770 to 790 ft-lbs of torque during the tests which represents a high loading condition.

The third form of testing was to conduct actual rock drilling tests to determine the increase in penetration rates made possible by the high power slim hole motor when combined with the high-power drag bits. These tests were conducted using Carthage marble, a hard, homogeneous rock (15,000 psi compressive strength).

4.2 Motor Performance Curves

Figures 4.3 A&B show speed and torque performance curves for the high-power

slim-hole 3⅝-in. DOE motor. Comparing these to the manufacturer's curves shows that the DOE motor operates at a higher rpm for the same flow rate. The difference between the laboratory measured speed and R & M's specification could result from several factors. The most logical explanation is that the longer stator of the high power motor has less slip and thus higher speed. Every motor has "slip" which is the fluid that leaks around the rotor and produces no work. A large amount of slip would reduce the speed of the motor. Increasing the number of stages reduces these losses - increasing motor speed and output horsepower.

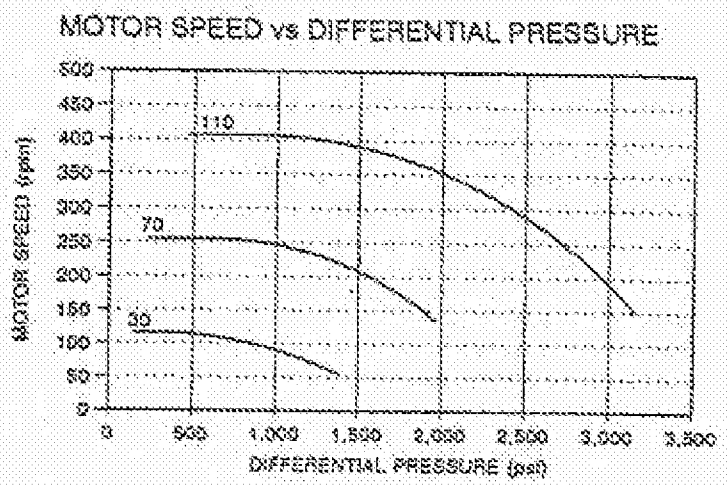


Figure 4.3A. Speed Curves

The torque output of a motor is a function of the pressure drop across the tool. Where the pressure drop is measured, can greatly affect the appearance of the torque curves and the motor efficiency. The data shown in **Figure 4.3B** were recorded using pressure transducers at the top and bottom of the motor. As a result, this pressure drop includes the losses through the bearing pack and provides the most realistic value for total motor efficiency. This can shift the torque curves from published data, resulting in a slightly lower torque at a given pressure drop. Most published data do not include pressure drop across the bearing pack - especially if the power section manufacturer, such as R&M Energy System, does not offer bearing packs for sale.

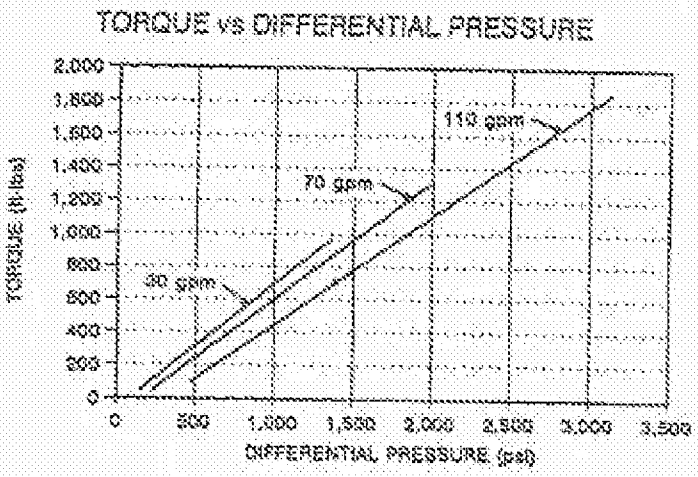


Figure 4.3B. Torque Curves.

An important source of lost energy is the pressure needed to overcome motor friction. The DOE tool has a higher startup pressure (150 to 250 psi) than conventional 3⅜-in. motors (50 to 100 psi) because of the longer power section. It takes more pressure to overcome the friction between the long rotor and stator. As a result, the DOE motor shows slightly less torque at a given pressure drop than the standard motor. However, the DOE motor can be operated at much higher differential pressures (2500 psi) and delivers twice the torque and horsepower of a conventional motor. (See Figure 4.4).

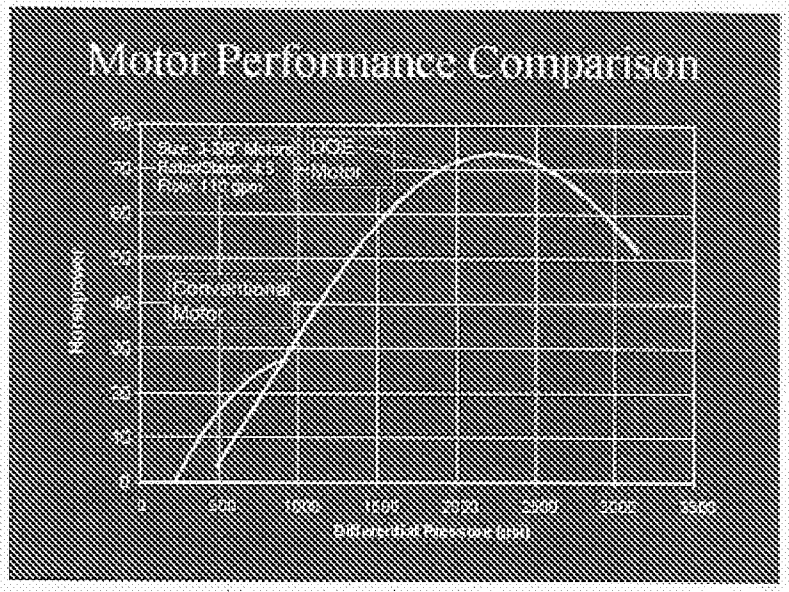


Figure 4.4. Power Curves

Motor torque is proportional to pressure drop. To take advantage of higher torques, the DOE motor must be operated at higher pressure drops. This requires rig pumps capable of producing the higher pressures at typical operating flow rates. This should not present a significant problem, as mud pumps are designed to operate at 5000 psi and most drillers operate their pump in the range of 2500 to 3000 psi.

Recently, extended-performance power sections have been introduced to the market. These new extended-length power sections were developed based on the same concepts that were used to design and build the DOE high-power motor. R & M Energy's extended-performance power sections are approximately 33% longer than their standard power sections, and therefore produce one-third more power. The DOE high-power motor is twice as long as standard, so it produces twice the power. This is two-thirds more power than commercial extended-performance power sections.

Maximum values for torque and pressure drop measured in typical laboratory tests are greater than typical field operating values. This is true because, in the laboratory, the torque load from the dynamometer is very uniform and is applied evenly, allowing the motor to perform up to maximum capability. In the field, the torque is produced from a bit drilling rock, a process that produces widely varying torque. If a motor is run too high on the performance curves (high pressure drop), spikes in the torque from the bit can stall the motor. To restart the motor, the driller must lift the bit off bottom, reestablish circulation and then slowly run back to bottom to start drilling again. This is a time-consuming process and slows overall drilling rates.

To avoid this problem, drillers normally operate motors in an area on the performance curves that allows the motor to continue drilling even when the bit torque spikes. This range is typically between 200 to 300 psi differential pressure for a standard motor. The high-power motor can easily be operated at 600 to 1000 psi differential pressure, providing twice the power. Because the high-power motor maintains rotary speed at higher pressure drops, it has the capability to continue rotating during larger torque spikes. This means that more weight on bit can be applied to increase penetration rate. This is how high-power motors achieve superior penetration rates when compared to conventional motors.

4.3 Reliability Test Results

During life testing on the dynamometer, several components suffered damage. This resulted in their redesign and retesting to validate the improvements to reliability. Specifically, the thrust bearings and load distribution system were damaged during the initial 20-hr life test as shown in **Figures 4.5 and 4.6.**

During dynamometer tests, the motor is run with no bit weight, which represents a worst-case operating situation since the "off-bottom" bearings are carrying the full hydraulic down thrust produced by the pressure drop across the motor. In normal operation, bit

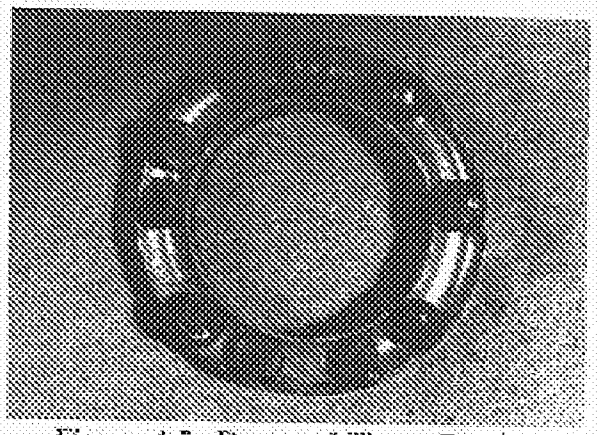


Figure 4.5. Damaged Thrust Bearing

weight offsets much of the down thrust, reducing the load on the off-bottom thrust bearings. Despite damaged thrust bearings and a broken flex coupling, the motor was still operating at full power at the end of the 20-hour endurance test.

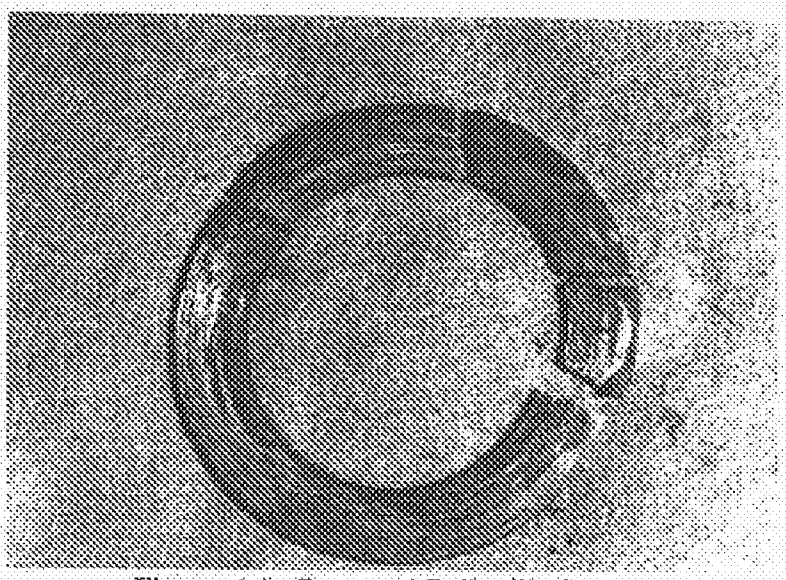


Figure 4.6. Damaged Belleville Spring.

Although bearing failure is not expected under normal drilling conditions, MEI strengthened the thrust bearings. The thickness was increased so that the bearings would flex less under load. MEI has used the same approach in the past and had excellent results. These modified thrust bearings performed well in field tests at the Catoosa test site in Oklahoma.

Belleville springs are used to distribute the load evenly between bearing sets. If these springs fail, the load can be distributed unevenly resulting in a premature bearing failure. Space constraints prevent significant design change on these components. One of the few changes that can be made is to limit the travel of the spring and thus limit the

stress in the spring. This is accomplished by machining the back of the ball race at the appropriate angle. After the dynamometer life test the stroke of the Belleville springs was reduced to reduce stress and prevent breakage. MEI has found that it is not uncommon for Belleville springs to develop a single crack and keep on functioning. When several cracks develop the shape and spring properties are lost causing incorrect load distribution.

The "baseball stitch" lobe on a flame-cut flex coupling failed during the dynamometer tests (**Figure 4.7**) due to the high torque and high thrust load produced by this high-power motor. This problem was anticipated prior to the dynamometer tests and resulted in the development of the titanium flex shaft previously described.

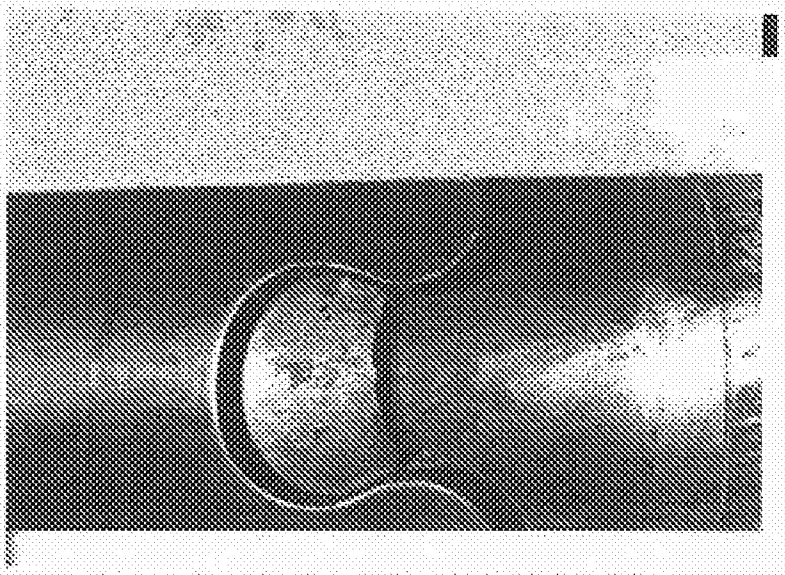


Figure 4.7. Broken Lobe On Flex Coupling.

The titanium flex shaft performed well in the second dynamometer test where the motor delivered the same power as with the conventional flame-cut flex coupling. Results confirmed that the titanium flex shaft efficiently transmitted the torque from the rotor to the drill bit. A 10-hr life test was completed with the titanium flex shaft.

4.4 Drilling Tests

The DOE high-power slim-hole drilling system consists of the high-power DOE motor and a high-power bit. Two advanced bits were manufactured for drilling tests with the high-power motor. The first, a large cutter TSP Bit (LC-TSP, **Figure 4.8**), was manufactured using the guidelines set out in Chapter 2 of this report. This bit has a large number of 8-mm round TSP cutters. As indicated previously, this bit design provides for the densest cutting structure possible in this size bit. This ensures cutter redundancy and

long bit life.

Previous R & D has shown that bits made with large 5– to 7-mm TSP cutters drill faster and last longer than conventional TSP bits with smaller 3-mm TSP cutters, and that rounding off the corners on the TSP cutters reduces breakage during drilling. The second DOE test bit is a hybrid design which uses both PDC and large TSP cutters (**Figure 4.9**). This bit utilizes 8-mm PDC cutters for drilling soft formations and 5-mm round TSP cutters for drilling hard formations. The PDC and TSP cutters are set at the same height so that they wear at the same rate. In the field, the hybrid design will allow the PDC cutters to drill soft formations at high rates yet drill through hard stringers with the TSPs. The TSPs main contribution is to prevent premature wear of the PDC cutters. This design has high drilling rates in nonhomogeneous formations that alternate between hard and soft rock.

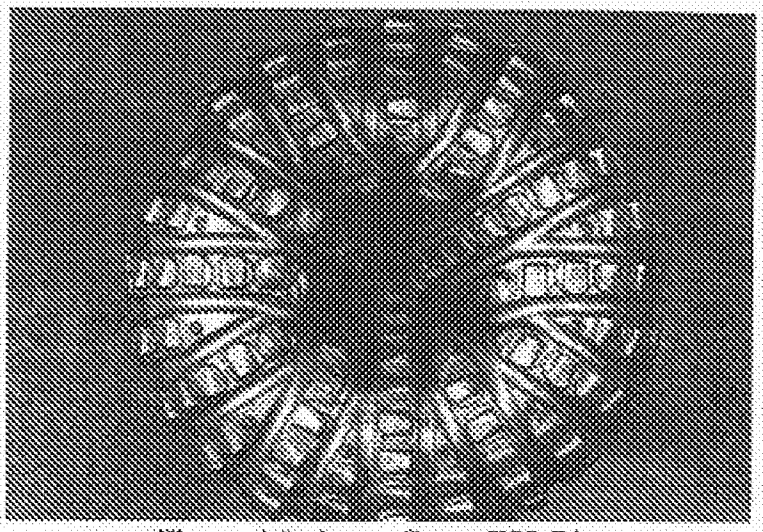


Figure 4.8. Large Cutter TSP Bit

Proper bit cleaning is critical in TSP and PDC bits because of their high drilling rates. Therefore, nozzles were added to the DOE TSP/PDC bit so that hydraulic horsepower used for cleaning the bit can be controlled and directed across the cutting faces.

Conventional diamond bit designs rely on small flow grooves and the narrow spaces between the bit body and rock face to aid in transporting the cuttings from under the bit. When drilling at high penetration rates, these small passages can become clogged with cuttings. This transfers some of the bit weight used to make the cutters penetrate the rock to the bit body, slowing penetration rates.

The design shown in **Figure 4.9** has large flow passages for removing the cuttings, and the nozzles increase the force and velocity of the fluid to move the cuttings more efficiently. Better cleaning increases penetration rates by eliminating energy wasted on re-grinding cuttings already removed from the rock faces.

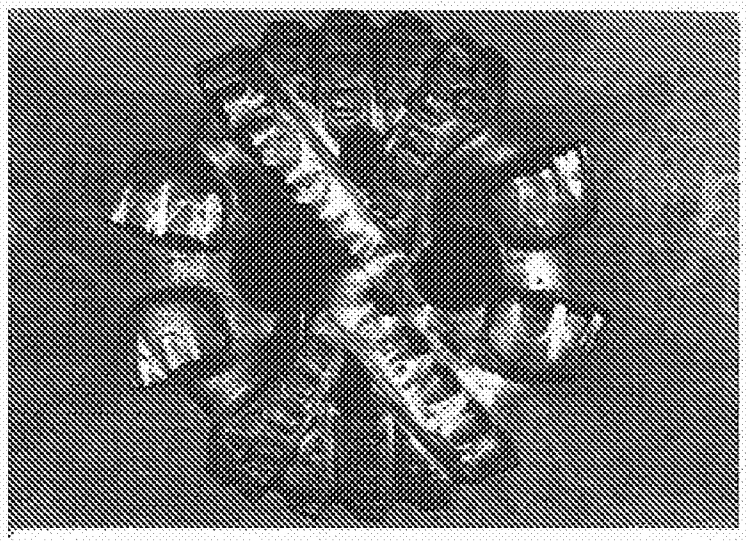


Figure 4.9. Hybrid TSP/PDC Bit.

The motor and bits were tested on the DRC motor test stand in Carthage marble. **Table 4.1** shows the conditions used for these tests.

TABLE 4.1. Motor Test Conditions

Motor:	3⅜ -in. DOE motor
Flow rate:	110 gpm
Bit:	4¾ in. LC-TSP & Hybrid TSP/PDC
Bit weight:	2000 to 14,000 lbs

Figure 4.10 shows that the 5-mm round TSP bit and motor combination drilled Carthage marble at rates of 10 to 50 ft/hr as weight on bit (WOB) was increased from 4000 to 12,000 lbs. This bit is designed to drill harder rocks and is well matched to the motor. The input pressure to the motor determines the work the motor is performing. As the WOB

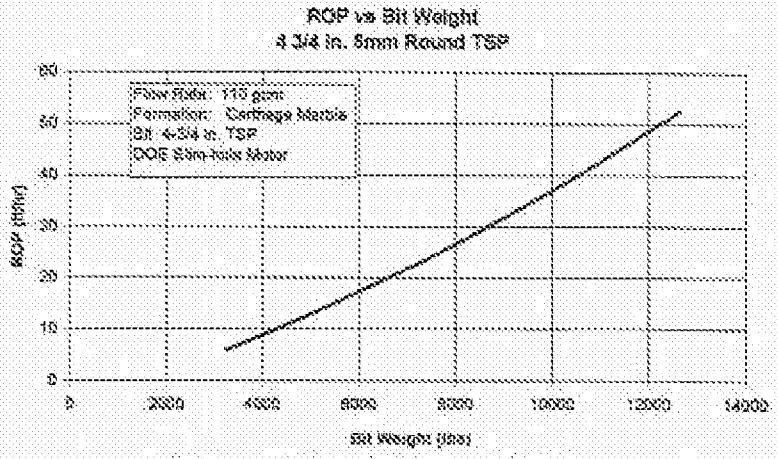


Figure 4.10. ROP For TSP Bit.

was increased from 4000 to 12,000 lbs, the pressure rose from 800 to 1400 psi (**Figure 4.11**).

This motor will operate well with a pressure drop of 1400 psi. These data show that, for hard rock, over 12,000 lbs weight on bit can be applied to the DOE slim-hole drilling system while remaining within operating parameters. A standard motor is designed to operate at a pressure drop of only 700 to 800 psi. This would correspond to a bit weight of less than 4000 lbs or only one-third that of the high-power slim-hole system.

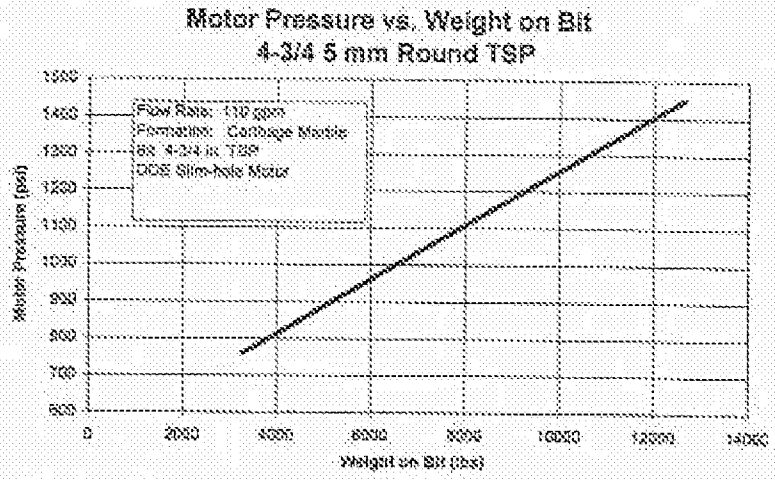


Figure 4.11. Motor Input Pressure As A Function Of bit Weight.

Figure 4.12 shows that the hybrid bit drilled Carthage marble at rates of 60 to 250 ft/hr, as weight on bit was increased from 4000 to 13,000 lbs. This is a high penetration rate for hard rock. The addition of PDC cutters and nozzles produced these very high penetration rates. Testing has shown that cleaning is very important, but it is unlikely that the high penetration rates obtained with this bit are solely due to improved cleaning.

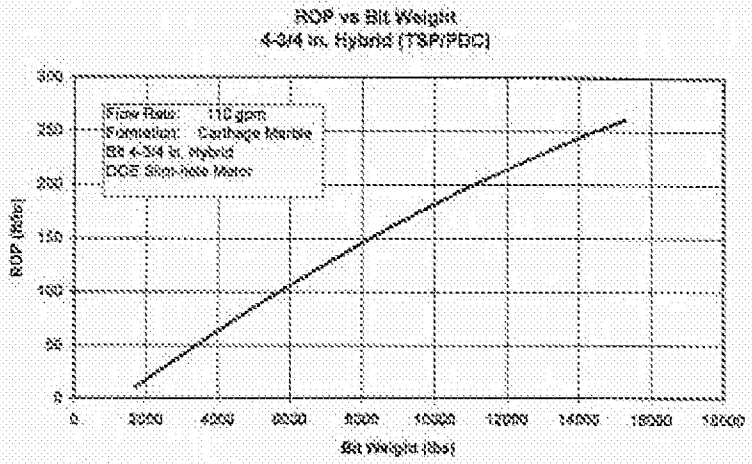


Figure 4.12. ROP For Hybrid PDC/TSP Bit.

As bit weight increased, more motor torque was required to rotate the bit. To increase motor torque output, the pressure drop across the DOE motor had to be increased. **Figure 4.13** shows how the motor pressure drop increased as a function of bit weight. These data show that at 12,000 lbs WOB the motor pressure drop was 1500 psi, and that the motor could operate at pressure drops up to 1700 psi. These data show that

the high-power motor can drill at high bit weights with aggressive PDC bits designed for drilling softer formations.

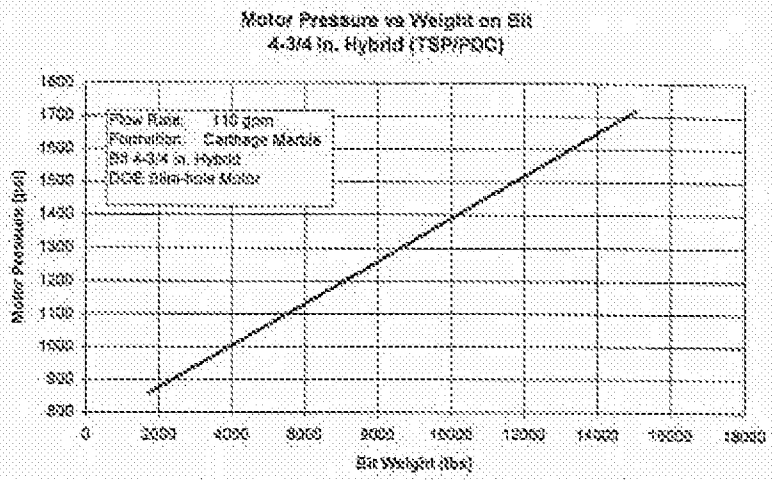


Figure 4.13. Motor Pressure & WOB for PDC/TSP Bit.

The PDC/TSP bit is designed to drill soft formations quickly, but if hard stringers of rock are encountered, the bit can continue drilling without damaging the PDCs. These tests demonstrated that both of these bits are good candidates for use with the high-power motor.

5. FIELD TESTING

5.1 Catoosa Test Site

Two field tests were conducted with the slim-hole high-power DOE motor at the Catoosa test facility in Oklahoma. This facility allows testing of oilfield down hole tools under actual well known field conditions. The site has numerous facilities for different types of testing including a large main drill rig that is instrumented so data can be gathered during the drilling process. **Figure 5.1** shows the Catoosa site large drilling rig.

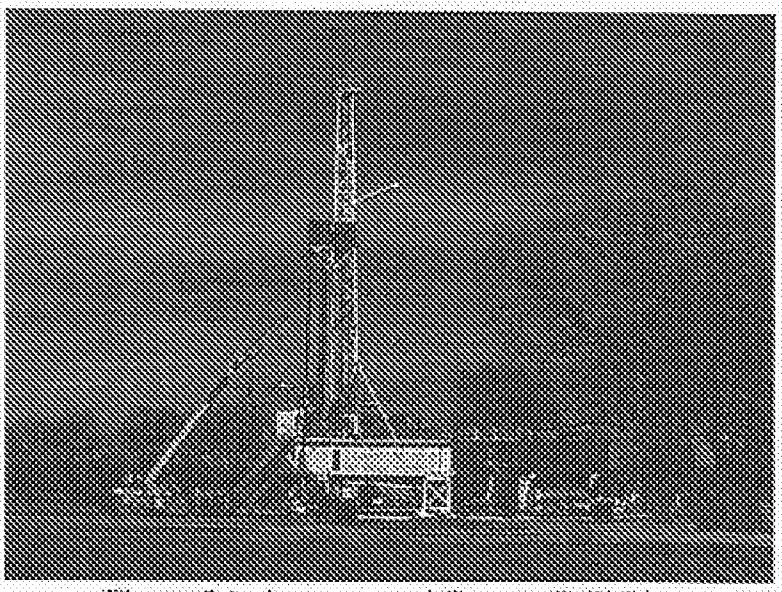


Figure 5.1. Instrumented Catoosa Drill Rig.

One of the unique features of Catoosa is the large number of formations that are encountered in a relatively shallow zone. **Figure 5.2** shows the lithology at Catoosa. The strength of the formations varies from very soft to vary hard. **Figure 5.3** is a plot of the rock strength, based on sonic logs, as a function of depth. The formations strengths vary from 5,000 to 30,000 psi compressive strength. At the top of the Mississippi Limestone at approximately 1380 feet is a formation know as "The Wall". The wall is a very hard section of rock that has historically proven to be difficult to drill. In fact, many drill bits that have been tested at Catoosa have failed to drill "The Wall". PDC bits are often severely damaged drilling this formation because of the hardness of the rock and the vibrations that it produces during drilling including bit whirl.

Drilling is conducted in 8 to 10 hour shifts during the day. At the end of the day the drill string is pulled to a safe level in the hole, usually to a point were all the bottom hole assembly components are inside cased hole. Since the formations are shallow this procedure does not excessively disrupt the drilling process and allows fewer technical

personnel to monitor tests.

		Surface - 70 ft	Big Lime
Pennsylvanian	Cherokee Group	70-277 ft	Peru Sandstone Zone
		277-304 ft	Oswego Limestone
		304-375 ft	Prue Sandstone Zone
		375-383 ft	Skinner Sandstone Zone
		383-595 ft	Skinner Sandstone Zone
		595-604 ft	Pink Limestone
		604-628 ft	Red Fork Sandstone Zone
		628-838 ft	Inola Limestone
		838-879 ft	Bartlesville Sandstone Zone
		879-1186 ft	Booch Sandstone Zone
		1186-1216 ft	Burgess Sandstone
Mississippian		1216-1252 ft	Fayetteville Shale
		1252-1549 ft	Mississippi Lime
Devonian		1549-1578 ft	Woodford Shale
		1578-1605 ft	Misener Sandstone
Cambro-Ordovician		1605-2980 ft	Arbuckle Group

Figure 5.2. Catoosa Lithology

The first test conducted at Catoosa was a "shake out" test for the motor. It was intended

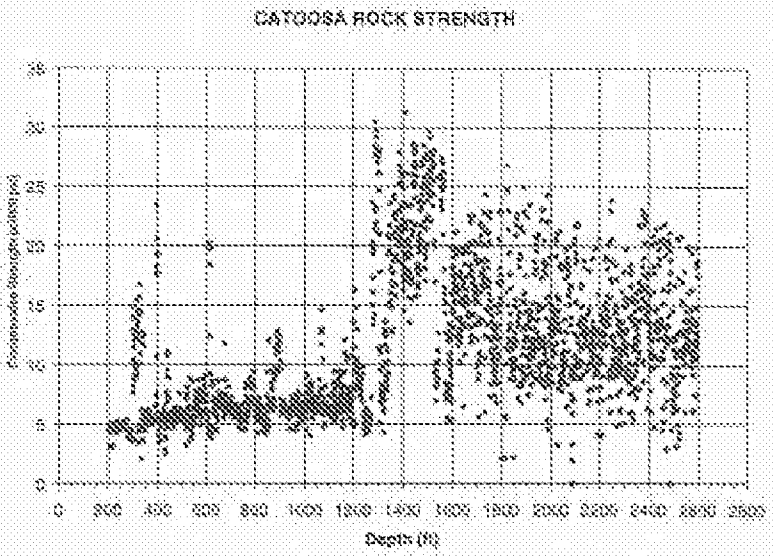


Figure 5.3. Catoosa Rock Strength.

only to find any obvious problems. The second test was conducted to compare the DOE drilling system against a conventional system.

5.2 First Field Test

The first test was conducted from February 22 to 27, 1996. During this test the DOE motor and a hybrid PDC/TSP bit were used to drill from 623 ft to 1450 ft. The drilling was conducted over three days. The majority or the first two days were through soft formations and the DOE system was able to drill at high rates. At the end of the second day, the bottom hole assembly entered "The Wall" at which time the penetration rates became considerably slower. **Figure 5.4** shows the drilling rate for the three days as a function of depth. **Appendix B** contains data for this field test.

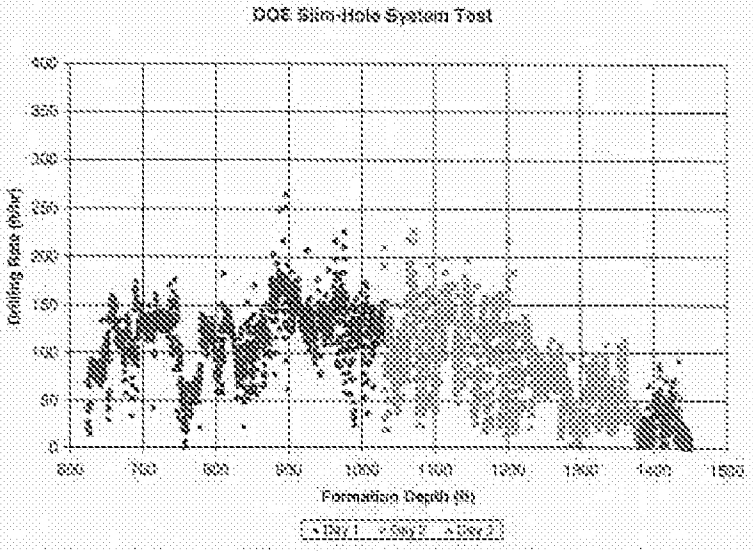


Figure 5.4. Drilling Rates Catoosa Shake Out Test.

Figure 5.4 shows that the drilling rate in the upper formations was averaging 100 to 175 feet per hour (fph). At the top of the Mississippi Limestone the average rate dropped to 50 to 75 fph. As the bit entered "The Wall" the rate dropped to less that 1 fph. The DOE system with hybrid bit drilled from 1380 to 1450 ft in this hard formation. Penetration rates varied in this section (1 to 12 fph), but the BHA continued to drill. The test was only terminated because time and test monies ran out, not because the system quit.

Bit weights were varied from 2,000 to 12,000 lbs, but averaged 8,000 to 10,000 lbs during the test. The motor performed well at different weights, but drilling rate was fairly independent of bit weight. This is because the upper portion of the hole is comprised of soft formations that do not require high bit weights to achieve maximum penetration rate. At "The Wall" higher weights are needed, but bit vibrations require that weight be reduced at some points in the drilling. **Figure 5.5** shows the bit weights as a function of depth. The total drilling hours on the system in this test was 16.4 hours. This is not the total time below the rotary table but the actual drilling time.

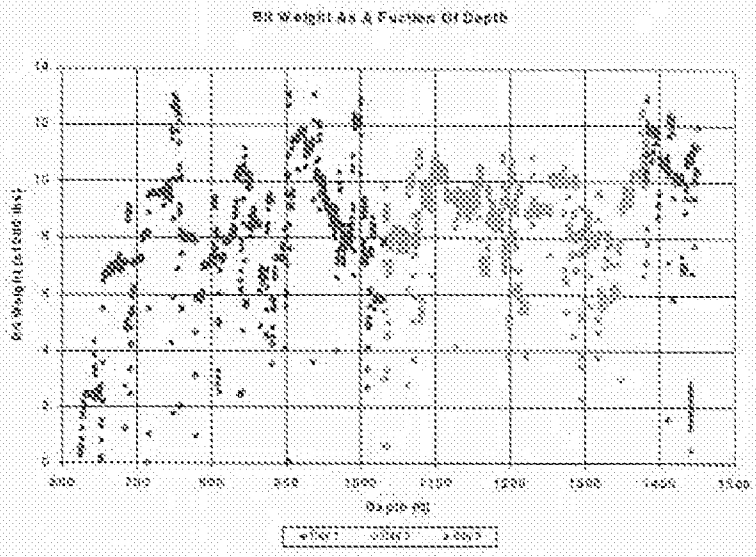


Figure 5.5. Bit Weight.

The motor and bit were still in excellent running condition at the completion of this test. **Figure 5.6** shows the bit at the conclusion of the test. The PDC cutters do have a wear flat from drilling through "The Wall". However, none were broken as is common when drilling this formation with conventional PDC bits. This bit could have continued drilling or could have been rerun as it came from the well. For our testing purposes, the bit was rebuilt by rotating the worn cutters to new locations. The TSP cutters were still in excellent shape.

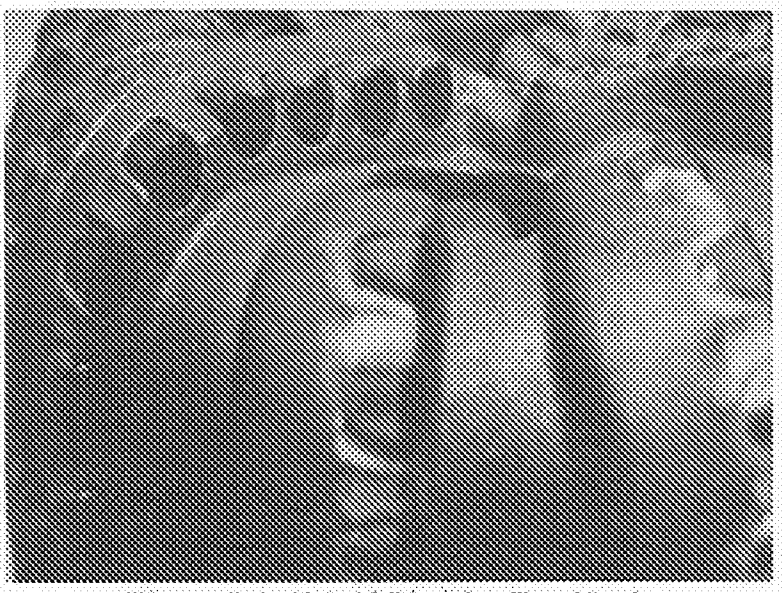


Figure 5.6. Hybrid Bit After Test No. 1.

The motor was returned to MEI's Drilling Research Center shop facility were it was disassemble and inspected. The bearing pack components were in excellent condition. The flex shaft showed no signs of wear. However, the bottom section of the stator showed some damage. This damage was in the form of "chunking" - pieces of rubber missing from the molded form. The stator was sent back to R & M Energy Systems for analysis. R & M did not have an explanation for the failure other than rubber fatigue. After further discussions between R &M engineers and MEI staff is was concluded that the titanium flex shaft was placing too high a load on the rubber. Further design analysis of the flex shaft and discussions with the titanium supplier concluded that too conservative a value for the endurance limit had been used in the initial design. The flex shaft was redesigned based upon a new, higher, value. The new design has a much smaller outside diameter making the shaft more flexible. The motor was repaired by relining the bottom section of the stator. The redesigned tool was then prepared for the second field test.

5.3 Second Field Test

The second field test compared the performance of the high-power slim-hole system against conventional motor drilling systems. To accomplish this comparison it is necessary to either have a uniform formation thick enough to justify running two bottom hole assemblies or significant offset well data where operating conditions are similar to the current well. This situation could not be found in actual wells so it was decided to test at Catoosa where BHAs could be changed out when necessary for test purposes. **Appendix C** contains printed data for each BHA.

The formation drilled during the test is the Arbuckle dolomite. (See **Figure 5.2**). It starts at 1605 ft and runs down to 2920 ft. This is the deepest formation drilled at the Catoosa site. The top 800 ft of the Arbuckle is very uniform and provides a location were the DOE drilling assembly performance could be compared to a conventional assembly.

The test plan was very simple. Three BHAs would be tested. The first and the third would use the high-power DOE motor with a conventional 3-3/8 motor run between these two in the second assembly. The hybrid bit was used on all assembles so that drilling rates would not be affected by differences in bit performance. **Figure 5.7** shows a schematic of the test plan.

Both the DOE motor and the commercial 3-3/8 motor had a maximum rated flow rate of 110 gpm. This flow was used through out the test to simplify performance comparison between the different BHAs. Since flow rate is constant the power would be a function of the pressure drop across the motor. Since the DOE motor is twice as long, and has twice the number of stages, the pressure drop across the DOE motor will be much higher then across the commercial motor. Thus the DOE motor was able to produce more torque and drill faster, because more weight on bit could be applied without stalling the motor.

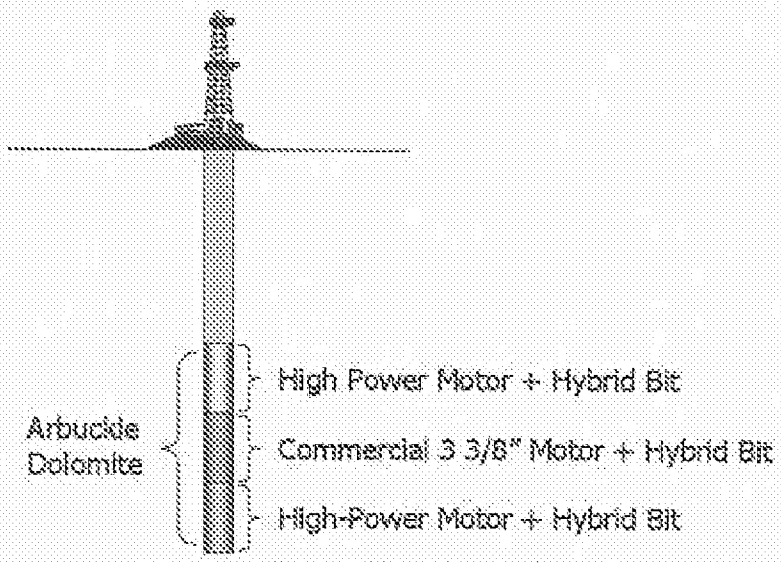


Figure 5.7. Field Test Plan Schematic.

The wells at Catoosa have not be drilled as slim holes so the upper portions of the well are completed with 13-3/8 in. casing. At 110 gpm and the velocity of the drilling fluid will not be fast enough to clean the hole. To avoid hole cleaning problems, two identical pumps (**Figure 5.8**) were used to drill the well. One pump provided drilling fluid to drill the well while the second pumped mud down a parasite string to increase the velocity in the upper section of the well. **Figure 5.9** shows how the pumps were used.

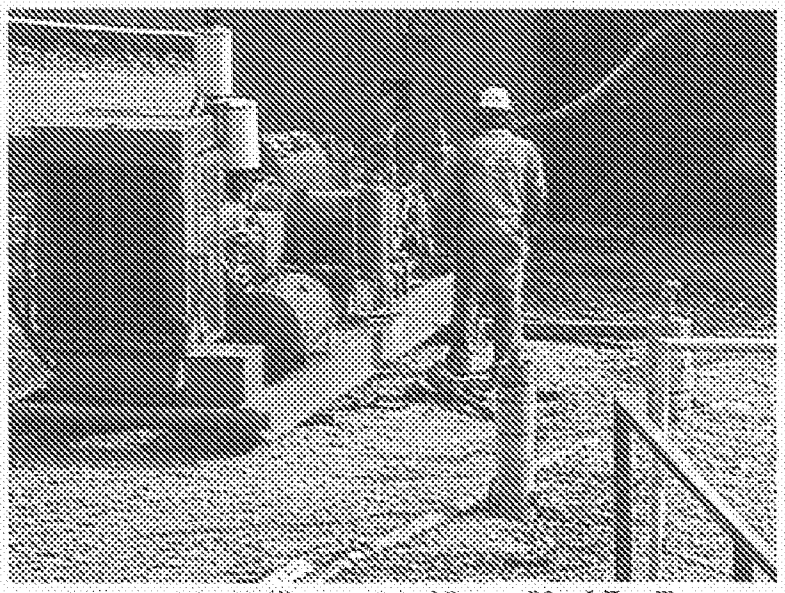


Figure 5.8. Haliburton Mud Pump Used For Test.

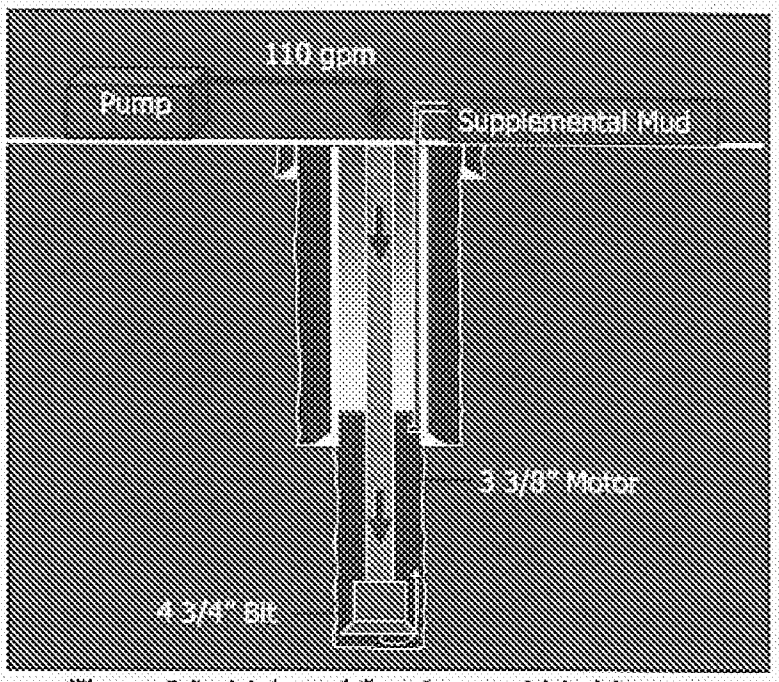


Figure 5.9. Main and Supplemental Mud Pumps.

Bottomhole Assembly #1

The first BHA consisted of the high-power motor and a new 4-3/4 in. hybrid bit. This assembly drilled a total of 98 feet in 4.7 hours for a penetration rate of 21 feet per hour. However, the first hour of drilling required several adjustments and repairs to the rig and mud pumps. Also, near the end of the run a very hard stringer of rock was encountered that slowed drilling. Since the other runs did not encounter these problems or similar hard stringers, a comparison can only be made if these sections are excluded. The average penetration rate for the middle section of drilling (1.5 to 3.5 hours) on BHA #1 is 29 feet per hour.

The testing of BHA No. 1 began on December 17, 1998. After rigging up the motor was surface tested. After confirming proper operation of the DOE motor, assembly was run into the hole and the bottom tagged. At this time, the rig tongs had to be repaired. Once the tongs were repaired the flow was increased to 76 gpm and the bit collared. Flow was then increased to 110 gpm and drilling begun. Problems with both the main pump and the supplemental pump caused further delays. After repairing the pumps, the BHA was brought up above the Bartlesville shale and operations concluded for the day. The Bartlesville shale can swell and sluff so this precaution was taken to prevent damage to the BHA.

Testing of BHA #1 resumed on December 15, 1998. The tool was run into the hole, the pumps were started and the driller washed to bottom. Flow rate on the pumps was set and drilling begun. The pump rate was set at 110 gpm. However the pump would speed

up on its own until it reached 118 gpm (**Figure 5.10**) were it would run consistently for long periods of time.

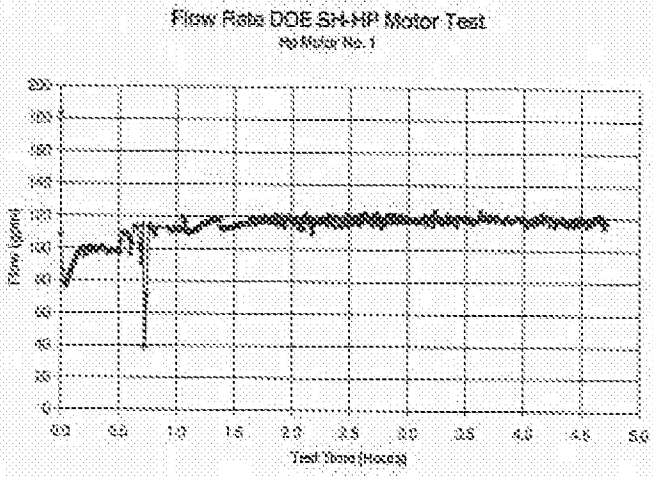


Figure 5.10. BHA No. 1 Flow Rate.

The bit weight was varied from 4,000 to 16,000 lbs during the test to find the optimum point. The optimum point is that bit weight that provides the highest penetration rate without stalling the motor. **Figure 5.11** shows a plot of bit weight throughout the test. The

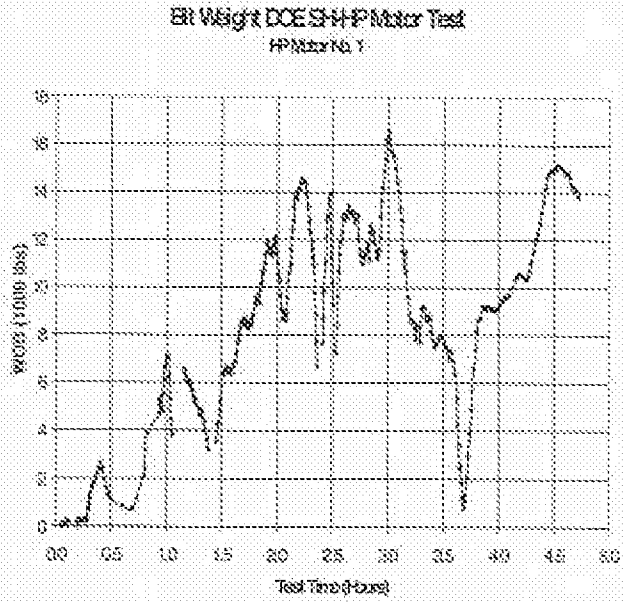


Figure 5.11. Bit Weight BHA No. 1.

BHA seemed to run best in the dolomite at a bit weight of approximately 12,000 lbs.

As bit weight was increased the torque to rotate the bit increased. The motor supplied the torque to rotate the bit and the pressure drop across the power section increased with the increased torque requirement. **Figure 5.12** shows the standpipe pressure. The increase in pressure corresponding to increased torque requirements can easily be seen. The off bottom or no load pressure was 1300 to 1400 psi. This makes the power section pressure drop 600 to 700 psi. This is very high for actual field conditions.

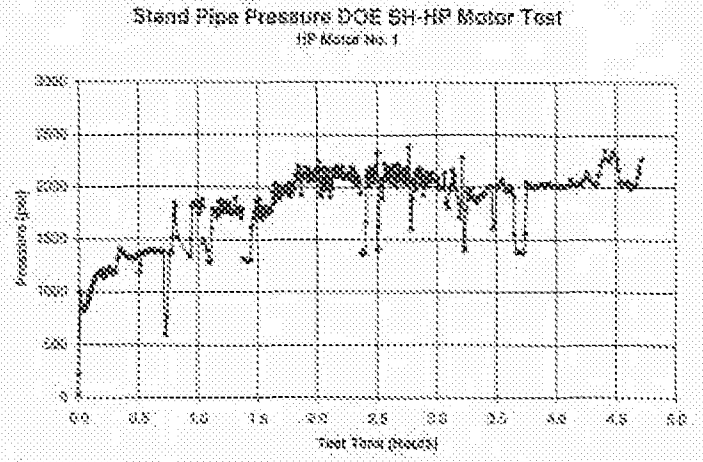


Figure 5.12. Stand Pipe Pressure BHA No. 1.

The penetration rate varied from under 1 fph through the hard stringer to over 70 fph. The majority of drilling was in the 20 to 40 fph range (**Figure 5.13**). When the BHA was pulled at the end of the run the bit was severely damaged. **Figure 5.14** shows how the bit was rung out. The manufacturer's designer examined the bit along with the bit used on the next two BHAs. He had seen this type of damage once before, and felt that one of the PDC inserts could have been pulled from the matrix because of the high drilling forces. The solution is to modify the design so that PDC inserts in this row are buried deeper into the matrix. This explanation has some supporting evidence from the field. When the drilling rate dropped off there were severe vibrations on the rig. These vibrations caused the whole rig to shake and the driller had to lift off bottom and run with light weight for several minutes before bit weight could be increased. It is possible that the vibrations were caused by the insert rolling under the bit, and this continued until the insert had been broken into small enough pieces that the mud could wash them away. Visual examination of the bit shows that some PDC cutters are missing from their braze pockets while other are still in place. If the formation were too hard for the bit all of the PDC cutters should be damaged. The TSP back up cutters are in good condition except for the wrung out area. This would be consistent with a lost PDC cutter rolling under the bit because it would have broken these TSP cutters. The drilling data do show that once through the hard stringer the ROP picked up again to over 20 fph despite the severe damage.

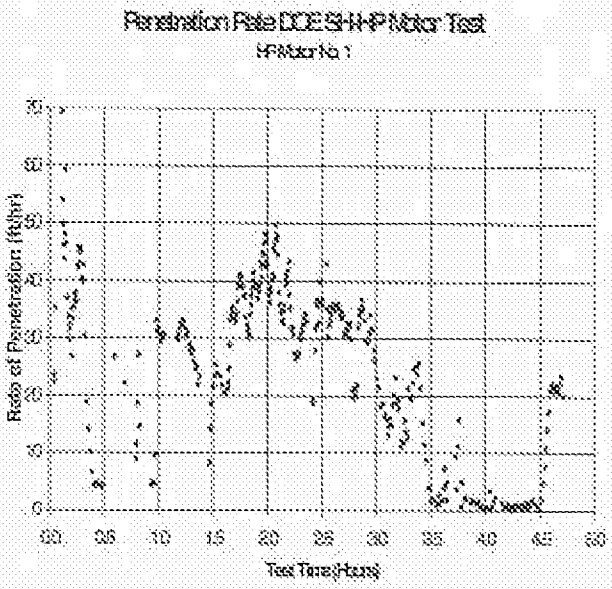


Figure 5.13. BHA No. 1 Penetration Rate.

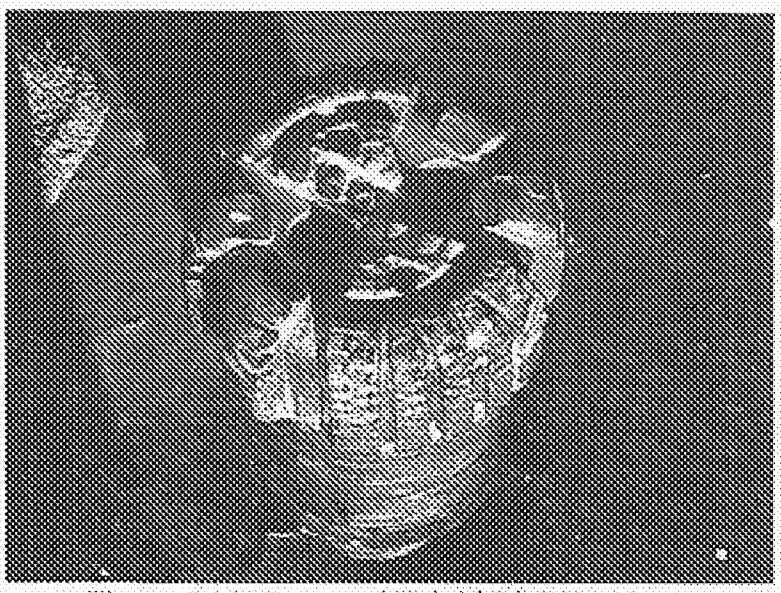


Figure 5.14. Damaged Hybrid Bit BHA No. 1.

Bottomhole Assembly #2

The second BHA used a commercial 3-3/8 in. mud motor. This tool was fitted with a new hybrid bit and run into the hole on December 16, 1998. After running to bottom and collaring the bit, drilling was begun. Recommended flow rate for this motor is 110 gpm. **Figure 5.15** shows the flow for BHA No. 2. During the first 1.25 hours of the test the flow was keep at this level. After a pump problem was repaired at 1.5 hours into the test, the flow was maintained at 120 gpm. As was previously stated, the pump had a "groove" at this flow rate.

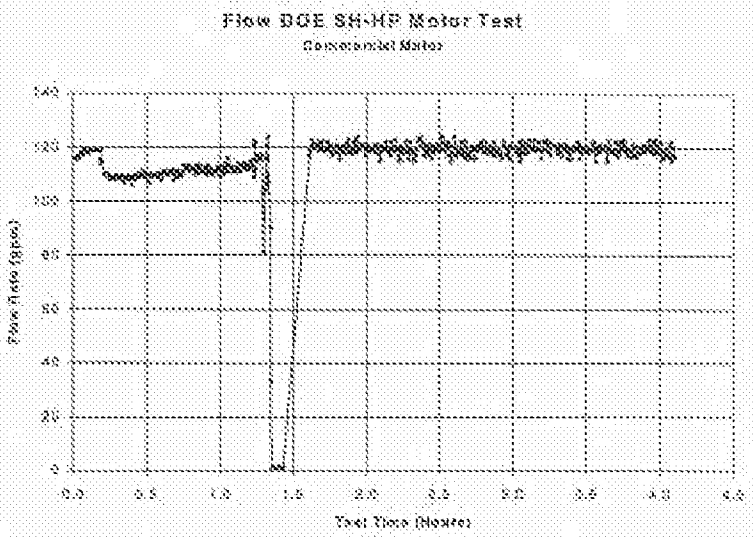


Figure 5.15. BHA No. 2 Flow Rate.

The driller applied bit weights that developed approximately 400 psi differential pressure on the motor. **Figure 5.16** shows the stand pipe pressure for this BHA. The driller commented that this tool stalled much easier then the high-power motor. Comparing **Figure 5.12 to 5.16** shows that the standpipe pressure for the conventional motor was only 1600 psi while the high-power motor had a stand pipe pressure of 2000 psi. At 120 gpm, the DOE tool was generating 28 more horsepower than the conventional motor.

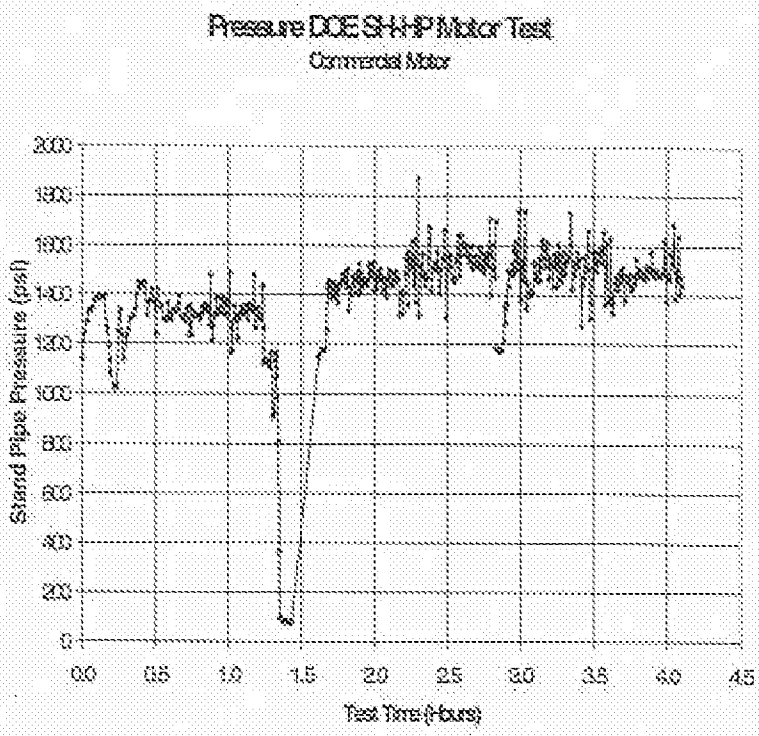


Figure 5.16. Stand Pipe Pressure BHA No. 2.

The bit weight for BHA # 2 (**Figure 5.17**) was a maximum of 6,800 lbs while the DOE motor ran at weights as high as 12,000 lbs. BHA # 2 drilled at approximately 20 fph with a flow rate of 110 gpm. Increasing the flow rate to 120 gpm helped and the rate increased to 25 fph (**Figure 5.18**).

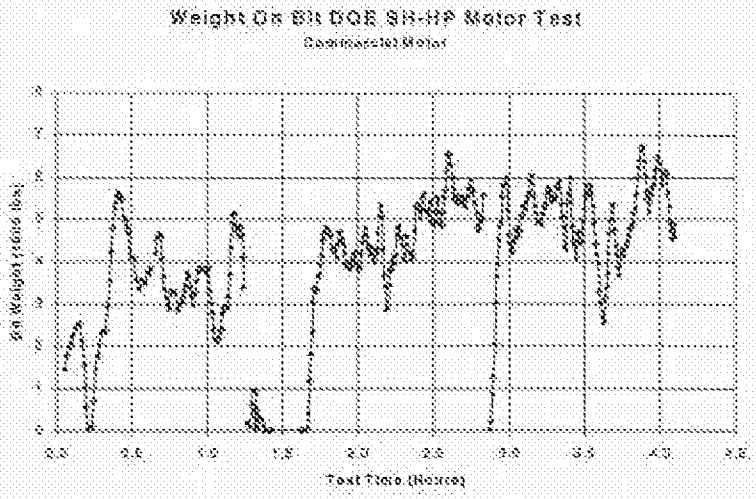


Figure 5.17. BHA No. 2 Bit Weight.

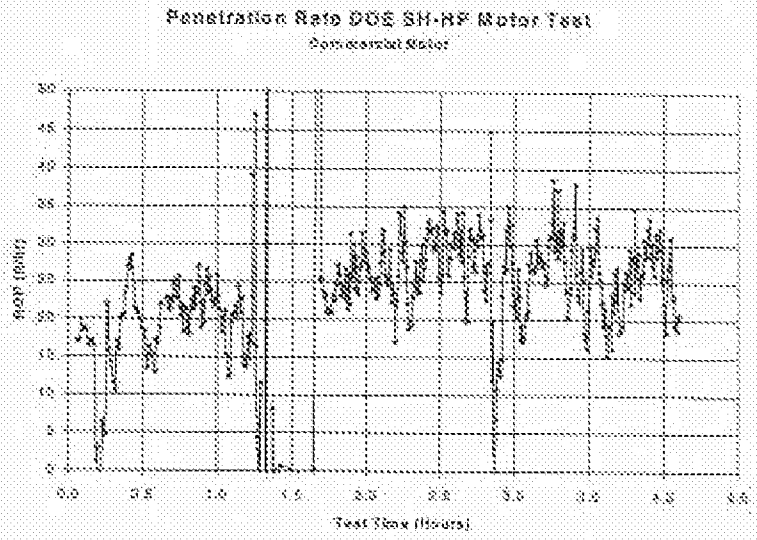


Figure 5.18. BHA. No. 2 Penetration Rate.

Although the penetration rates for BHA #2 are at times comparable to BHA #1, it must be noted that great efforts were made to obtain the best rates for BHA #2. The driller kept the motor as near to the stalling point as was possible. He was able to do this because the test lasted only a few hours and his attention on this test rig were not divided between other duties as they often are on an actual drilling operation.

At the conclusion of the run the motor and bit were pulled from the hole. The bit was in excellent condition so the decision was made to use it on BHA #3.

Bottomhole Assembly #3

BHA #3 reused the bit from BHA # 2 and a new double length motor. The assembly was run into the hole on December 17, 1998. After tagging bottom and collaring the hole drilling begun. Flow was set at 115 to a 120 gpm as shown in **Figure 5.19.** The purpose of the DOE high-power slim-hole drilling system is to double penetration rates in small holes so on this run the driller was instructed to keep high bit weights on the motor. **Figure 5.20** shows the bit weight for BHA #3. Bit weight was held at 8,000 to 10,000 lbs, generating a standpipe pressure of 1,800 to 2,000 psi (**Figure 5.21**). This is a 600 to 800 psi motor differential pressure. This assembly obtained penetration rates of 40 to 80 fph with an overall average of 47 fph. This is double the rate for the conventional system. **Figure 5.22** shows the penetration rate for BHA #3. This shows that doubling the length of a motor, and thus doubling the power, can more than double the penetration rate.

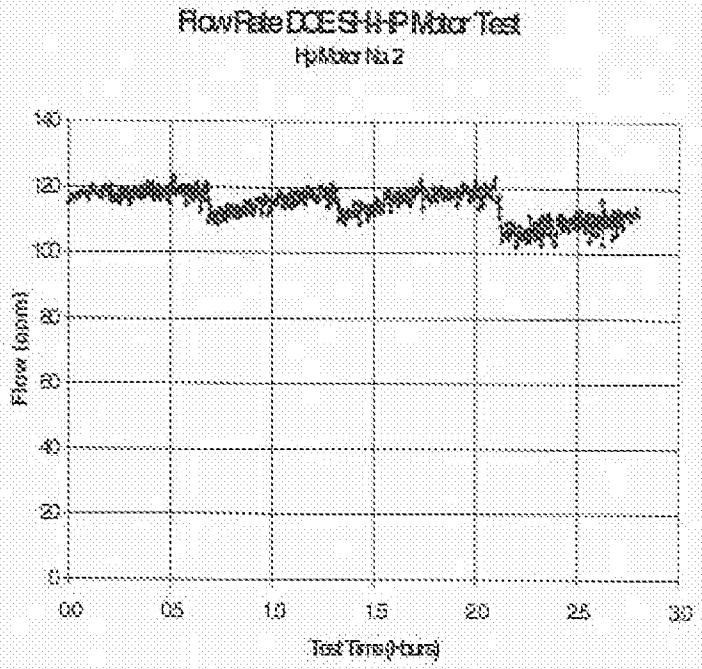


Figure 5.19. Flow Rate BHA No. 3.

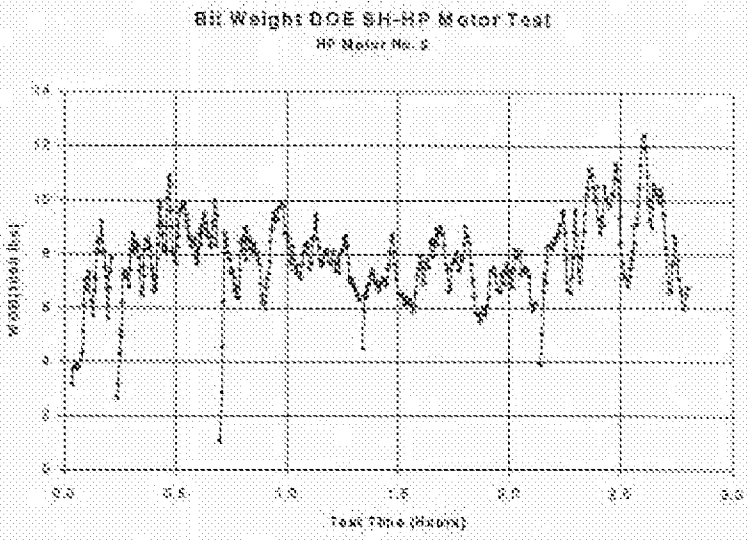


Figure 5.20. Bit Weight BHA No. 3.

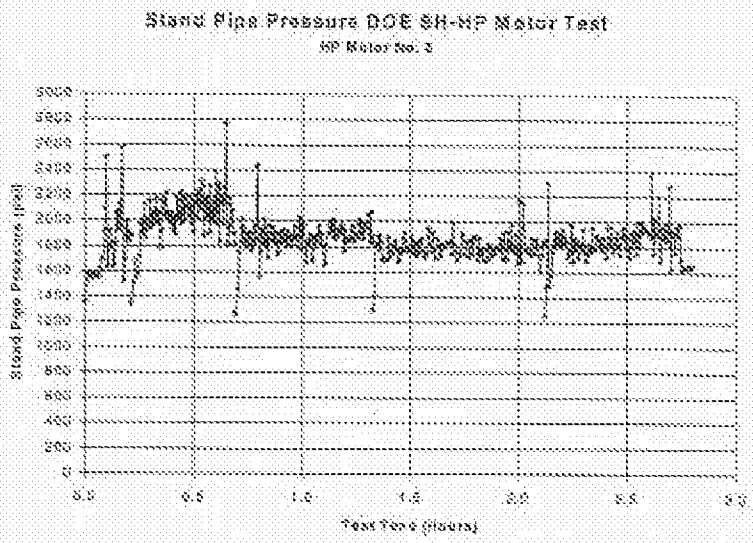


Figure 5.21. Standpipe Pressure BHA No. 3.

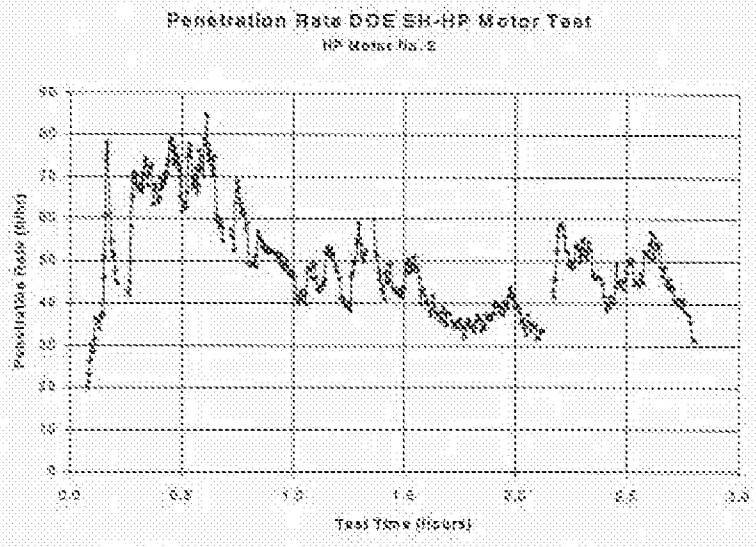


Figure 5.22. Penetration Rate BHA. No. 3.

Figure 5.23 shows the penetration rates for the different BHAs. BHA #1 was only 17% faster than BHA #2 because as part of the first test we intentionally varied the drilling parameters

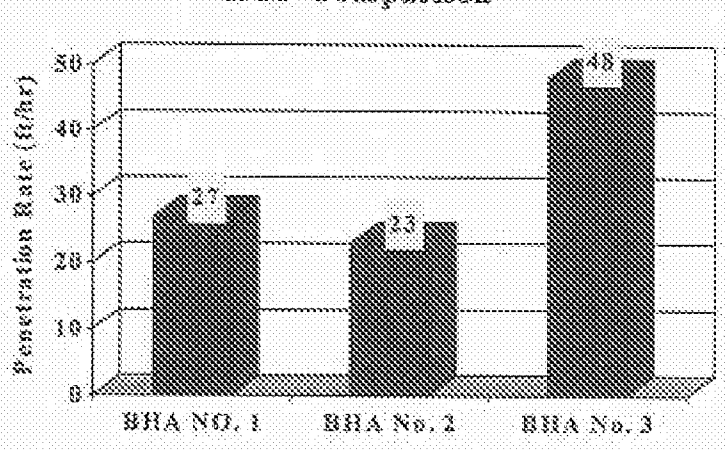


Figure 5.23. Penetration Rates For Different BHAs.

to see how the DOE motor responded. Also, even though the worst of the drilling through the hard streak was omitted from the average time, examination of the penetration rate curve for BHA #1 shows that the rate falling off even before the hard steak was contacted. If we compare the middle portion of the run, the rates are more in line with BHA #3, being from 35 to 45 fph.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The work completed under this project has shown that a slim-hole drilling system comprise of a high-power mud motor and hybrid bit can be manufactured that has the ability to drill faster and have long life. This system overcomes many of the problems associated with slim-hole drilling particularly those areas that are most often sited, slow drilling rates and poor BHA life, as the reason slim-holes are not drilled more often. The following are major conclusion of the project.

1. A high-power slim-hole (HP SH) drilling system was developed that drills at double the rate of conventional systems.
2. The HP SH drilling system, when combined into a complete slim-hole drilling operation, will provide significant savings when drilling gas wells.
3. A high-power 3¾-inch diameter drilling motor was developed that delivers twice the power of conventional drilling motors. This motor was made by welding two conventional stators together forming a single power section twice the length.
4. Doubling the torque output and thus the power of a mud motor increases the drilling rate when the proper bit is used.
5. Two conventional stators can be welded together to produce a single power section twice as long as a standard power section.
6. A double-length power section produces twice the torque and thus twice the power of a standard power section.
7. A flex shaft manufactured from titanium can transmit the high rotational torque from a mud motor rotor to the bearing pack shaft.
8. The flex shaft, if designed correctly does not damage the stator.
9. High strength ball thrust bearings and metal-on-metal radial bearings improved the performance of a conventional bearing pack.
10. Metal-on-metal radial bearings carry higher loads in a shorter package than elastomer marine bearings.
11. Improved bit performance can be achieved through the combined use of poly-crystalline diamond compact (PDC) cutters and thermally stable product (TSP) cutters.
12. TSP cutters set behind and at the same level of PDC cutters can reduce wear of the PDC cutters when drilling mixed formations or through hard stringers in shale formations.

13. A hybrid bit can drill both soft and hard formations at high drilling rates.
14. The hybrid bit is a good bit to use with the high-power DOE motor.
15. Commercial application of the hybrid bit shows that it can replace multiple-roller or PDC bits.

6.2 Recommendations

The following recommendations are made as a result of the previous work.

1. Additional work should be done on the development of slim-hole drilling concepts and equipment.
2. Current slim-hole or reduce-hole-size projects should be reviewed to identify the areas needing development work, (i.e., identify the items which prevent slim-hole from being considered in the planning stages).
3. Continue field testing the high-power slim-hole drilling system developed in this project.
4. Identify and involve a commercial provider of mud motors in further work.
5. Integrate the DOE high-power slim-hole motor and bit into a complete slim-hole drilling operation.

7. REFERENCES

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APPENDIX A
DOE High-Power Slim-Hole Motor Dynamometer data

- 30 gpm
- 70 gpm
- 110 gpm

Drilling Research Center
DCE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:35.84
Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
0	4	32.25	128	119	210	7	203	4	24	0.5	15%
1	5	32.25	116	102	205	9	197	3	20	0.4	11%
2	6	32.25	116	108	211	7	204	4	22	0.5	13%
3	7	32.25	116	108	208	7	201	4	22	0.5	13%
4	8	32.25	122	113	208	9	199	3	24	0.5	13%
5	9	32.25	126	116	208	9	199	3	24	0.5	13%
6	10	32.25	122	113	206	7	199	3	22	0.5	14%
7	11	32.25	122	113	208	9	199	3	20	0.4	12%
8	12	32.25	122	113	208	9	199	3	22	0.5	14%
9	13	32.25	122	113	211	7	204	4	22	0.5	13%
10	14	32.83	126	114	208	9	199	3	24	0.5	13%
11	15	33.13	126	113	202	7	195	3	22	0.5	14%
12	16	32.25	126	116	208	9	199	3	23	0.5	14%
13	17	32.25	116	108	204	9	195	3	23	0.5	13%
14	18	32.25	119	111	208	9	199	3	24	0.5	13%
15	19	32.25	122	113	208	9	199	3	24	0.5	13%
16	20	31.85	128	120	206	9	197	3	20	0.5	13%
17	21	34.01	128	113	206	9	197	3	24	0.5	15%
18	22	32.25	122	113	202	9	193	3	24	0.5	15%
19	23	32.25	119	111	211	9	202	4	22	0.5	13%
20	24	31.95	128	120	208	7	201	4	24	0.5	15%
21	25	32.36	113	105	208	9	199	3	22	0.4	13%
22	26	34.01	122	108	208	7	201	4	22	0.5	13%
23	27	32.36	125	116	202	7	195	3	20	0.4	13%
24	28	31.66	125	118	208	9	199	3	22	0.5	14%
25	29	31.67	122	118	204	9	195	3	23	0.5	14%
26	30	32.25	122	113	208	9	199	3	22	0.5	14%
27	31	32.25	128	119	208	9	199	3	24	0.5	15%
28	32	31.67	125	121	208	9	199	3	20	0.5	13%
29	33	31.67	125	121	208	9	199	3	24	0.5	15%
30	34	31.97	119	114	206	9	197	3	24	0.5	15%
31	35	32.25	113	105	208	11	197	3	24	0.5	14%
32	36	31.67	122	116	208	9	199	3	24	0.5	15%
33	37	31.67	122	118	208	9	199	3	24	0.5	15%
34	38	31.95	122	115	208	9	199	3	22	0.5	14%
35	39	32.13	116	105	208	9	199	3	22	0.4	13%
36	40	31.67	122	116	211	9	202	4	24	0.5	15%
37	41	31.67	113	109	206	9	197	3	24	0.5	14%
38	42	31.66	128	120	208	9	199	3	22	0.5	14%
39	43	32.25	122	113	206	11	195	3	22	0.5	14%
40	44	31.67	128	124	208	11	197	3	24	0.6	15%
41	45	31.66	128	121	208	9	199	3	24	0.6	15%
42	46	31.66	119	113	208	9	199	3	24	0.5	15%
43	47	31.66	122	116	208	9	199	3	26	0.6	15%
44	48	31.67	116	112	206	9	197	3	24	0.5	15%
45	49	31.67	122	118	208	7	201	4	23	0.5	14%
46	50	32.28	128	119	208	9	199	3	24	0.5	15%
47	51	31.66	122	116	211	11	200	4	24	0.5	15%
48	52	31.67	116	112	208	9	199	3	25	0.5	15%
49	53	31.67	119	115	208	9	199	3	22	0.5	14%
50	54	31.66	122	115	208	9	199	3	23	0.5	15%
51	55	32.25	119	111	208	9	199	3	24	0.5	15%
52	56	32.25	128	116	211	7	204	4	23	0.5	14%
53	57	32.25	130	124	206	7	201	4	24	0.6	15%

Drilling Research Center
DOE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:30.64
Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
54	58	31.07	128	124	211	9	202	4	24	0.6	16%
55	59	31.07	119	115	208	9	199	3	22	0.5	14%
56	60	31.07	122	118	208	9	199	3	24	0.5	15%
57	61	31.07	125	121	210	9	201	4	26	0.6	17%
58	62	31.85	125	117	308	9	199	3	23	0.5	14%
59	63	31.07	122	118	211	9	202	4	24	0.5	15%
60	64	32.25	119	111	211	9	202	4	28	0.6	17%
61	65	33.13	119	108	211	11	200	4	26	0.5	15%
62	66	31.86	122	116	211	9	202	4	25	0.5	17%
63	67	31.86	122	116	211	11	200	4	25	0.5	16%
64	68	32.25	119	111	211	7	204	4	24	0.5	13%
65	69	32.25	128	119	211	9	202	4	25	0.6	18%
66	70	33.13	122	110	211	9	202	4	28	0.6	17%
67	71	34.01	119	105	211	7	204	4	28	0.6	16%
68	72	31.68	122	116	213	7	206	4	29	0.6	18%
69	73	32.25	113	105	211	11	200	4	28	0.6	16%
70	74	31.07	122	118	211	9	202	4	30	0.7	19%
71	75	31.07	128	124	215	9	206	4	33	0.7	20%
72	76	31.66	122	116	213	7	206	4	32	0.7	20%
73	77	31.07	119	115	217	9	208	4	30	0.7	18%
74	78	31.07	119	115	215	9	206	4	34	0.7	21%
75	79	31.07	116	112	221	9	212	4	40	0.9	23%
76	80	31.07	122	118	227	9	218	4	40	0.9	24%
77	81	31.07	125	121	233	6	224	4	43	1.0	25%
78	82	35.49	122	109	243	9	234	4	57	1.3	32%
79	83	31.07	128	124	254	9	245	4	71	1.7	39%
80	84	31.07	119	115	276	9	269	5	78	1.7	35%
81	85	30.2	116	115	288	9	279	5	92	2.0	41%
82	86	29.9	119	119	305	9	296	5	105	2.4	48%
83	87	30.2	116	115	321	12	309	5	118	2.6	48%
84	88	29.9	113	113	348	7	333	5	135	2.9	50%
85	89	30.2	119	115	352	9	343	6	144	3.2	53%
86	90	29.9	116	116	368	7	361	6	158	3.5	56%
87	91	30.49	116	114	375	9	366	6	164	3.6	58%
88	92	30.49	116	114	385	9	386	7	179	3.9	58%
89	93	29.9	116	116	403	7	396	7	191	4.2	61%
90	94	29.9	116	116	414	9	405	7	193	4.3	60%
91	95	29.32	119	122	420	11	409	7	196	4.5	63%
92	96	30.49	119	117	438	9	429	8	206	4.5	61%
93	97	32.25	119	111	438	9	429	8	218	4.8	61%
94	98	29.9	116	116	451	9	442	8	227	5.0	65%
95	99	30.2	119	118	453	7	446	8	228	5.1	65%
96	100	30.2	119	118	467	9	458	8	231	5.2	65%
97	101	30.49	116	114	465	9	456	8	237	5.2	65%
98	102	30.2	119	118	473	9	464	8	241	5.4	67%
99	103	32.25	113	105	475	9	466	8	247	4.9	61%
100	104	29.9	119	119	485	9	476	8	249	5.7	68%
101	105	30.49	119	117	489	11	478	8	247	5.5	68%
102	106	29.9	116	116	492	9	483	8	257	5.7	67%
103	107	30.2	119	118	498	9	487	9	262	5.9	65%
104	108	31.37	119	114	500	9	491	9	268	5.8	67%
105	109	30.2	119	119	512	11	501	9	272	6.1	70%
106	110	30.2	119	119	512	9	503	9	272	6.1	70%
107	111	30.2	119	119	515	9	507	9	272	6.1	69%

Drilling Research Center
DCE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:30.84
Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
108	112	34.01	119	105	514	9	505	9	284	5.7	64%
109	113	30.2	122	121	524	9	515	9	286	6.5	73%
110	114	30.2	119	118	518	9	509	9	287	6.6	73%
111	115	29.9	119	119	531	9	522	9	284	6.5	71%
112	116	30.2	116	115	535	9	526	9	286	6.3	68%
113	117	30.2	119	118	539	9	530	9	287	6.5	70%
114	118	30.2	116	115	541	9	532	9	301	6.6	71%
115	119	30.2	116	115	537	9	528	9	299	6.6	71%
116	120	29.9	116	116	555	7	548	10	301	6.7	70%
117	121	29.82	113	117	567	7	560	10	305	6.8	70%
118	122	29.82	113	116	572	7	565	10	311	6.8	69%
119	123	29.82	116	119	569	9	560	10	322	7.0	74%
120	124	29.82	116	119	572	11	561	10	324	7.0	75%
121	125	29.82	116	119	582	9	573	10	328	7.4	74%
122	126	29.82	113	117	582	7	575	10	330	7.3	75%
123	127	29.82	116	120	592	9	583	10	335	7.5	74%
124	128	29.82	116	119	590	9	581	10	332	7.5	74%
125	129	29.82	116	120	602	9	593	10	348	7.8	77%
126	130	29.82	116	119	600	9	591	10	350	8.0	77%
127	131	29.82	113	116	606	9	597	10	353	7.8	74%
128	132	29.82	113	116	618	7	608	11	353	7.8	73%
129	133	29.82	116	113	613	9	604	11	357	7.7	72%
130	134	29.82	110	113	633	7	626	11	363	7.8	71%
131	135	29.82	110	113	627	9	618	11	369	7.9	73%
132	136	29.82	110	113	623	9	614	11	377	8.1	75%
133	137	31.67	110	105	637	9	628	11	380	7.7	70%
134	138	29.82	116	120	633	12	621	11	380	8.2	80%
135	139	29.82	116	119	647	9	638	11	380	8.8	77%
136	140	29.82	113	117	648	12	636	11	384	8.5	77%
137	141	29.82	113	117	650	11	639	11	386	8.6	78%
138	142	29.9	116	118	664	9	655	11	392	8.7	78%
139	143	29.82	113	117	664	9	655	11	396	8.8	77%
140	144	29.82	113	116	670	9	661	12	400	8.8	76%
141	145	29.82	116	119	684	9	675	11	406	9.2	80%
142	146	29.82	116	119	682	9	673	12	413	9.3	79%
143	147	29.9	119	119	699	11	688	12	421	9.5	79%
144	148	29.81	119	119	699	9	690	12	423	9.5	79%
145	149	27.85	119	119	697	9	688	12	427	9.8	80%
146	150	25.89	116	121	701	9	692	12	431	9.9	82%
147	151	25.89	105	121	713	9	704	12	435	10.0	81%
148	152	25.8	105	122	719	11	708	12	442	10.3	83%
149	153	25.89	105	121	723	11	712	12	446	10.3	82%
150	154	28.38	99	113	730	9	721	13	448	9.8	76%
151	155	26.38	105	119	738	7	731	13	455	10.4	81%
152	156	27.20	108	119	746	11	735	13	458	10.4	81%
153	157	26.97	116	132	750	12	738	13	462	10.8	83%
154	158	27.36	108	119	754	9	745	13	466	10.5	81%
155	159	26.97	108	120	758	9	749	13	471	10.8	82%
156	160	25.68	105	118	762	9	753	13	471	10.6	80%
157	161	25.97	108	120	764	11	753	13	477	10.9	83%
158	162	26.97	105	117	769	9	760	13	481	10.7	80%
159	163	26.13	108	115	773	9	764	13	485	10.6	80%
160	164	27.85	110	118	779	9	770	13	493	11.1	83%
161	165	29.02	113	117	783	11	772	14	504	11.2	83%

Drilling Research Center
DCE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:30.64
Test date: August 4, 1995

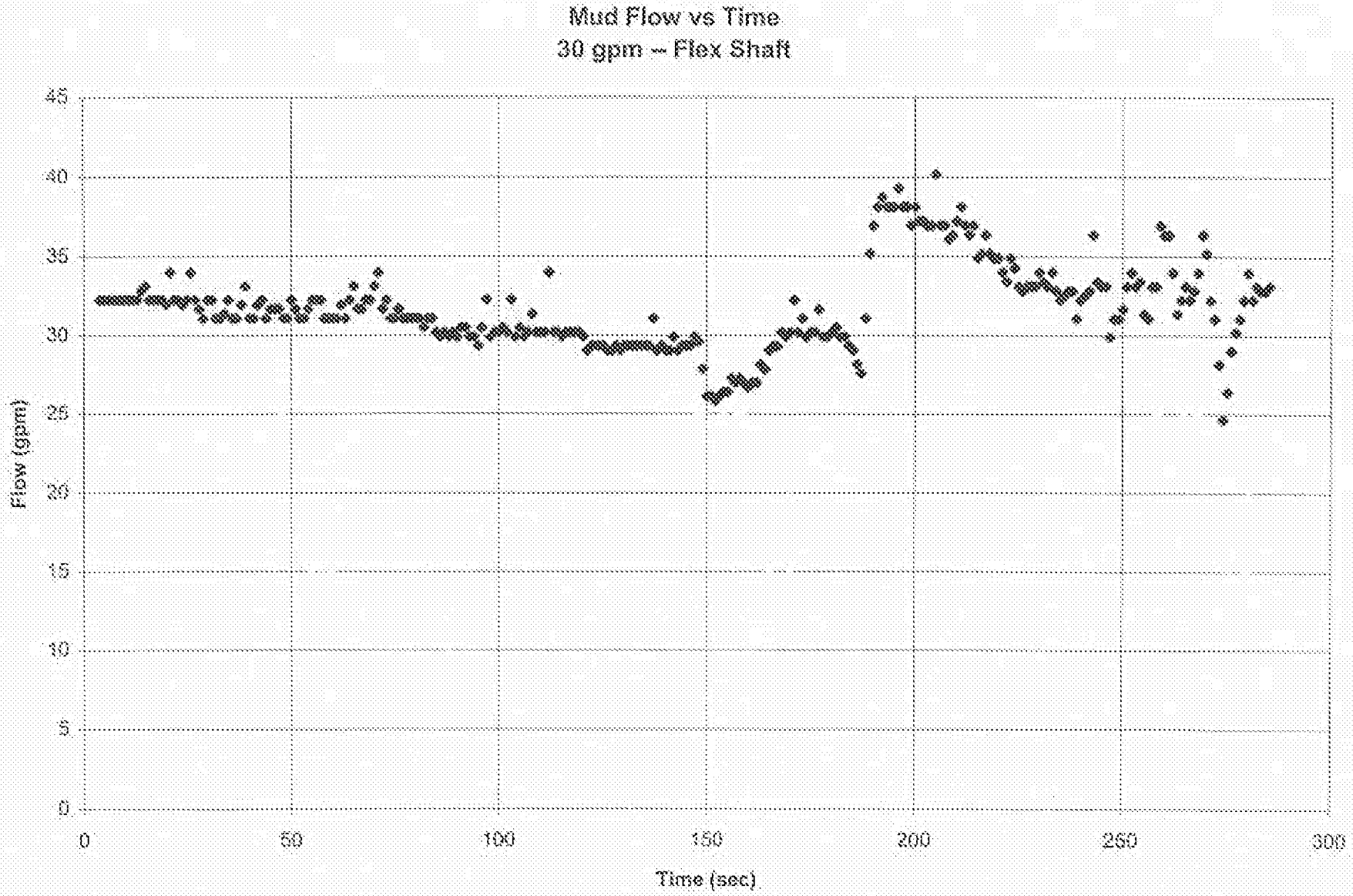
Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
162	166	29.32	113	116	785	7	778	14	804	11.1	81%
163	167	29.32	116	119	789	9	780	14	804	11.4	82%
164	168	30.2	119	118	793	9	784	14	805	11.3	82%
165	169	29.9	118	119	793	11	782	14	805	11.3	82%
166	170	30.2	119	118	795	9	786	14	485	11.1	81%
167	171	32.25	139	111	795	11	784	14	497	10.5	76%
168	172	30.2	118	116	797	9	788	14	502	11.0	80%
169	173	31.07	113	109	795	11	784	14	508	10.6	77%
170	174	29.9	116	116	799	9	790	14	504	11.2	81%
171	175	30.2	116	115	805	9	796	14	506	11.1	80%
172	176	30.2	116	115	805	7	798	14	504	11.1	79%
173	177	31.60	116	110	805	9	796	14	518	10.8	78%
174	178	29.9	116	116	807	11	796	14	520	11.5	83%
175	179	29.9	116	116	814	9	805	14	524	11.6	82%
176	180	30.2	116	115	813	9	803	14	522	11.5	81%
177	181	30.49	116	114	816	9	807	14	518	11.2	79%
178	182	29.9	116	116	816	9	807	14	518	11.5	81%
179	183	29.9	113	113	824	9	815	14	524	11.3	79%
180	184	29.32	119	113	826	9	817	14	531	11.4	80%
181	185	29.02	119	114	834	11	823	14	547	11.8	82%
182	186	28.14	119	117	847	9	838	15	549	12.3	84%
183	187	27.36	116	126	863	11	852	15	557	13.4	90%
184	188	31.07	122	118	879	7	872	15	574	12.9	84%
185	189	35.18	139	113	892	11	881	15	575	12.3	80%
186	190	36.84	139	113	900	11	889	15	580	12.6	81%
187	191	38.11	139	109	904	7	897	15	580	12.1	77%
188	192	28.7	142	110	908	11	897	16	590	12.4	78%
189	193	38.11	136	107	910	9	901	16	586	11.9	76%
190	194	38.11	139	109	918	7	911	16	595	12.4	78%
191	195	38.11	136	107	920	9	911	16	592	12.1	76%
192	196	38.28	136	104	926	7	919	16	605	12.6	74%
193	197	38.11	139	109	925	9	925	16	601	12.5	78%
194	198	38.11	136	107	937	7	930	16	606	12.4	76%
195	199	36.84	139	113	941	7	934	16	611	13.1	80%
196	200	38.11	136	107	947	9	938	16	615	12.6	77%
197	201	37.23	136	110	951	11	940	16	619	12.9	79%
198	202	37.23	136	110	957	9	948	17	626	13.1	79%
199	203	36.94	133	108	961	9	952	17	628	12.8	77%
200	204	36.94	133	108	968	9	959	17	636	13.1	78%
201	205	40.16	139	104	972	11	961	17	632	12.5	74%
202	206	36.94	133	108	976	11	965	17	644	13.2	78%
203	207	36.94	130	106	984	9	975	17	644	12.9	76%
204	208	36.06	130	108	992	9	983	17	652	13.4	78%
205	209	36.65	133	110	1000	11	989	17	659	13.8	80%
206	210	37.23	133	107	1004	9	995	17	662	13.3	76%
207	211	38.11	133	105	1002	11	991	17	661	13.2	76%
208	212	36.94	130	106	1004	9	995	17	658	13.2	76%
209	213	39.35	125	100	1003	7	1002	18	663	13.0	74%
210	214	36.94	125	102	1035	9	1026	18	669	12.9	73%
211	215	34.89	122	105	1013	9	1004	18	663	13.2	75%
212	216	35.18	122	104	1011	9	1002	18	667	13.2	75%
213	217	36.35	125	105	1011	9	1020	18	671	13.5	77%
214	218	35.18	125	107	1007	9	998	17	663	13.5	77%
215	219	34.89	125	107	1004	11	993	17	659	13.5	78%

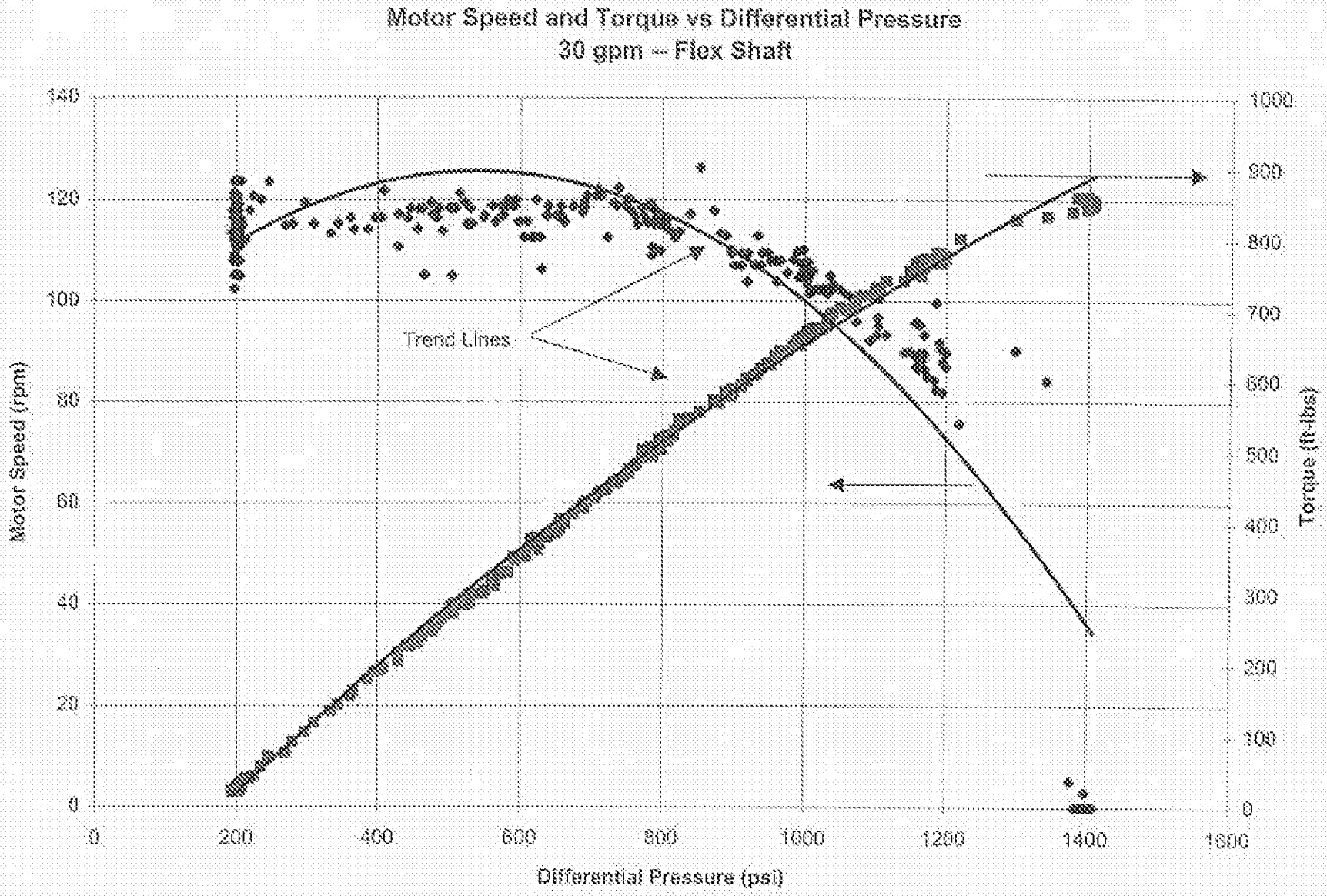
Drilling Research Center
DOE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:30.64
Test date: August 4, 1995

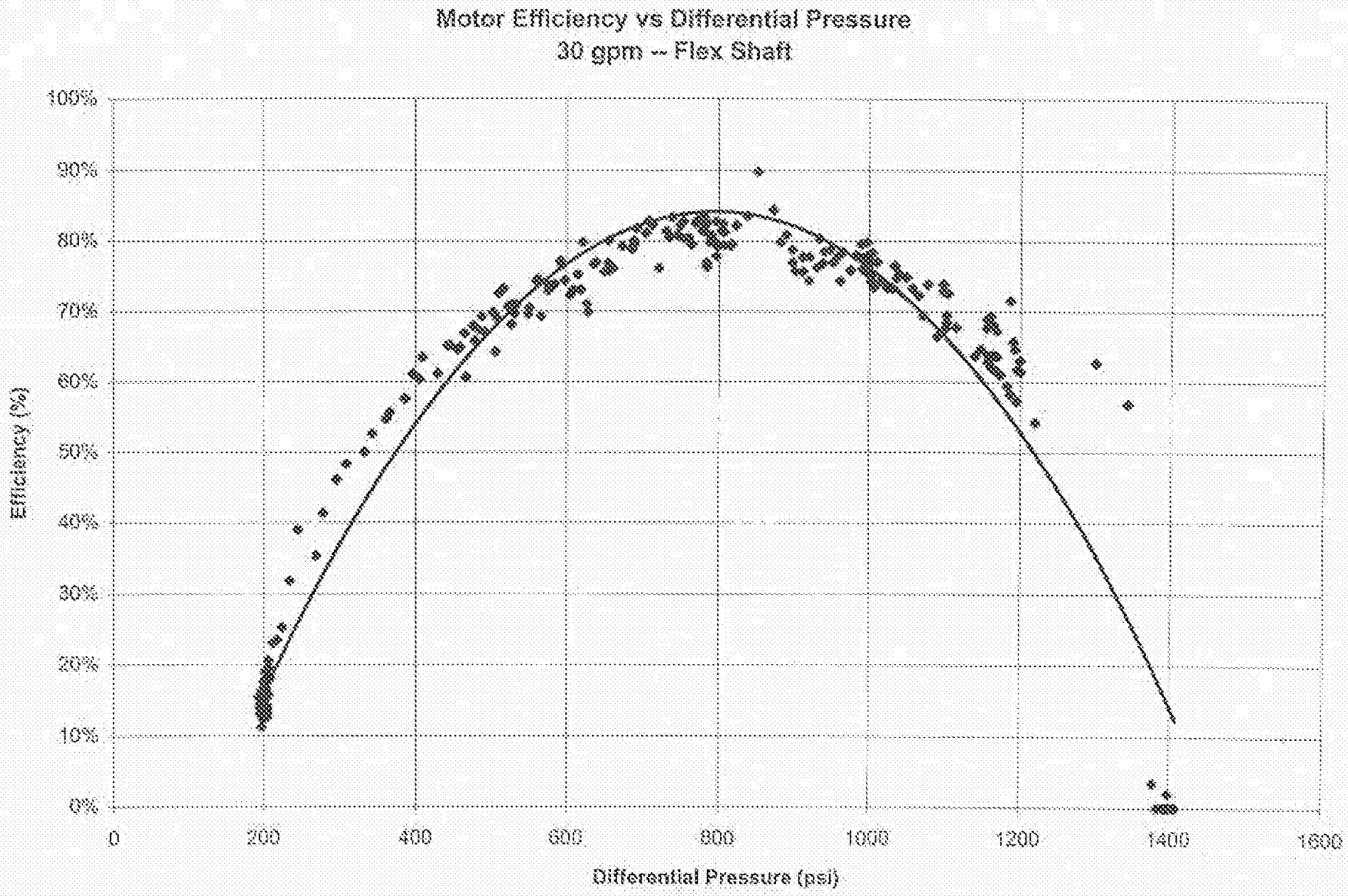
Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
216	220	34.89	128	110	1004	7	997	17	665	13.9	80%
217	221	34.01	122	108	1007	9	998	17	665	13.6	78%
218	222	33.42	119	107	1007	7	1000	18	663	13.5	77%
219	223	34.89	122	105	1011	11	1000	18	659	13.2	75%
220	224	34.3	119	104	1011	9	1002	18	667	13.2	75%
221	225	33.13	119	108	1013	9	1004	18	671	13.8	78%
222	226	32.83	116	106	1019	9	1010	18	675	13.6	77%
223	227	33.13	113	102	1023	9	1014	18	677	13.2	74%
224	228	33.13	113	102	1029	9	1020	18	677	13.2	74%
225	229	33.13	113	102	1035	9	1026	18	675	13.2	73%
226	230	34.01	116	102	1039	9	1030	18	679	13.2	73%
227	231	33.42	113	101	1041	11	1030	18	684	13.2	73%
228	232	33.13	116	105	1045	11	1034	18	692	13.8	76%
229	233	34.01	116	102	1045	9	1036	18	696	13.6	75%
230	234	32.83	113	103	1048	9	1039	18	698	13.7	75%
231	235	32.35	110	102	1058	9	1049	18	706	13.8	76%
232	236	32.54	110	101	1068	11	1057	18	702	13.6	73%
233	237	32.83	110	101	1074	9	1065	18	704	13.6	73%
234	238	32.83	105	96	1078	7	1071	18	712	13.8	69%
235	239	31.67	105	101	1089	12	1077	19	721	13.9	74%
236	240	32.25	99	92	1101	11	1090	19	729	12.7	66%
237	241	32.54	105	97	1111	9	1102	19	727	13.4	69%
238	242	32.83	110	101	1113	9	1104	19	733	14.0	73%
239	243	33.35	113	93	1109	9	1100	19	733	13.9	66%
240	244	33.42	113	101	1107	9	1098	19	725	14.0	73%
241	245	33.13	113	102	1109	11	1098	19	725	14.2	74%
242	246	33.13	105	95	1113	11	1102	19	729	13.2	68%
243	247	29.9	93	93	1125	11	1114	19	743	13.2	68%
244	248	31.07	93	90	1148	9	1139	20	743	12.7	64%
245	249	31.07	99	95	1164	9	1155	20	752	13.7	68%
246	250	31.56	93	85	1173	9	1163	20	750	13.6	62%
247	251	33.13	99	90	1179	11	1168	20	762	13.0	64%
248	252	34.01	105	95	1175	12	1163	20	764	13.9	68%
249	253	33.13	99	90	1173	11	1162	20	760	13.0	64%
250	254	33.42	99	89	1175	11	1164	20	758	13.0	64%
251	255	31.37	88	84	1191	9	1182	21	768	12.3	59%
252	256	31.07	91	88	1208	11	1196	21	772	12.9	62%
253	257	33.13	99	90	1206	7	1199	21	775	13.2	63%
254	258	33.13	96	87	1210	11	1199	21	779	12.8	61%
255	259	36.54	113	93	1199	9	1190	21	783	13.7	66%
256	260	35.35	113	93	1179	11	1168	20	774	13.7	67%
257	261	36.35	115	96	1184	9	1175	20	784	13.9	68%
258	262	34.01	102	90	1158	11	1147	20	758	13.0	65%
259	263	31.37	93	89	1165	9	1156	20	762	12.9	64%
260	264	32.25	93	87	1177	9	1168	20	764	12.8	62%
261	265	33.13	91	82	1193	9	1184	21	772	12.1	58%
262	266	32.25	88	82	1203	9	1194	21	788	12.6	57%
263	267	32.83	99	90	1201	9	1192	21	785	13.5	65%
264	268	34.01	113	100	1195	9	1186	21	783	14.9	72%
265	269	36.35	115	96	1171	11	1160	20	772	14.1	69%
266	270	35.18	102	87	1167	11	1156	20	758	12.7	63%
267	271	32.25	93	87	1169	9	1160	20	756	12.6	62%
268	272	31.07	88	85	1185	12	1173	21	775	12.5	61%
269	273	28.14	71	76	1228	9	1219	21	803	11.6	54%

Drilling Research Center
DCE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 14:42:30.64
Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 30 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
270	274	24.63	74	90	1310	11	1299	23	830	19.2	83%
271	275	26.36	74	84	1351	9	1342	25	834	13.4	57%
272	276	29.02	6	6	1386	9	1377	24	841	0.8	3%
273	277	30.2	3	3	1405	7	1398	24	845	0.5	2%
274	278	31.07	0	0	1417	11	1406	25	849	0.0	0%
275	279	32.25	0	0	1419	11	1408	25	853	0.0	0%
276	280	34.01	0	0	1417	11	1406	25	857	0.0	0%
277	281	32.25	0	0	1415	11	1404	25	857	0.0	0%
278	282	33.18	0	0	1409	11	1398	24	861	0.0	0%
279	283	32.83	0	0	1404	9	1395	24	857	0.0	0%
280	284	32.83	0	0	1400	9	1391	24	861	0.0	0%
281	285	33.13	0	0	1396	12	1384	24	861	0.0	0%


Mud Flow vs Time
30 gpm – Flex Shaft
Flow (gpm)
45
40
35
30
25
20
15
10
5
0
0
50
100
150
200
250
300
Time (sec)


Motor Speed and Torque vs Differential Pressure
30 gpm -- Flex Shaft
Motor Speed (rpm)
Torque (in-lbs)
Differential Pressure (psi)
Trend Lines
0
20
40
60
80
100
120
140
0
100
200
300
400
500
600
700
800
900
1000
0
200
400
600
800
1000
1200
1400
1600


Motor Efficiency vs Differential Pressure
30 gpm -- Flex Shaft
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
200
400
600
800
1000
1200
1400
1600
Differential Pressure (psi)

Drilling Research Center
CDE 3-3/8 in. 6/5 multilobe motor--Flex Shaft
Test Time: 16:28:18.58
Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 70 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
72	77	76.36	260	234	312	5	307	12	92	1.5	12%
73	78	76.67	255	233	313	9	304	12	91	1.6	13%
74	79	76.67	255	231	313	5	308	13	94	1.6	13%
75	80	69.77	235	235	313	9	304	12	88	1.6	14%
76	81	76.84	261	238	320	6	314	13	96	1.6	14%
77	82	75.88	257	238	327	7	320	13	98	1.7	13%
78	83	76.05	272	254	332	5	327	13	97	1.6	12%
79	84	76.22	275	250	333	7	325	13	99	1.4	11%
80	85	75.53	272	251	336	7	329	13	82	1.5	11%
81	86	77.1	278	252	338	5	333	14	94	1.6	12%
82	87	77.1	278	252	334	7	327	13	92	1.5	12%
83	88	77.1	278	252	334	9	325	13	94	1.6	12%
84	89	76.81	267	252	338	5	333	14	96	1.6	13%
85	90	77.1	278	252	340	9	331	14	98	1.6	14%
86	91	77.1	267	251	336	9	327	13	90	1.5	13%
87	92	77.1	278	252	338	9	329	13	96	1.6	14%
88	93	77.1	278	252	340	7	333	14	95	1.7	13%
89	94	77.1	278	252	344	7	337	14	92	2.0	15%
90	95	77.1	278	252	345	7	341	14	93	2.1	15%
91	96	76.81	261	256	350	9	343	14	97	2.3	16%
92	97	76.88	278	247	355	8	351	14	99	2.5	16%
93	98	77.1	278	252	356	5	353	14	93	2.5	18%
94	99	77.1	278	250	364	5	359	15	90	2.5	16%
95	100	77.1	261	255	379	9	370	15	71	2.4	22%
96	101	76.23	278	255	399	7	392	16	88	4.2	26%
97	102	76.51	272	246	412	9	403	16	98	4.6	28%
98	103	77.1	278	250	436	7	429	17	115	5.5	32%
99	104	76.22	278	253	457	5	452	18	133	6.4	35%
100	105	75.93	272	251	477	9	468	19	144	7.1	37%
101	106	77.1	278	252	483	9	474	20	162	7.8	39%
102	107	73.29	264	252	498	9	489	20	181	8.7	44%
103	108	71.53	258	250	505	7	501	20	198	9.4	46%
104	109	70.36	250	249	516	9	509	21	209	9.9	47%
105	110	68.68	253	257	531	7	524	21	218	10.7	50%
106	111	69.19	247	250	543	7	536	22	227	11.3	52%
107	112	69.85	244	248	558	7	552	23	245	11.8	51%
108	113	69.45	247	249	575	9	567	23	257	12.2	53%
109	114	70.07	250	253	594	7	587	24	268	12.9	54%
110	115	71.53	264	258	608	8	600	25	276	13.5	55%
111	116	73.13	261	253	621	7	614	26	282	13.6	54%
112	117	73	261	258	637	7	630	26	287	13.7	53%
113	118	73.29	261	249	646	7	641	26	289	14.2	54%
114	119	75.03	264	248	655	8	649	27	296	14.3	54%
115	120	73	267	258	670	9	661	27	323	15.7	58%
116	121	73.29	264	252	684	8	676	28	332	15.9	57%
117	122	73.29	261	249	691	6	684	28	348	16.1	57%
118	123	75.03	261	241	717	6	708	29	353	16.2	56%
119	124	73.83	258	243	735	5	730	30	369	17.2	58%
120	125	72.12	258	250	748	5	743	30	362	16.2	54%
121	126	72.12	255	248	771	9	762	31	402	18.6	61%
122	127	71.82	258	251	795	9	786	32	419	20.1	62%
123	128	73.12	261	253	832	7	825	33	435	21.0	64%
124	129	72.12	258	250	832	7	825	34	432	21.6	64%
125	130	72.12	253	246	865	9	856	35	470	22.1	64%
126	131	72.12	258	250	879	7	872	36	463	23.5	65%
127	132	72.12	258	251	902	7	895	37	508	24.2	66%
128	133	72.12	255	248	926	7	919	38	525	24.8	66%
129	134	73.39	258	248	951	7	944	39	543	25.8	66%

Drilling Research Center

DOE 3-3/8 in 4/5 multilobe motor--Flex Shaft

Test Time: 16:26 16:56

Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 70 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
130	135	72.7	260	248	976	7	969	40	582	28.6	69%
131	136	73.29	263	248	1002	7	995	41	578	27.1	67%
132	137	73.86	263	244	1051	9	1010	41	597	27.6	67%
133	138	73.86	258	244	1043	7	1036	42	609	28.3	67%
134	139	74.17	261	246	1063	9	1055	43	638	28.5	66%
135	140	73.95	258	245	1086	9	1077	44	649	28.9	66%
136	141	73.86	259	244	1109	7	1102	45	659	28.7	64%
137	142	73.68	255	244	1125	9	1116	46	673	31.3	68%
138	143	73.68	255	243	1152	7	1145	47	686	32.0	68%
139	144	75.05	253	236	1179	7	1172	48	712	32.0	67%
140	145	73.86	258	244	1206	7	1199	49	736	34.3	70%
141	146	73.68	256	242	1254	7	1247	50	744	34.2	69%
142	147	75.05	253	236	1245	9	1236	50	760	34.1	68%
143	148	75.05	251	236	1273	9	1264	52	774	34.8	67%
144	149	75.05	255	236	1292	9	1283	52	787	35.6	68%
145	150	74.76	255	237	1308	7	1301	53	801	35.1	68%
146	151	75.05	250	233	1334	7	1327	54	805	35.9	67%
147	152	75.05	247	233	1341	9	1332	54	826	36.3	67%
148	153	75.05	247	233	1383	7	1376	56	834	36.6	66%
149	154	74.76	247	231	1382	6	1376	56	847	37.3	67%
150	155	75.05	245	232	1404	9	1395	57	861	36.4	64%
151	156	75.05	238	232	1431	9	1422	58	874	36.9	64%
152	157	75.05	238	232	1448	7	1441	59	883	37.1	63%
153	158	73.86	236	228	1476	6	1469	60	897	38.5	64%
154	159	75.05	235	232	1489	9	1480	61	918	38.2	63%
155	160	75.34	237	231	1523	9	1514	62	927	37.2	60%
156	161	75.05	233	232	1538	7	1531	63	936	38.3	61%
157	162	75.63	233	235	1550	9	1541	63	946	38.7	61%
158	163	75.63	231	235	1562	9	1553	63	956	38.2	60%
159	164	75.63	231	235	1578	9	1569	64	958	38.2	60%
160	165	75.22	231	233	1589	7	1582	65	967	38.4	59%
161	166	75.63	231	235	1601	9	1592	65	975	38.8	60%
162	167	75.22	231	233	1608	7	1601	65	985	38.1	59%
163	168	77.1	234	238	1620	9	1611	66	987	39.2	59%
164	169	76.22	233	235	1636	9	1627	66	990	37.7	57%
165	170	75.93	230	199	1649	7	1642	67	1000	37.6	57%
166	171	75.39	224	213	1658	7	1652	67	1004	38.7	57%
167	172	76.22	228	198	1665	7	1658	68	1014	38.9	57%
168	173	76.22	228	205	1679	7	1672	68	1023	38.6	57%
169	174	76.22	228	195	1684	7	1677	69	1029	38.6	56%
170	175	76.27	227	195	1716	9	1707	69	1035	38.5	55%
171	176	76.22	226	193	1722	9	1713	70	1042	38.3	55%
172	177	76.61	225	194	1729	8	1720	70	1047	38.7	55%
173	178	79.16	230	186	1733	7	1726	70	1050	37.1	53%
174	179	76.22	220	183	1747	9	1738	71	1058	38.6	54%
175	180	77.39	216	180	1753	7	1746	71	1062	38.8	54%
176	181	76.57	221	179	1758	7	1752	72	1066	38.3	53%
177	182	77.1	224	185	1774	9	1765	72	1072	37.8	52%
178	183	76.22	193	177	1772	7	1765	72	1076	39.3	55%
179	184	75.66	196	183	1803	9	1794	73	1085	37.8	52%
180	185	75.66	199	184	1823	9	1814	74	1095	38.3	52%
181	186	77.1	196	178	1823	7	1816	74	1097	37.2	50%
182	187	76.22	196	174	1839	7	1832	75	1107	38.6	50%
183	188	74.76	194	172	1868	9	1857	76	1126	39.6	49%
184	189	75.05	176	158	1857	7	1850	77	1140	38.8	48%
185	190	75.05	167	156	1944	9	1935	79	1159	34.4	43%
186	191	74.76	164	154	1975	9	1966	80	1174	34.3	43%
187	192	74.76	159	149	1991	9	1982	81	1188	33.6	42%
188	193	75.05	156	148	2030	9	2021	83	1205	33.4	40%
189	194	76.22	153	151	2057	7	2050	84	1213	33.5	39%

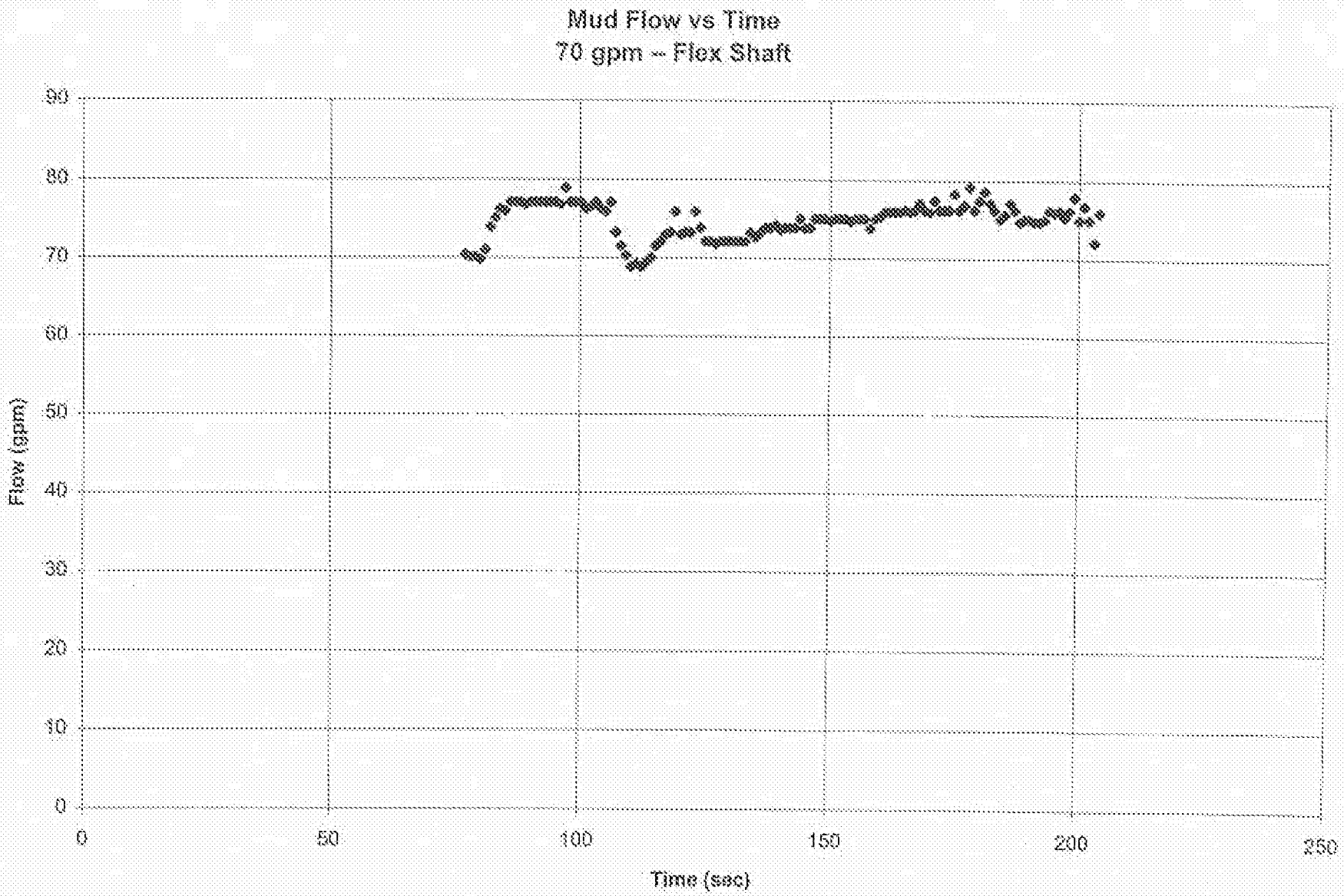
Drilling Research Center

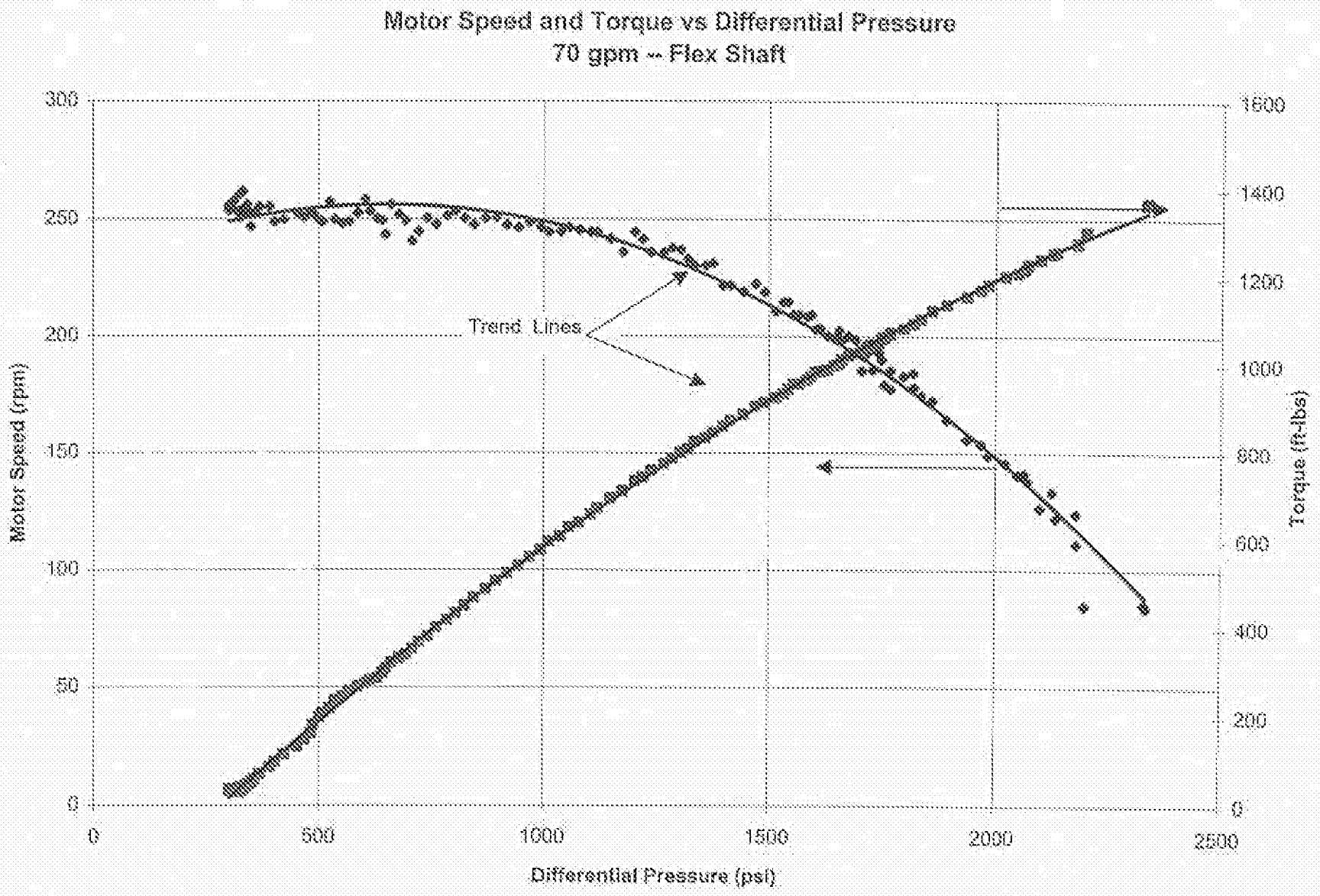
CDS 5-3/8 in. 4/5 multilobe motor - Five Stage

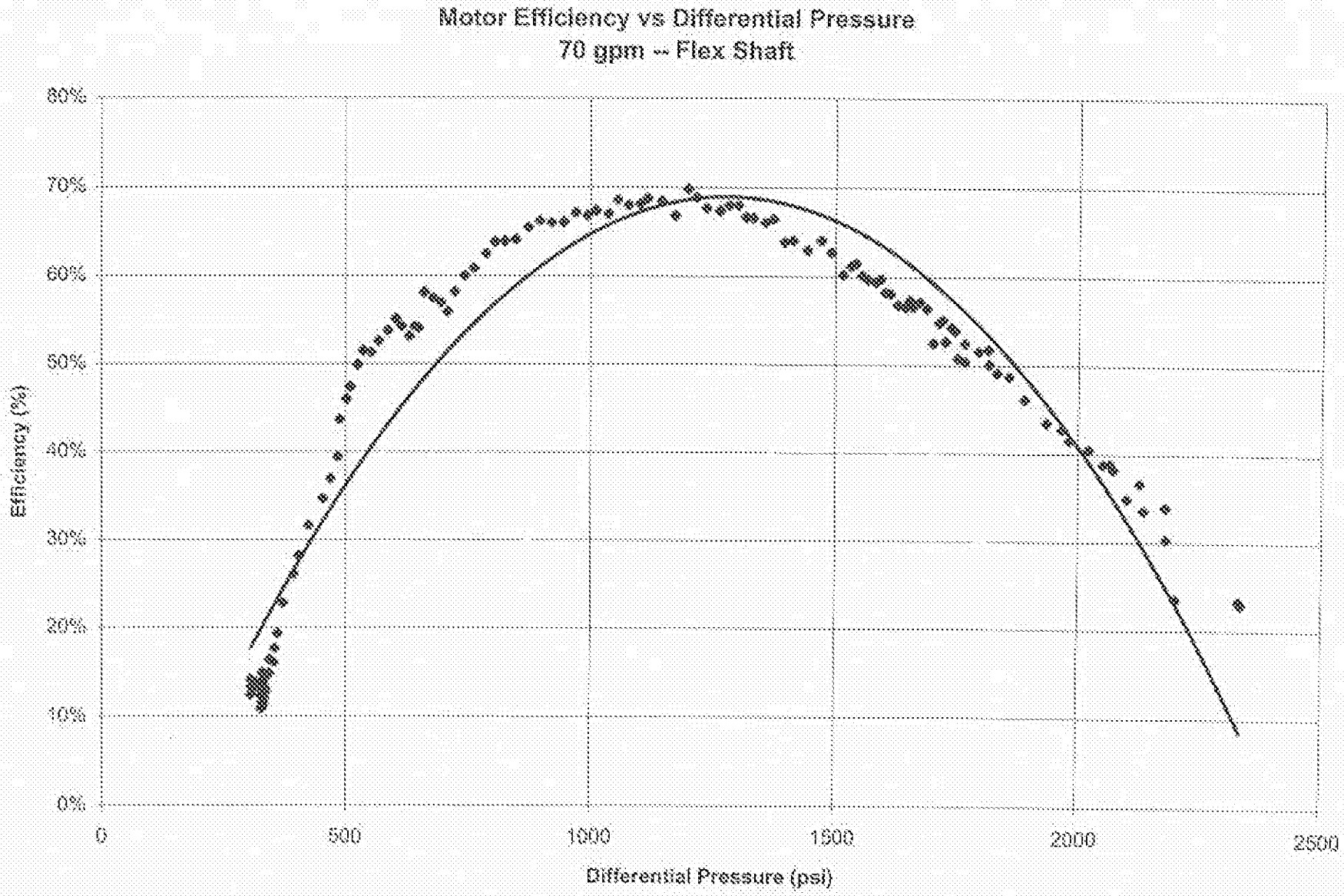
Test Times: 10:35-18:48

Test Date: August 4, 1995

Pt. No	Time	Flow	Speed	Speed Adjusted to 70 gpm	Input Pressure	Output Pressure	Differential Pressure	Hydraulic Horsepower	Torque	Mechanical Horsepower	Efficiency
	(sec)	(gpm)	(rpm)	(rpm)	(psi)	(psi)	(psi)	(hp)	(ft-lbs)	(hp)	(%)
190	185	75.93	153	141	2071	7	2064	84	1321	32.8	39%
191	195	76.28	156	138	2069	9	2071	85	1282	32.3	38%
192	197	75.94	136	122	2165	9	2089	86	1244	29.6	35%
193	198	75.22	148	133	2135	9	2126	87	1356	31.6	37%
194	199	77.85	136	122	2143	9	2134	87	1310	29.3	34%
195	200	78.05	119	111	2160	9	2181	89	1279	27.0	30%
196	201	76.81	136	124	2158	7	2178	85	1291	28.2	34%
197	202	75.95	91	85	2309	9	2300	80	1305	21.1	26%
198	203	72.12	85	83	2340	9	2331	85	1308	20.3	23%
199	204	75.83	91	84	2346	11	2335	85	1372	21.8	25%


Mud Flow vs Time
70 gpm – Flex Shaft
Flow (gpm)
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250
Time (sec)


Motor Speed and Torque vs Differential Pressure
70 gpm -- Flex Shaft
Motor Speed (rpm)
Torque (ft-lbs)
Differential Pressure (psi)
Trend Lines
300
250
200
150
100
50
0
1600
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
2500


Motor Efficiency vs Differential Pressure
70 gpm -- Flex Shaft
80%
70%
60%
50%
40%
30%
20%
10%
0%
Efficiency (%)
0
500
1000
1500
2000
2500
Differential Pressure (psi)

Drilling Research Center
SOE 3-3/8 in. 4/5 multilobe motor--Flex Shaft
Test Time: 16:31:12.68
Test date: August 4, 1998

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 119 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
0	41	113.16	412	400	504	9	488	32	49	3.1	10%
1	42	113.16	412	400	505	7	498	32	58	2.8	9%
2	43	113.16	408	398	508	9	499	32	49	3.0	9%
3	44	113.16	412	400	512	7	505	33	43	3.3	10%
4	45	111.99	412	405	514	7	507	33	43	3.3	10%
5	46	112.57	412	403	516	9	507	33	45	3.4	11%
6	47	113.16	402	398	516	9	507	33	45	3.4	10%
7	48	111.99	408	403	524	9	515	33	48	3.7	11%
8	49	111.99	408	402	529	9	520	33	69	4.5	14%
9	50	113.16	412	400	559	7	552	35	82	6.3	18%
10	51	107.3	389	393	585	9	576	35	166	8.0	22%
11	52	99.05	358	397	597	7	590	37	168	12.1	32%
12	53	94.98	335	385	617	7	610	38	212	15.7	40%
13	54	91.17	324	391	670	9	661	42	262	19.5	46%
14	55	89	324	395	732	9	723	46	309	22.8	49%
15	56	92.05	336	404	807	9	798	51	348	26.8	52%
16	57	97.04	346	392	879	9	870	56	388	29.6	52%
17	58	100.85	353	396	941	9	932	60	425	32.6	54%
18	59	106.12	363	397	1007	9	998	64	446	33.7	53%
19	60	109.93	382	392	1056	9	1041	67	473	35.3	53%
20	61	111.11	400	396	1087	7	1080	69	497	37.5	54%
21	62	113.16	400	399	1111	9	1102	71	520	38.8	54%
22	63	113.75	400	397	1149	7	1139	73	539	39.7	55%
23	64	111.99	397	390	1169	9	1160	74	556	41.3	55%
24	65	113.16	403	392	1197	9	1188	76	578	43.1	57%
25	66	113.45	403	391	1218	9	1209	78	591	44.3	57%
26	67	113.16	400	389	1238	7	1231	79	608	45.1	57%
27	68	115.8	400	380	1261	9	1252	80	624	45.1	56%
28	69	116.09	403	382	1288	9	1279	82	642	46.7	57%
29	70	114.33	400	385	1314	9	1305	84	663	48.6	58%
30	71	113.75	403	390	1329	9	1320	85	679	50.4	59%
31	72	113.45	400	388	1351	9	1342	86	690	51.0	59%
32	73	114.33	400	385	1370	9	1361	87	708	51.9	59%
33	74	114.04	400	385	1358	9	1389	89	729	53.6	60%
34	75	114.04	400	385	1419	9	1410	90	739	54.3	60%
35	76	113.75	400	387	1439	7	1428	92	752	55.4	61%
36	77	114.92	397	380	1462	9	1453	93	772	55.9	60%
37	78	114.92	395	378	1480	9	1471	94	787	56.7	60%
38	79	114.33	392	377	1509	7	1502	96	808	58.0	60%
39	80	114.92	392	378	1538	7	1531	98	829	58.6	60%
40	81	114.04	395	381	1562	9	1553	100	837	60.7	61%
41	82	114.92	396	380	1591	9	1582	102	865	60.6	60%
42	83	113.16	386	375	1624	9	1615	104	889	63.6	61%
43	84	112.87	380	370	1659	7	1652	106	911	64.3	61%
44	85	113.16	380	369	1696	9	1687	108	938	65.4	60%
45	86	113.16	386	376	1698	9	1689	106	958	64.9	60%
46	87	111.4	375	370	1776	9	1767	113	973	68.6	60%
47	88	111.4	363	358	1807	9	1798	115	1014	69.8	60%
48	89	111.69	363	358	1864	9	1855	119	1035	70.5	59%
49	90	113.16	346	336	1901	9	1892	121	1082	68.0	56%
50	91	111.99	377	370	1932	9	1923	123	1052	74.2	60%
51	92	115.21	336	323	1919	9	1910	123	1101	67.7	55%
52	93	110.81	333	330	2024	9	2015	129	1140	71.5	55%
53	94	111.11	335	332	2069	7	2062	132	1165	72.9	55%

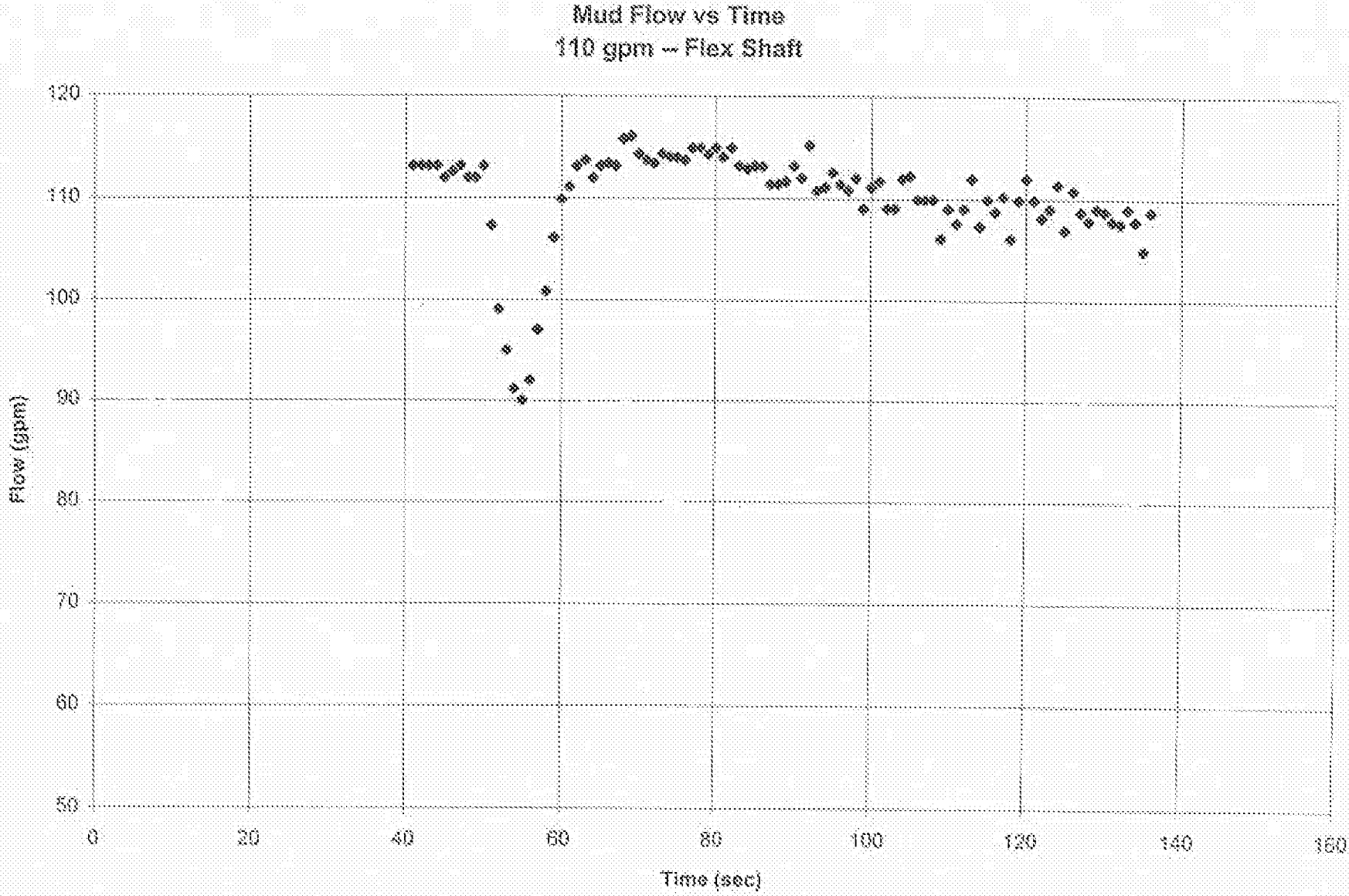
Oilfield Research Center

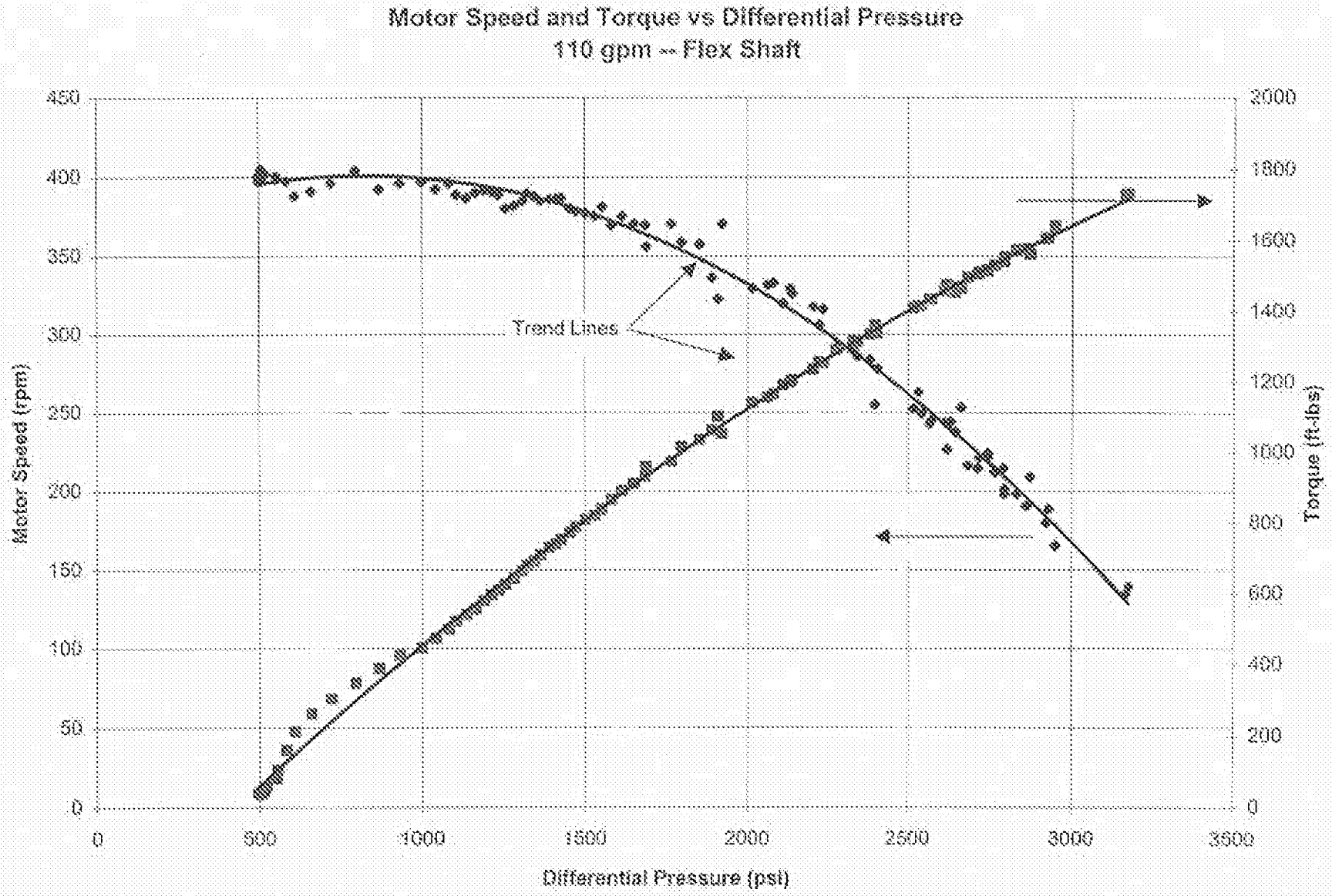
COE 3-3/8 in. 4/5 multilobe motor--Flex Shaft

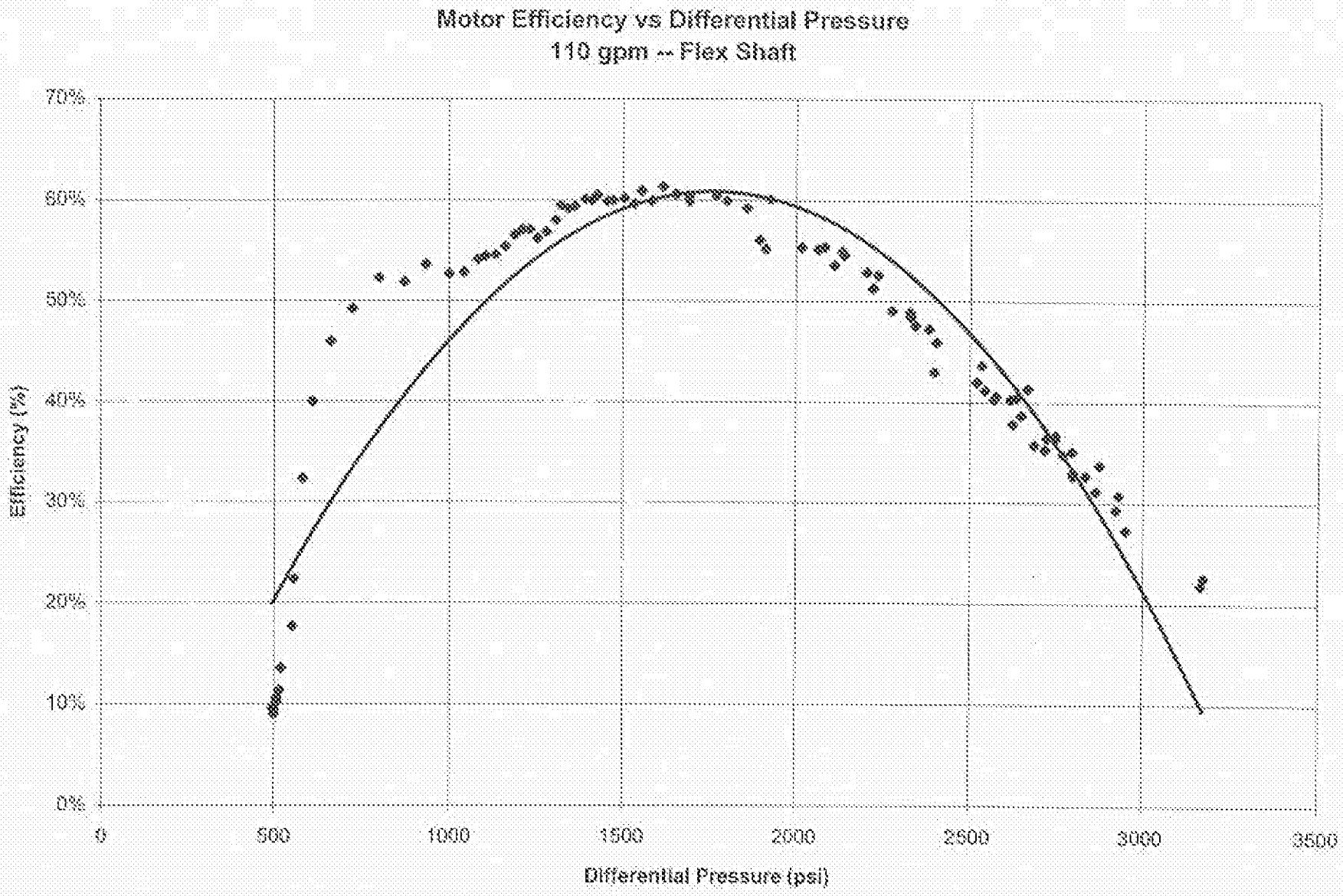
Test Time: 16:31:12.66

Test date: August 4, 1995

Pt. No.	Time (sec)	Flow (gpm)	Speed (rpm)	Speed Adjusted to 110 gpm (rpm)	Input Pressure (psi)	Output Pressure (psi)	Differential Pressure (psi)	Hydraulic Horsepower (hp)	Torque (ft-lbs)	Mechanical Horsepower (hp)	Efficiency (%)
54	95	112.57	341	333	2093	9	2081	134	1165	73.9	55%
55	96	111.4	324	320	2119	9	2110	135	1190	72.5	54%
56	97	110.81	332	330	2143	11	2132	137	1186	75.2	55%
57	98	111.99	332	326	2147	9	2138	137	1205	74.8	55%
58	99	109.06	315	318	2213	9	2204	141	1236	74.8	53%
59	100	111.11	309	305	2233	11	2222	143	1236	73.2	51%
60	101	111.69	321	316	2244	9	2235	143	1252	75.4	53%
61	102	102.06	269	291	2287	11	2276	146	1281	71.7	49%
62	103	105.06	287	289	2338	9	2329	149	1314	72.4	48%
63	104	111.69	301	296	2339	7	2327	149	1296	73.0	49%
64	105	112.28	292	286	2354	11	2343	150	1314	71.8	48%
65	106	109.93	284	284	2393	11	2382	153	1335	72.2	47%
66	107	109.93	278	278	2412	9	2403	154	1337	70.8	46%
67	108	109.62	266	268	2408	11	2397	154	1380	68.1	43%
68	109	108.12	244	263	2529	11	2518	162	1409	67.9	42%
69	110	102.06	261	263	2541	9	2532	162	1415	70.9	44%
70	111	107.59	244	248	2553	11	2542	163	1415	67.2	41%
71	112	109.06	241	243	2576	9	2567	165	1434	66.4	40%
72	113	111.99	250	246	2584	11	2573	165	1434	67.0	41%
73	114	107.3	221	227	2631	11	2620	168	1475	63.6	38%
74	115	109.93	244	244	2642	11	2631	169	1468	66.3	40%
75	116	108.76	235	238	2654	9	2645	170	1453	65.8	39%
76	117	110.23	244	243	2623	9	2614	168	1459	67.6	40%
77	118	106.12	227	235	2724	11	2713	174	1508	64.5	38%
78	119	109.93	231	231	2736	12	2724	174	1511	66.6	38%
79	120	111.99	238	233	2674	11	2663	171	1465	70.7	41%
80	121	109.93	216	216	2693	11	2682	172	1493	61.5	36%
81	122	108.18	218	222	2752	9	2743	176	1517	64.0	36%
82	123	109.69	210	212	2777	11	2766	178	1531	61.7	35%
83	124	111.4	227	224	2755	11	2744	176	1515	64.7	37%
84	125	107	195	203	2806	11	2795	179	1542	59.2	33%
85	126	110.81	216	214	2804	11	2793	179	1542	63.0	35%
86	127	108.76	196	198	2806	10	2795	179	1554	58.7	33%
87	128	107.88	187	191	2873	12	2861	184	1577	57.3	31%
88	129	109.06	207	209	2864	12	2852	184	1582	62.1	34%
89	130	108.76	196	198	2839	7	2832	182	1573	59.4	33%
90	131	107.88	187	191	2873	11	2862	184	1577	57.3	31%
91	132	107.59	176	180	2931	11	2920	187	1616	55.0	29%
92	133	108.06	187	189	2939	12	2927	188	1608	57.7	31%
93	134	107.88	162	165	2960	12	2948	189	1641	51.6	27%
94	135	104.95	133	139	3185	11	3174	204	1732	46.8	23%
95	136	108.76	133	135	3177	12	3165	203	1728	44.3	22%


Mud Flow vs Time
110 gpm -- Flex Shaft
Flow (gpm)
120
110
100
90
80
70
60
50
0
20
40
60
80
100
120
140
160
Time (sec)


Motor Speed and Torque vs Differential Pressure
110 gpm -- Flex Shaft
Motor Speed (rpm)
Torque (ft-lbs)
Differential Pressure (psi)
Trend Lines
450
400
350
300
250
200
150
100
50
0
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
3000
3500


Motor Efficiency vs Differential Pressure
110 gpm -- Flex Shaft
70%
60%
50%
40%
30%
20%
10%
0%
Efficiency (%)
0
500
1000
1500
2000
2500
3000
3500
Differential Pressure (psi)

APPENDIX B
DOE High-Power Slim-Hole System
Catoosa Field Test

- Day 1
- Day 2
- Day 3

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/23/98																
Starting Depth =	623.92			Bit Type =	Walker McDonald MF6SB												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	659.49			Pipe (ft) =	251.81				Collar (ft)	406.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
11:35:23	623.82	105	727	381	739	757	36	17.25	1.77	0.12	0.30	1.29	1.46	89.66	3.89	0
11:35:47	624.17	108	751	392	739	761	41	17.12	1.76	0.1	0.43	0.86	0.89	36.47	4.22	0.01
11:36:08	624.43	107	758	389	740	761	41	17.09	1.75	0.09	0.46	0.74	0.87	42.60	4.47	0.02
11:36:38	624.85	106	763	385	740	761	41	17.04	1.79	0.13	0.51	1.36	1.13	27.46	4.7	0.02
11:37:08	624.83	109	755	396	742	761	36	16.98	1.76	0.08	0.57	0.91	1.01	20.83	4.88	0.03
11:37:38	624.99	108	762	393	743	761	36	16.96	1.76	0.09	0.59	0.86	1.32	19.76	5.04	0.03
11:38:08	625.14	106	776	386	742	761	36	16.97	1.77	0.11	0.58	1.01	0.79	17.50	5.19	0.05
11:38:38	625.31	108	781	393	743	761	36	17	1.75	0.09	0.54	0.96	0.85	20.25	5.35	0.06
11:39:08	625.5	108	787	392	740	761	41	17.03	1.76	0.09	0.51	0.79	0.55	23.28	5.53	0.07
11:39:38	625.68	107	781	389	740	761	36	17.02	1.76	0.1	0.52	0.74	1.08	22.02	5.71	0.07
11:40:08	625.85	108	787	394	741	757	33	17.03	1.75	0.09	0.52	0.77	0.67	19.81	5.9	0.08
11:40:38	626.02	108	785	392	741	757	32	17.03	1.76	0.11	0.52	1.61	1.7	20.41	6.08	0.09
11:41:08	626.13	109	790	393	741	761	36	17.02	1.75	0.1	0.52	0.74	0.45	14.08	6.19	0.1
11:41:38	626.27	108	786	393	740	757	32	17.03	1.75	0.09	0.51	0.91	0.5	16.53	6.33	0.11
11:42:08	626.4	109	790	395	742	757	32	17.04	1.76	0.09	0.51	1.51	1.32	15.59	6.46	0.11
11:42:38	626.52	108	788	394	742	757	32	17.03	1.75	0.09	0.51	0.86	0.67	14.06	6.57	0.12
11:43:03	626.77	107	844	391	743	761	45	16.67	1.78	0.14	0.87	1.94	1.53	40.85	6.84	0.13
11:43:14	627.02	108	965	392	745	761	40	16.52	1.79	0.15	1.23	1.46	0.53	65.62	7.06	0.13
11:43:28	627.27	108	981	395	746	765	32	15.91	1.8	0.18	1.64	2.11	0.56	75.42	7.31	0.14
11:43:37	627.52	108	1062	387	746	765	36	15.37	2.7	1.87	2.08	3.97	3.09	83.70	7.57	0.14
11:43:58	627.77	108	1014	393	743	777	85	16.8	3.72	2.14	1.64	4.5	5.07	46.85	7.81	0.14
11:44:08	628.02	108	944	394	744	765	41	15.77	1.89	0.31	1.79	2.3	1.05	77.68	8.07	0.15
11:44:18	628.27	108	966	392	743	761	36	15.55	1.81	0.19	2.06	2.75	1.1	69.45	8.33	0.15
11:44:28	628.52	108	960	395	744	761	32	15.56	1.84	0.23	2.06	2.37	0.67	85.86	8.58	0.15
11:44:38	628.77	110	953	401	745	765	36	15.56	1.81	0.22	2.06	2.25	0.5	92.31	8.84	0.16
11:44:48	629.03	109	955	397	746	765	32	15.57	1.85	0.26	1.96	2.25	0.53	85.99	9.07	0.16
11:44:58	629.28	108	953	393	746	765	32	15.58	1.83	0.24	1.88	2.25	0.66	86.23	9.33	0.16
11:45:08	629.53	108	942	392	747	765	36	15.42	1.81	0.19	2.13	2.49	0.67	84.07	9.58	0.16
11:45:20	629.78	110	968	400	747	765	32	15.13	1.81	0.18	2.42	2.88	0.55	82.97	9.85	0.17
11:45:30	630.03	108	962	392	746	765	36	15.12	1.8	0.16	2.44	2.86	0.48	92.75	10.02	0.17
11:45:41	630.28	108	978	393	746	765	36	15.1	1.82	0.23	2.45	2.73	0.5	83.55	10.33	0.17
11:45:51	630.53	108	994	386	745	761	32	15.13	1.81	0.2	2.42	2.68	0.5	90.89	10.58	0.18
11:46:01	630.78	110	973	395	745	761	36	15.08	1.82	0.22	2.58	3.04	1.32	86.99	10.83	0.18
11:46:13	631.03	108	957	394	744	761	32	15.08	1.85	0.25	2.47	2.68	0.46	77.33	11.09	0.18

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.92			Bit Type =	Walker McDonald MPS8H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =		251.81			Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Meters
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	GS	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
11:46:23	631.26	107	969	390	744	781	36	15.1	1.81	0.19	2.46	2.85	0.85	90.07	11.33	0.19
11:46:34	631.53	106	968	386	744	785	36	15.09	1.83	0.24	2.45	3.35	2.21	81.58	11.58	0.19
11:46:45	631.78	108	980	393	744	785	41	15.11	1.58	0.26	2.44	3.49	1.7	82.82	11.84	0.19
11:46:56	632.03	106	965	389	743	781	36	15.09	1.81	0.23	2.46	3.33	1.13	85.62	12.09	0.19
11:47:08	632.28	105	971	392	742	781	36	15.08	1.8	0.18	2.47	2.75	0.53	74.63	12.33	0.2
11:47:19	632.53	106	985	388	744	781	32	15.08	1.64	0.23	2.47	2.73	0.45	81.82	12.6	0.2
11:47:30	632.78	110	981	401	744	785	41	15.08	1.8	0.18	2.48	2.85	0.82	79.26	12.82	0.2
11:47:41	633.03	108	982	392	743	781	36	15.08	1.82	0.23	2.47	2.7	0.5	79.22	13.07	0.21
11:47:52	633.28	108	982	393	743	781	36	15.09	1.85	0.26	2.46	2.7	0.63	81.53	13.33	0.21
11:48:04	633.54	108	984	392	743	785	41	15.08	1.85	0.31	2.46	2.78	0.79	77.13	13.6	0.21
11:48:15	633.79	108	981	394	743	781	36	15.08	1.86	0.29	2.46	2.78	0.67	83.55	13.84	0.22
11:48:27	634.04	107	986	388	743	781	36	15.11	1.83	0.27	2.44	2.75	0.62	80.65	14.08	0.22
11:48:38	634.29	107	987	390	744	785	41	15.1	1.87	0.3	2.44	2.75	0.62	81.36	14.33	0.22
11:48:48	634.54	106	985	388	743	781	36	15.1	1.84	0.28	2.45	2.75	0.67	82.87	14.58	0.23
11:49:01	634.79	108	986	397	743	781	45	15.1	1.85	0.27	2.46	2.78	0.62	74.54	14.84	0.23
11:49:11	635.04	110	982	399	743	781	36	15.1	1.83	0.23	2.45	2.75	0.77	85.00	15.06	0.23
11:49:23	635.28	105	978	384	741	715	41	15.1	1.81	0.19	2.45	2.68	0.53	76.58	15.31	0.24
11:49:34	635.54	108	979	393	742	781	36	15.09	1.82	0.21	2.45	2.68	0.5	80.98	15.61	0.24
11:49:46	635.79	105	979	395	742	781	36	15.11	1.83	0.22	2.44	2.78	0.62	82.54	15.86	0.24
11:49:58	636.04	108	966	394	743	781	36	15.07	1.81	0.2	2.47	2.75	0.57	76.97	16.08	0.24
11:50:08	636.29	107	975	390	743	781	36	15.13	1.81	0.22	2.41	2.73	0.6	90.78	16.36	0.25
11:50:19	636.54	108	978	392	743	781	36	15.1	1.82	0.21	2.44	2.78	0.67	79.79	16.59	0.25
11:50:30	636.79	108	977	394	744	781	36	15.1	1.82	0.21	2.44	2.7	0.56	81.61	16.84	0.25
11:50:40	637.04	107	982	393	742	781	36	15.13	1.81	0.19	2.42	2.68	0.53	88.85	17.1	0.26
11:51:51	637.29	107	988	392	742	781	36	15.13	1.81	0.19	2.41	2.7	0.56	79.78	17.34	0.26
11:51:02	637.54	110	981	401	743	781	36	15.1	1.81	0.19	2.45	2.75	0.62	82.19	17.59	0.27
11:51:14	637.79	106	979	387	744	781	36	15.09	1.83	0.21	2.45	2.78	0.65	78.13	17.85	0.27
11:51:26	638.04	105	978	383	744	781	32	15.08	1.81	0.19	2.47	2.73	0.55	77.63	18.08	0.27
11:51:36	638.3	107	983	390	744	785	41	15.1	1.81	0.19	2.44	2.75	0.6	83.57	18.34	0.27
11:51:48	638.55	109	987	396	742	781	36	15.11	1.81	0.2	2.43	2.7	0.53	77.31	18.59	0.28
11:51:59	638.8	108	981	395	744	781	32	15.12	1.8	0.19	2.42	2.68	0.53	86.29	18.85	0.28
11:52:10	639.05	106	978	386	743	781	36	15.08	1.81	0.21	2.46	2.73	0.65	77.23	19.09	0.28
11:52:23	639.3	108	981	394	742	781	36	15.11	1.81	0.19	2.43	2.7	0.53	76.85	19.34	0.29
11:52:34	639.55	107	980	389	742	785	41	15.09	1.81	0.19	2.45	2.75	0.85	76.78	19.59	0.29

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/86				
Starting Depth =	633.92	Bit Type =	Walker McDonnald MP58H		
Ending Depth =	1033.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 13		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	99.58	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	660.49	Pipe (ft) =	251.81	Collar (ft)	408.68

TIME	BIT DEPTH	FLOW	PPES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
Hr:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:52:46	639.6	111	984	405	742	781	41	15.1	1.82	0.23	2.44	2.78	0.6	71.77	19.85	0.29
11:52:57	640.09	112	981	405	744	781	38	15.09	1.8	0.18	2.45	2.73	0.53	82.88	20.12	0.29
11:53:09	640.3	108	981	396	743	785	41	15.11	1.81	0.19	2.43	2.75	0.57	76.39	20.34	0.3
11:53:21	640.85	107	969	388	740	757	36	15.08	1.8	0.17	2.46	2.73	0.53	75.44	20.6	0.3
11:53:33	640.8	108	976	392	741	761	38	15.1	1.81	0.19	2.44	2.7	0.53	78.34	20.88	0.3
11:53:44	641.05	108	979	393	743	781	38	15.11	1.81	0.19	2.43	2.68	0.48	77.78	21.11	0.31
11:53:55	641.3	106	978	396	742	781	38	15.09	1.84	0.23	2.45	2.8	0.62	83.30	21.34	0.31
11:54:08	641.55	108	936	392	741	761	36	15.03	1.8	0.18	2.81	2.82	0.62	68.18	21.6	0.31
11:54:22	641.8	108	936	395	741	765	41	15.01	1.81	0.18	2.63	2.82	0.6	65.06	21.87	0.32
11:54:35	642.05	108	953	394	742	761	38	15.01	1.81	0.18	2.63	2.68	0.55	68.15	22.13	0.32
11:54:48	642.3	109	944	396	742	781	41	15.06	1.81	0.19	2.48	2.78	0.57	69.05	22.38	0.32
11:55:03	642.55	108	920	394	742	781	38	14.99	1.81	0.17	2.64	3.14	0.93	75.45	22.63	0.33
11:55:12	642.81	108	952	393	743	757	32	14.11	1.81	0.19	3.43	4	1.2	78.23	22.88	0.33
11:55:24	643.06	110	947	396	743	781	38	13.6	1.81	0.19	3.95	4.6	1.32	76.73	23.11	0.34
11:55:34	643.31	109	1015	394	741	781	38	13.2	1.83	0.23	4.34	4.69	0.93	90.67	23.37	0.34
11:55:41	643.56	105	1023	388	740	757	36	13.73	1.81	0.2	3.82	4.26	1.36	133.37	23.61	0.34
11:55:50	643.81	109	978	397	741	757	32	14.26	1.8	0.19	3.28	3.71	0.86	96.17	23.86	0.34
11:56:01	644.06	108	965	394	741	757	32	14.1	1.8	0.17	3.44	3.75	0.67	79.35	24.1	0.35
11:56:11	644.31	109	971	393	740	757	32	14.16	1.81	0.18	3.37	3.69	0.68	89.22	24.36	0.35
11:56:21	644.56	108	1037	392	740	757	32	14.46	1.81	0.23	3.09	3.49	0.93	94.05	24.6	0.35
11:56:32	644.81	105	991	383	737	753	32	15.23	1.83	0.25	2.39	3.13	1.36	80.65	24.85	0.35
11:56:41	645.06	110	987	396	740	757	32	15.2	1.84	0.26	2.33	2.7	0.89	94.78	25.11	0.36
11:56:51	645.31	108	940	387	740	757	32	15.08	1.84	0.22	2.43	2.79	0.62	90.59	25.37	0.36
11:57:00	645.56	110	961	401	742	761	49	15.06	1.85	0.27	2.48	2.85	0.81	105.36	25.6	0.36
11:57:09	645.82	107	979	389	743	761	36	15.07	1.87	0.31	2.47	2.82	0.79	100.44	25.86	0.36
11:57:19	646.07	107	952	389	743	761	36	15.02	1.85	0.28	2.51	2.92	0.86	86.14	26.11	0.37
11:57:30	646.32	108	956	392	743	761	36	14.97	1.81	0.18	2.57	2.85	0.55	83.62	26.37	0.37
11:57:42	646.57	107	948	389	743	761	36	14.94	1.83	0.21	2.59	2.92	0.77	77.66	26.6	0.37
11:57:54	646.82	108	932	394	744	761	32	14.91	1.81	0.19	2.63	2.94	0.6	72.45	26.86	0.38
11:58:03	647.07	108	942	394	744	761	32	15.11	1.84	0.26	2.42	2.75	0.91	100.45	27.12	0.38
11:58:14	647.32	108	953	392	743	761	36	15.02	1.83	0.22	2.51	2.87	0.69	93.49	27.37	0.38
11:58:23	647.57	110	953	400	742	765	41	15.04	1.83	0.23	2.50	2.78	0.82	97.62	27.6	0.39
11:58:33	647.82	107	953	390	743	761	36	15.05	1.81	0.2	2.48	2.8	0.65	92.56	27.85	0.39
11:58:43	648.07	108	951	396	744	761	32	15.13	1.83	0.23	2.41	2.75	0.69	100.27	28.12	0.39

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/25/98																
Starting Depth =	623.93			Bit Type =	Walker McDonald M756H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.06			Mud Type =		Water Based											
Average ROP =	99.56			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.45			Pipe (ft) =	251.81				Collar (ft)	408.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
11:58:51	646.32	110	936	400	743	761	36	15.06	1.82	0.21	2.47	2.67	0.77	97.04	29.37	0.39
11:59:01	646.67	108	940	393	744	765	36	15.09	1.82	0.21	2.46	2.8	0.72	92.63	28.61	0.4
11:59:10	646.82	107	942	388	743	761	36	15.07	1.81	0.21	2.46	2.78	0.67	102.27	28.86	0.4
11:59:20	646.97	108	940	393	742	757	32	14.97	1.81	0.19	2.56	3.04	0.83	89.69	28.13	0.4
11:59:29	646.32	107	956	389	742	761	36	14.85	1.82	0.23	2.68	3.08	0.81	119.32	29.39	0.4
11:59:39	646.97	109	956	395	743	761	32	14.85	1.84	0.23	2.68	3.08	0.77	115.05	29.63	0.41
11:59:49	646.82	109	1006	395	743	757	28	14.81	1.83	0.34	2.72	3.09	0.74	101.46	29.86	0.41
11:59:59	650.07	110	1014	402	743	761	32	14.83	1.82	0.21	2.79	3.04	0.69	112.98	30.14	0.41
12:00:01	650.32	107	1006	391	743	761	36	14.85	1.83	0.22	2.68	3.06	0.79	114.45	30.39	0.41
12:00:09	650.57	107	1021	390	742	757	32	14.85	1.83	0.23	2.68	3.11	0.96	107.76	30.62	0.41
12:00:17	650.83	107	1015	390	743	761	32	14.81	1.83	0.21	2.71	3.04	0.68	113.89	30.9	0.42
12:00:26	651.08	106	1011	388	742	757	32	14.8	1.83	0.24	2.73	3.11	0.72	102.37	31.12	0.42
12:00:34	651.33	106	1015	387	742	757	28	14.81	1.81	0.2	2.73	3.09	0.74	108.01	31.4	0.42
12:00:43	651.58	109	1018	387	743	757	28	14.82	1.82	0.21	2.71	3.09	0.96	110.74	31.63	0.42
12:00:51	651.83	108	1024	384	742	757	32	14.79	1.82	0.22	2.73	3.14	0.72	100.12	31.89	0.43
12:01:00	652.08	105	1023	383	742	757	28	14.74	1.81	0.19	2.79	3.11	0.62	98.06	32.12	0.43
12:09:26	651.31	109	726	395	740	757	32	17.87	1.81	0.19	0.13	0.67	0.79	114.82	32.19	0.43
12:09:33	651.36	108	732	395	738	753	28	17.86	1.82	0.18	0.12	0.31	0.41	135.38	32.41	0.43
12:09:41	651.81	108	724	393	740	757	32	17.8	2.01	0.43	0.26	0.5	0.63	114.81	32.59	0.43
12:09:48	652.06	105	721	396	740	757	32	17.77	1.82	0.22	0.23	0.48	0.48	121.43	32.79	0.43
12:10:18	652.31	106	768	392	740	757	36	17.19	1.92	0.41	0.89	1.13	1.57	29.68	32.96	0.44
12:10:39	652.56	105	858	397	751	1016	262	16.68	2.62	0.86	1.32	5.22	5	42.71	33.6	0.45
12:11:01	652.81	109	992	396	743	834	109	16.46	1.89	0.35	1.54	3.49	2.87	41.27	32.85	0.45
12:11:18	653.06	108	1026	392	742	757	32	15.8	1.97	0.44	2.26	2.51	1.1	61.56	33.11	0.46
12:11:34	653.31	108	1033	392	742	761	36	15.78	1.85	0.44	2.22	2.48	0.55	57.18	33.36	0.46
12:11:51	653.56	109	1026	395	741	757	32	15.79	1.85	0.44	2.22	2.51	0.55	55.18	33.62	0.47
12:12:05	653.81	108	1039	391	739	757	36	15.82	1.83	0.42	2.18	2.47	0.62	57.88	33.89	0.47
12:12:22	654.06	107	1035	390	741	757	28	15.77	1.84	0.43	2.23	2.78	0.83	55.88	34.13	0.47
12:12:31	654.31	109	1141	396	746	757	32	14.42	1.98	0.67	3.59	4.98	2.44	91.86	34.36	0.48
12:12:38	654.56	106	1347	386	741	757	28	12.62	1.99	0.68	5.66	6.42	1.82	140.28	34.61	0.48
12:12:44	654.82	107	1443	390	741	757	32	11.55	2.09	0.68	6.47	7.11	1.17	149.13	34.87	0.48
12:12:51	655.07	103	1454	377	739	753	28	11.34	2.06	0.68	6.69	6.94	0.53	131.75	35.13	0.48
12:12:57	655.32	105	1499	381	741	757	36	11.34	2.05	0.64	6.69	7.11	0.74	136.31	35.38	0.48
12:13:03	655.57	106	1443	387	741	757	28	11.34	1.96	0.48	6.68	6.94	0.53	136.51	35.63	0.49

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.92			Bit Type =	Walker McDonnald MP68H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	688.49			Pipe (ft) =	251.61			Collar (ft)	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
12:13:09	655.82	107	1456	368	742	757	32	11.34	2.01	0.84	6.68	7.01	0.5	155.81	35.85	0.49
12:13:15	656.07	104	1468	379	742	761	36	11.31	1.97	0.55	6.71	7.01	0.52	150.70	36.13	0.49
12:13:22	656.32	107	1446	369	742	757	32	11.32	2.06	0.86	6.70	7.04	0.59	138.14	36.35	0.49
12:13:28	656.57	105	1475	383	741	757	32	11.29	2.15	0.73	6.74	7.09	0.67	146.76	36.64	0.49
12:13:34	656.82	107	1479	368	742	757	32	11.31	2.01	0.82	6.71	7.01	0.79	142.03	36.89	0.49
12:13:40	657.07	104	1522	378	742	761	38	11.4	2.1	0.7	6.62	7.09	0.79	155.26	37.11	0.5
12:13:46	657.32	102	1538	373	741	757	32	11.37	2.06	0.71	6.64	7.25	1.01	169.36	37.38	0.5
12:13:52	657.57	105	1530	382	767	857	247	11.35	1.95	0.55	6.67	7.06	0.77	146.12	37.62	0.5
12:13:58	657.82	106	1506	367	743	761	32	11.26	1.95	0.46	6.78	7.16	0.84	145.58	37.91	0.5
12:14:05	658.07	104	1477	380	783	761	32	11.27	2.09	0.74	6.75	7.16	0.77	142.91	38.15	0.5
12:14:11	658.32	104	1522	380	742	761	35	11.25	2.06	0.69	6.77	7.06	0.67	136.21	38.39	0.51
12:14:18	658.58	103	1499	375	762	757	28	11.18	2.09	0.79	6.84	7.58	1.24	134.08	38.62	0.51
12:14:24	658.83	106	1455	387	742	757	28	11.33	1.94	0.51	6.69	7.01	0.77	139.78	38.88	0.51
12:14:31	659.08	107	1439	381	780	757	32	11.18	1.94	0.56	6.84	7.18	0.67	137.67	39.15	0.51
12:14:38	659.33	106	1440	384	780	757	32	11.22	1.96	0.46	6.86	7.16	0.69	133.71	39.37	0.51
12:14:44	659.58	106	1418	385	741	757	32	11.27	1.91	0.42	6.75	7.11	0.69	139.90	39.62	0.51
12:14:50	659.83	106	1415	385	741	757	32	11.28	2.05	0.54	6.73	6.97	0.6	146.34	39.9	0.52
12:14:56	660.08	108	1470	383	742	757	33	11.21	1.95	0.47	6.81	7.13	0.63	125.16	40.13	0.52
12:15:04	660.33	107	1437	385	742	757	32	11.22	1.93	0.49	6.80	7.05	0.6	141.83	40.38	0.52
12:15:11	660.58	106	1458	385	740	757	32	11.21	1.98	0.55	6.81	7.09	0.6	122.58	40.62	0.52
12:15:17	660.83	108	1451	385	741	761	38	11.27	2	0.5	6.75	7.01	0.55	150.65	40.9	0.52
12:15:23	661.08	107	1415	393	742	761	32	11.16	1.96	0.5	6.84	7.16	0.74	142.64	41.13	0.52
12:15:30	661.33	106	1459	383	743	761	32	11.24	1.96	0.5	6.78	7.13	0.74	125.98	41.39	0.53
12:15:36	661.58	105	1456	384	743	757	28	11.28	1.97	0.47	6.74	7.04	0.67	150.01	41.63	0.53
12:15:42	661.83	105	1455	384	743	761	32	11.33	1.95	0.47	6.69	6.99	0.57	151.06	41.88	0.53
12:15:48	662.09	106	1457	385	743	757	28	11.25	1.97	0.46	6.77	7.04	0.53	146.01	42.15	0.53
12:15:54	662.34	105	1478	383	743	761	32	11.22	2.04	0.54	6.80	7.13	0.63	146.77	42.39	0.53
12:16:02	662.59	108	1396	394	743	761	32	11.09	1.88	0.34	6.98	7.25	0.86	112.58	42.64	0.54
12:16:08	662.84	108	1384	385	743	757	28	11.2	1.88	0.38	6.81	7.28	0.74	169.87	42.86	0.54
12:16:14	663.09	104	1396	386	743	757	28	11.3	1.98	0.57	6.71	7.06	0.59	150.77	43.13	0.54
12:16:21	663.34	105	1442	382	743	761	36	11.19	2.03	0.57	6.82	7.18	0.77	134.31	43.39	0.54
12:16:28	663.59	105	1436	388	743	761	32	11.18	1.92	0.41	6.85	7.25	0.74	139.75	43.65	0.54
12:16:35	663.84	104	1534	378	743	761	32	11.01	2	0.5	7.01	7.32	0.67	130.53	43.92	0.55
12:16:43	664.09	101	1502	389	742	757	28	11.12	1.94	0.44	6.90	7.18	0.67	132.36	44.14	0.55

DOE high power morter test Amaco Catoosa Test Site

Well No. 29	Date: 2/23/96																	
Starting Depth =	623.92				Bit Type =	Walker McDonald MP68R												
Ending Depth =	1031.19				Bit Size =	4.75												
Total Depth Drilled	407.27				Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09				Mud Type =		Water Based											
Average ROP =	99.58				Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	680.49				Pipe (ft) =	251.61				Collar (ft)	468.88							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
12:16:50	664.34	103	1636	375	742	757	32	11.06	1.98	0.51	6.97	7.3	0.57	139.29	44.39	0.55
12:16:58	664.59	105	1602	383	742	757	32	11.04	1.98	0.5	6.99	7.54	0.86	118.94	44.65	0.55
12:17:06	664.84	103	1631	376	742	757	28	11.01	1.93	0.46	7.01	7.3	0.85	118.03	44.89	0.55
12:17:14	665.09	100	1616	365	741	761	36	10.98	1.96	0.45	7.04	7.3	0.5	106.40	45.14	0.56
12:17:22	665.34	105	1595	382	742	757	28	10.95	1.97	0.48	7.06	7.38	0.57	113.17	45.39	0.56
12:17:31	665.59	103	1607	377	742	761	32	10.98	1.99	0.56	7.04	7.62	0.5	106.37	45.65	0.56
12:17:39	665.85	104	1606	380	741	757	32	10.99	1.96	0.45	7.03	7.71	0.68	111.71	45.89	0.56
12:17:46	666.1	103	1634	376	742	757	32	11.01	1.97	0.52	7.01	7.3	0.85	115.72	46.14	0.56
12:17:55	666.35	103	1664	377	741	761	36	11.03	2	0.56	6.99	7.3	0.57	106.58	46.41	0.57
12:18:02	666.6	106	1652	386	742	757	28	11	2.02	0.55	7.02	7.3	0.53	118.04	46.67	0.57
12:18:11	666.85	103	1630	376	741	757	32	10.97	1.96	0.5	7.04	7.38	0.62	109.03	46.92	0.57
12:18:18	667.1	105	1641	381	742	757	32	11.03	1.97	0.54	6.99	7.32	0.62	116.77	47.14	0.57
12:18:26	667.35	105	1653	382	742	761	32	11.06	2.04	0.61	6.96	7.3	0.62	123.18	47.41	0.58
12:18:33	667.6	107	1661	391	742	757	32	11.08	2.11	0.74	6.93	7.28	0.72	116.13	47.65	0.59
12:18:40	667.85	106	1654	388	742	761	32	11.13	2.03	0.59	6.88	7.18	0.62	122.83	47.91	0.58
12:18:47	668.1	103	1681	375	742	757	28	11.22	2.07	0.67	6.79	7.16	0.74	134.08	48.14	0.58
12:18:54	668.35	104	1677	378	741	757	32	11.15	2.03	0.58	6.86	7.21	0.82	122.83	48.4	0.58
12:19:01	668.6	103	1652	376	742	757	32	11.04	1.94	0.46	6.97	7.28	0.69	121.08	48.65	0.59
12:19:10	668.85	104	1641	378	740	757	32	10.99	1.98	0.51	7.02	7.3	0.5	105.88	48.91	0.59
12:19:17	669.1	103	1610	374	741	757	32	11	1.94	0.48	7.01	7.25	0.45	117.36	49.14	0.58
12:19:25	669.35	102	1628	372	742	757	28	11	1.95	0.49	7.01	7.25	0.55	113.24	49.4	0.58
12:19:33	669.6	101	1610	369	741	757	28	10.95	1.93	0.48	7.05	7.3	0.45	119.38	49.67	0.58
12:19:41	669.85	104	1623	381	742	757	32	10.98	1.96	0.5	7.03	7.33	0.51	114.65	49.91	0.6
12:19:50	670.1	104	1628	379	741	757	32	10.96	1.94	0.52	7.05	7.35	0.55	105.73	50.16	0.6
12:19:58	670.35	105	1626	381	742	757	32	10.92	1.93	0.48	7.09	7.35	0.5	109.77	50.42	0.6
12:20:06	670.61	105	1635	382	742	757	28	10.97	1.96	0.51	7.04	7.3	0.55	112.48	50.66	0.6
12:20:15	670.89	104	1635	379	743	761	32	10.98	1.95	0.52	7.02	7.3	0.57	104.38	50.91	0.61
12:20:23	671.11	106	1631	385	742	757	28	10.99	1.92	0.4	7.02	7.28	0.55	113.63	51.17	0.61
12:20:31	671.36	105	1630	384	741	757	32	10.98	1.98	0.52	7.03	7.32	0.57	105.63	51.42	0.61
12:20:39	671.61	102	1639	372	742	757	28	11.01	2.02	0.54	7.00	7.3	0.5	120.82	51.68	0.61
12:20:47	671.86	106	1633	389	743	757	28	10.99	1.99	0.5	7.02	7.35	0.62	114.86	51.91	0.61
12:20:54	672.11	105	1656	382	742	761	32	11.05	1.98	0.5	6.98	7.28	0.67	115.32	52.19	0.62
12:21:03	672.36	104	1627	378	743	757	28	10.94	1.95	0.45	7.07	7.37	0.55	111.04	52.4	0.62
12:21:12	672.61	103	1615	374	741	761	36	10.93	1.94	0.43	7.08	7.32	0.67	99.75	52.65	0.62

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96			Bit Type =	Walker McDonald MP68K													
Starting Depth =	623.92			Bit Size =	4.75													
Ending Depth =	1031.19			Bit Nozzles =		9, 9, 12, 12												
Total Depth Drilled	407.27			Mud Type =		Water Based												
Hours On Bit =	4.09			Mud Weight (lbs/gal) =		9.00												
Average ROP =	99.58			Pipe (ft) =	251.81			Collar (ft)	408.80									
Drillstring (ft) =	660.49																	
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:21:20	673.56	107	1599	391	741	761	36	10.89	1.91	0.42	7.13	7.44	0.65	133.77	52.91	0.62
12:21:30	673.11	103	1592	377	741	761	36	10.83	1.94	0.44	7.18	7.62	0.6	92.74	53.17	0.63
12:21:40	673.36	106	1565	385	740	757	32	10.83	1.92	0.41	7.19	7.47	0.53	87.64	53.4	0.63
12:21:50	673.61	104	1602	380	741	757	32	10.84	1.95	0.44	7.17	7.49	0.67	95.39	53.68	0.63
12:22:00	673.86	105	1605	382	742	757	32	10.84	1.98	0.46	7.17	7.47	0.62	87.26	53.91	0.64
12:22:10	674.11	104	1591	380	741	761	36	10.81	1.94	0.41	7.20	7.47	0.53	90.61	54.17	0.64
12:22:22	674.36	105	1559	382	740	763	28	10.74	1.91	0.38	7.27	7.49	0.53	79.51	54.4	0.64
12:22:33	674.61	106	1543	388	740	757	53	10.7	1.94	0.39	7.28	7.59	0.65	79.45	54.66	0.64
12:22:46	674.86	104	1589	380	740	757	32	10.81	1.92	0.39	7.36	7.71	0.72	70.95	54.91	0.65
12:22:57	675.12	105	1551	385	740	757	32	10.76	1.93	0.4	7.21	7.64	0.78	80.09	55.15	0.65
12:23:06	675.37	105	1543	384	740	763	28	10.81	1.91	0.43	7.15	7.4	0.56	96.67	55.44	0.65
12:23:16	675.62	105	1532	385	740	757	32	10.78	1.93	0.4	7.18	7.42	0.63	89.85	55.66	0.66
12:23:27	675.87	103	1543	376	740	757	28	10.8	1.97	0.57	7.15	7.42	0.69	87.89	55.93	0.66
12:23:34	676.12	105	1597	384	738	763	28	10.96	2.05	0.68	7.01	7.85	0.74	114.91	56.19	0.66
12:23:50	676.37	105	1618	384	740	763	28	10.97	1.89	0.31	7.39	7.78	0.79	87.30	56.43	0.67
12:23:59	676.62	107	1634	388	739	763	28	10.89	2.04	0.61	7.07	7.59	1.03	104.05	56.66	0.67
12:24:08	676.87	103	1691	378	738	757	32	11.07	2.08	0.73	6.89	7.23	0.74	122.75	56.94	0.67
12:24:14	677.12	103	1768	377	740	757	28	11.01	2.13	0.84	6.85	7.37	0.86	118.58	57.19	0.67
12:24:21	677.37	103	1743	377	738	757	32	11.06	2.06	0.64	6.88	7.23	0.72	132.78	57.41	0.67
12:24:28	677.62	104	1754	380	739	763	28	11.06	2.13	0.87	6.86	7.3	0.69	117.67	57.67	0.68
12:24:35	677.87	101	1715	366	739	763	28	11.13	2.07	0.65	6.83	7.13	0.68	138.44	57.92	0.68
12:24:42	678.12	102	1714	373	740	757	32	11.12	2.01	0.66	6.84	7.16	0.73	135.05	58.18	0.68
12:24:48	678.37	105	1697	385	741	757	32	11.13	2.09	0.69	6.83	7.11	0.72	124.35	58.42	0.68
12:24:55	678.63	105	1680	382	741	757	32	11.09	2.14	0.71	6.87	7.18	0.69	134.17	58.67	0.68
12:25:03	678.88	103	1685	375	741	761	32	11.09	2.06	0.63	6.87	7.25	0.81	118.23	58.93	0.69
12:25:10	679.13	103	1677	376	741	761	36	11.08	2.13	0.74	6.87	7.23	0.74	133.89	59.18	0.69
12:25:17	679.38	104	1672	378	741	757	32	11.06	2.08	0.57	6.96	7.21	0.62	129.32	59.43	0.69
12:25:24	679.63	102	1669	372	741	757	36	11.07	2.09	0.67	6.88	7.13	0.62	121.35	59.67	0.69
12:25:31	679.88	104	1663	378	741	757	32	11.06	1.98	0.54	6.89	7.18	0.57	129.93	59.93	0.69
12:25:39	680.13	104	1669	379	741	757	32	11.05	2.09	0.65	6.90	7.21	0.67	121.15	60.2	0.7
12:25:46	680.38	104	1657	378	741	757	32	11.05	2	0.54	6.91	7.15	0.6	122.45	60.43	0.7
12:25:54	680.63	105	1640	383	741	757	32	11.01	2.11	0.65	6.85	7.23	0.57	119.59	60.68	0.7
12:26:02	680.86	105	1622	382	739	757	32	10.97	1.98	0.53	6.99	7.28	0.58	106.76	60.94	0.7
12:26:09	681.13	104	1619	378	738	757	36	10.97	2	0.62	6.99	7.25	0.57	121.64	61.18	0.7

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/22/88																
Starting Depth =	623.82			Bit Type =	Walker McDonald MPS3H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.05											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:26:18	681.38	106	3687	385	739	767	32	10.93	1.96	0.45	7.03	7.38	0.53	106.57	61.43	0.73
12:26:25	681.63	107	1656	386	740	767	32	10.91	1.95	0.4	7.04	7.38	0.5	113.82	61.69	0.71
12:26:34	681.88	103	1587	376	737	753	32	10.9	1.91	0.35	7.06	7.32	0.6	107.80	61.93	0.71
12:26:44	682.13	107	1575	388	736	753	32	10.89	1.91	0.39	7.06	7.32	0.53	88.39	62.18	0.71
12:26:52	682.38	105	1582	383	736	763	28	10.9	1.91	0.37	7.06	7.35	0.55	113.19	62.44	0.72
12:27:00	682.63	107	1571	389	737	753	28	10.89	1.94	0.4	7.07	7.32	0.57	101.13	62.69	0.72
12:27:09	682.88	106	1568	387	736	763	32	10.85	1.9	0.35	7.19	7.37	0.57	106.36	62.95	0.72
12:27:18	683.14	106	1578	386	736	761	32	10.82	1.94	0.46	7.18	7.71	0.84	99.56	63.18	0.72
12:27:28	683.39	107	1564	389	737	753	28	10.82	1.93	0.37	7.18	7.42	0.62	94.21	63.44	0.73
12:27:37	683.64	106	1553	385	736	753	32	10.77	1.89	0.33	7.19	7.47	0.57	93.64	63.69	0.73
12:34:00	684.07	105	1218	384	739	767	35	16.67	1.79	0.33	1.35	1.46	1.65	23.56	64.11	0.74
12:34:17	684.32	104	1335	390	738	767	49	15.09	1.81	0.17	3.74	4.75	3.78	92.55	64.35	0.74
12:34:30	684.57	104	1483	378	739	767	45	12.93	1.8	0.18	4.92	5.19	0.77	73.75	64.63	0.75
12:34:43	684.82	106	1482	386	739	767	36	12.88	1.81	0.19	4.97	5.18	0.63	65.65	64.86	0.75
12:34:53	685.07	105	1480	382	738	763	28	12.93	1.81	0.18	4.92	5.17	0.53	95.53	65.11	0.75
12:35:03	685.32	105	1508	382	738	757	32	13.03	1.82	0.19	4.81	5.17	0.69	92.18	65.37	0.76
12:35:12	685.57	105	1538	383	737	766	36	13.06	1.84	0.24	4.79	5.05	0.5	97.09	65.63	0.76
12:35:20	685.82	104	1574	378	737	753	28	13.06	1.81	0.22	4.79	5.07	0.6	105.74	65.86	0.76
12:35:30	686.07	104	1588	379	737	757	36	13.08	1.85	0.26	4.77	5.1	0.62	88.34	66.12	0.76
12:35:38	686.32	103	1569	376	736	753	28	13.06	1.84	0.24	4.79	5.03	0.53	101.15	66.39	0.76
12:35:47	686.57	106	1518	385	736	757	36	13.09	1.82	0.21	4.76	5.03	0.55	89.43	66.63	0.77
12:35:55	686.82	107	1505	389	738	757	32	13.07	1.81	0.19	4.77	5	0.48	100.70	66.87	0.77
12:36:07	687.07	106	1484	386	738	753	32	12.94	1.81	0.19	4.91	5.1	0.36	88.21	67.12	0.77
12:36:24	687.32	105	1489	384	738	753	28	12.74	1.82	0.21	5.11	5.86	1.1	52.07	67.33	0.78
12:36:33	687.57	105	1536	383	739	753	28	10.73	1.81	0.21	7.12	8.19	2.53	95.13	67.62	0.78
12:36:41	687.82	102	1613	373	738	757	35	9.25	1.83	0.22	8.61	9.26	1.41	112.53	67.88	0.78
12:36:48	688.07	104	1716	389	737	753	36	8.71	1.86	0.29	9.16	9.65	1.1	144.35	68.12	0.78
12:36:53	688.33	102	1718	373	738	753	32	8.67	1.83	0.27	8.89	9.17	0.53	164.63	68.37	0.79
12:36:59	688.58	105	1697	381	739	753	29	8.83	1.85	0.28	8.95	9.22	0.5	145.34	68.62	0.79
12:37:05	688.83	103	1704	381	739	757	36	8.91	1.84	0.28	8.86	9.22	0.63	164.54	68.89	0.79
12:37:10	689.08	102	1746	371	739	748	39	9.04	1.86	0.33	8.83	9.12	0.62	193.06	69.18	0.79
12:37:16	689.33	104	1815	390	735	748	28	8.99	1.88	0.33	8.88	9.17	0.55	164.80	69.38	0.79
12:37:21	689.58	102	1805	371	737	753	32	8.97	1.87	0.31	8.89	9.14	0.55	187.56	69.63	0.79
12:37:27	689.83	101	1805	369	738	753	32	8.93	1.88	0.34	8.94	9.19	0.6	151.44	69.89	0.79

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/98																
Starting Depth =	623.52			Bit Type =	Walker McDonald MPS6H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.03			Mud Type =		Water Based											
Average ROP =	99.68			Mud Weight (lbs/gal) =		9.55											
Drillstring (ft) =	660.88			Pipe (ft) =	251.81				Collar (ft)	408.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:37:32	690.68	104	1827	378	734	748	28	8.84	1.85	0.3	8.92	9.19	0.53	173.84	70.12	0.8
12:37:38	690.33	102	1911	374	718	761	195	8.9	1.86	0.47	8.86	9.31	0.74	144.69	70.32	0.8
12:37:44	690.58	101	1954	384	661	769	255	8.84	1.85	0.41	9.03	9.91	1.44	167.91	70.54	0.8
12:37:50	690.83	104	2016	407	588	716	203	8.89	1.82	0.42	8.87	9.65	3.47	154.27	70.80	0.8
12:38:25	691.25	104	1380	375	737	753	32	15.35	1.82	0.2	2.46	3.33	2.06	61.34	71.29	0.81
12:38:45	691.5	104	1450	379	736	753	32	14.5	1.83	0.23	3.34	4.19	1.24	85.19	71.55	0.81
12:38:55	691.75	106	1519	385	737	753	32	13.63	1.85	0.27	4.21	4.48	0.86	92.07	71.79	0.82
12:39:05	692	105	1513	384	737	753	32	13.56	1.83	0.23	4.27	4.52	0.55	97.96	72.04	0.82
12:39:13	692.25	105	1581	384	738	753	35	13.01	1.83	0.27	4.83	5.38	1.2	104.86	72.29	0.82
12:39:21	692.5	103	1630	375	737	757	41	12.55	1.84	0.29	5.36	5.6	0.74	117.65	72.54	0.82
12:39:28	692.75	104	1629	377	737	753	32	12.52	1.83	0.28	5.33	5.61	0.6	124.53	72.8	0.83
12:39:36	693	105	1627	381	735	748	32	12.54	1.82	0.29	5.31	5.6	0.6	120.53	73.05	0.83
12:39:43	693.25	104	1614	378	735	748	38	12.49	1.81	0.22	5.35	5.66	0.62	121.03	73.31	0.83
12:39:51	693.5	107	1621	388	737	757	36	12.31	1.83	0.26	5.57	6.03	0.91	115.84	73.58	0.83
12:39:58	693.75	101	1641	388	738	757	45	11.86	1.86	0.29	5.99	6.3	0.72	131.23	73.79	0.83
12:40:04	694	103	1781	376	740	761	36	11.76	1.86	0.3	6.08	6.53	0.91	138.59	74.05	0.84
12:40:12	694.25	103	1686	377	738	757	32	11.69	1.84	0.27	6.16	6.42	0.65	124.63	74.32	0.84
12:40:18	694.51	104	1663	379	736	753	32	11.65	1.82	0.24	6.26	6.51	0.82	134.73	74.57	0.84
12:40:26	694.76	103	1673	376	739	757	36	11.63	1.84	0.27	6.22	6.49	0.57	123.61	74.81	0.84
12:40:33	695.01	103	1682	379	739	757	32	11.64	1.84	0.3	6.28	6.46	0.6	129.37	75.06	0.84
12:40:40	695.26	105	1631	382	736	753	28	11.61	1.83	0.25	6.23	6.53	0.87	121.79	75.32	0.85
12:40:47	695.51	103	1648	382	736	753	32	11.58	1.83	0.24	6.29	7.11	1.13	120.13	75.57	0.85
12:40:53	695.76	104	1708	378	736	757	36	10.75	1.87	0.3	7.09	7.42	0.58	150.22	75.8	0.85
12:41:00	696.01	101	1756	369	736	757	32	10.73	1.9	0.34	7.08	7.37	0.69	142.35	76.08	0.85
12:41:06	696.26	104	1718	378	739	757	32	10.74	1.84	0.31	7.11	7.42	0.65	143.15	76.31	0.85
12:41:12	696.51	106	1719	386	739	753	28	10.74	1.85	0.27	7.11	7.44	0.67	148.76	76.56	0.85
12:41:19	696.76	103	1728	374	739	753	28	10.72	1.84	0.26	7.13	7.52	0.72	134.31	76.8	0.86
12:41:25	697.01	104	1715	381	737	757	36	10.71	1.86	0.32	7.14	7.52	0.73	141.18	77.05	0.86
12:41:32	697.26	103	1665	376	736	753	28	10.69	1.82	0.28	7.16	7.56	0.69	139.21	77.31	0.86
12:41:39	697.51	104	1668	381	736	753	28	10.65	1.84	0.26	7.20	7.54	0.65	134.79	77.57	0.86
12:41:46	697.76	104	1669	381	736	753	28	10.63	1.86	0.27	7.22	7.48	0.53	129.62	77.8	0.86
12:41:53	698.01	107	1679	388	738	753	28	10.65	1.84	0.28	7.20	7.44	0.55	128.91	78.05	0.87
12:42:00	698.26	105	1708	384	738	753	28	10.65	1.85	0.3	7.19	7.49	0.65	139.38	78.31	0.87
12:42:07	698.52	105	1678	381	738	757	32	10.62	1.85	0.28	7.24	7.58	0.62	124.14	78.57	0.87

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	823.92			Bit Type =	Walker McDonnald MP66H												
Ending Depth =	1331.19			Bit Size =	4.75												
Total Depth Drilled	497.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.65			Mud Type =		Water Based											
Average ROP =	96.58			Mud Weight (lbs/gal) =		8.90											
Drillstring (ft) =	680.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit	
12:42:13	698.77	104	1670	380	737	757	38	10.67	1.83	0.28	7.18	7.4	0.53	139.28	76.82	0.87	
12:42:20	699.02	104	1724	379	738	783	38	10.69	1.84	0.37	7.16	7.52	0.65	136.63	79.48	0.87	
12:42:27	699.27	107	1693	391	738	753	28	10.66	1.84	0.26	7.13	7.46	0.57	127.13	79.32	0.88	
12:42:34	699.52	105	1682	384	739	757	32	10.63	1.82	0.25	7.33	7.47	0.48	139.19	79.57	0.88	
12:42:41	699.77	104	1694	380	739	763	28	10.66	1.85	0.28	7.19	7.51	0.52	128.60	79.83	0.88	
12:42:47	700.02	105	1685	383	738	757	32	10.65	1.83	0.27	7.18	7.47	0.55	134.11	80.08	0.88	
12:42:54	700.27	104	1683	378	739	753	28	10.64	1.85	0.29	7.30	7.49	0.57	140.53	80.32	0.88	
12:43:01	700.52	105	1684	383	739	753	28	10.65	1.82	0.23	7.20	7.52	0.57	124.32	80.59	0.88	
12:43:08	700.77	107	1697	391	739	757	32	10.65	1.86	0.34	7.30	7.44	0.56	137.01	80.81	0.89	
12:43:15	701.02	105	1681	384	737	755	28	10.67	1.86	0.39	7.18	7.42	0.5	130.13	81.08	0.89	
12:43:22	701.27	104	1655	379	738	783	28	10.62	1.87	0.39	7.22	7.54	0.5	126.17	81.32	0.89	
12:43:28	701.52	104	1686	379	738	757	32	10.66	1.84	0.3	7.30	7.44	0.5	130.58	81.57	0.89	
12:43:35	701.77	105	1664	381	738	753	28	10.61	1.86	0.31	7.24	7.56	0.62	128.36	81.83	0.89	
12:43:43	702.03	106	1687	388	739	753	28	10.59	1.82	0.24	7.28	7.58	0.68	131.32	82.09	0.9	
12:43:50	702.28	105	1680	383	739	753	28	10.66	1.83	0.27	7.19	7.49	0.6	128.04	82.32	0.9	
12:43:57	702.53	105	1659	384	739	753	28	10.67	1.84	0.28	7.16	7.54	0.67	132.02	82.57	0.9	
12:44:03	702.78	106	1682	386	738	753	28	10.64	1.84	0.26	7.21	7.44	0.57	122.08	82.83	0.9	
12:44:11	703.03	106	1701	386	739	753	28	10.65	1.83	0.27	7.19	7.48	0.55	124.50	83.07	0.9	
12:44:17	703.28	106	1688	386	738	753	28	10.62	1.83	0.26	7.22	7.52	0.6	133.95	83.32	0.91	
12:44:25	703.53	104	1677	382	739	753	28	10.61	1.84	0.28	7.23	7.52	0.57	124.74	83.58	0.91	
12:44:32	703.78	107	1663	389	739	751	28	10.53	1.83	0.24	7.31	7.71	0.67	120.34	83.83	0.91	
12:44:39	704.03	106	1654	383	738	753	28	10.54	1.84	0.29	7.30	7.59	0.6	125.38	84.09	0.91	
12:44:47	704.28	106	1647	386	738	753	28	10.59	1.82	0.26	7.25	7.52	0.57	118.85	84.32	0.91	
12:44:54	704.53	105	1684	383	738	753	28	10.66	1.87	0.27	7.30	7.64	0.67	128.35	84.58	0.92	
12:45:01	704.79	105	1657	382	738	753	28	10.58	1.84	0.29	7.26	7.54	0.57	123.93	84.85	0.92	
12:45:08	705.04	108	1673	392	738	757	32	10.62	1.85	0.28	7.22	7.52	0.65	126.90	85.11	0.92	
12:45:15	705.29	104	1679	378	738	753	28	10.61	1.84	0.27	7.23	7.46	0.5	134.47	85.32	0.92	
12:45:23	705.54	104	1677	380	739	753	28	10.61	1.85	0.28	7.23	7.54	0.5	121.07	85.58	0.92	
12:45:30	705.79	105	1665	383	738	753	28	10.56	1.85	0.29	7.28	7.56	0.57	127.15	85.83	0.93	
12:45:38	706.04	109	1642	387	738	753	28	10.6	1.85	0.26	7.35	7.64	0.6	114.23	86.09	0.93	
12:45:45	706.29	102	1654	373	738	759	28	10.58	1.84	0.26	7.28	7.64	0.69	120.67	86.35	0.93	
12:45:52	706.54	104	1673	380	738	757	32	10.62	1.86	0.29	7.23	7.54	0.69	133.33	86.6	0.93	
12:46:00	706.79	105	1660	381	739	757	32	10.55	1.85	0.31	7.29	7.62	0.74	112.53	86.83	0.93	
12:46:07	707.04	105	1647	383	738	753	28	10.6	1.86	0.29	7.23	7.51	0.62	135.61	87.11	0.94	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 3/22/95			Bit Type =	Walker McDonald MF68R												
Starting Depth =	603.92			Bit Size =	8.75												
Ending Depth =	1001.19			Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled	407.27			Mud Type =		Water Based											
Hours On Bit =	4.09			Mud Weight (lbs/gal) =		9.00											
Average ROP =	99.58			Pipe (ft) =	251.81				Collar (ft)	408.60							
Drillstring (ft) =	660.49																
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:46:13	707.29	105	1677	381	727	763	32	9.93	1.84	0.3	7.91	8.4	1.34	125.77	87.34	0.84
12:46:25	707.54	105	1707	386	737	746	38	9.85	1.86	0.28	8.06	8.4	0.74	140.08	87.59	0.84
12:46:27	707.79	104	1702	379	736	763	28	9.81	1.68	0.31	8.04	8.35	0.67	134.14	87.85	0.84
12:46:34	708.09	105	1707	384	738	763	26	9.81	1.67	0.31	8.64	8.35	0.67	129.61	88.1	0.84
12:46:46	708.3	104	1723	380	736	763	28	9.85	1.68	0.31	7.69	8.26	0.57	148.59	88.34	0.85
12:46:47	708.55	105	1723	385	738	763	28	9.81	1.68	0.35	8.63	8.4	0.74	137.15	88.59	0.85
12:46:53	708.8	105	1713	386	739	763	38	9.81	1.66	0.3	8.63	8.31	0.65	134.54	88.85	0.85
12:47:00	709.05	105	1709	382	739	763	28	9.76	1.66	0.31	8.06	8.43	0.72	139.23	89.12	0.85
12:47:07	709.3	105	1699	387	739	763	28	9.71	1.65	0.29	8.14	8.52	0.72	122.87	89.34	0.85
12:47:14	709.55	105	1702	381	738	763	28	9.74	1.66	0.31	8.16	8.43	0.8	134.08	89.61	0.85
12:47:21	709.8	105	1704	382	737	763	28	9.75	1.63	0.27	8.09	8.35	0.6	128.79	89.85	0.86
12:47:28	710.05	106	1689	383	737	763	26	9.75	1.64	0.28	8.09	8.35	0.6	129.14	90.11	0.86
12:47:35	710.3	106	1684	378	736	763	28	9.7	1.64	0.28	8.14	8.43	0.65	127.78	90.34	0.86
12:47:42	710.55	105	1687	382	736	748	28	9.75	1.65	0.29	8.09	8.35	0.57	124.56	90.6	0.86
12:47:49	710.8	103	1694	377	737	763	33	9.74	1.67	0.3	8.11	8.4	0.53	134.47	90.85	0.86
12:47:56	711.05	105	1682	381	736	763	28	9.74	1.67	0.31	8.16	8.39	0.6	129.96	91.11	0.87
12:48:03	711.3	103	1678	377	736	763	28	9.68	1.65	0.28	8.15	8.45	0.6	122.27	91.36	0.87
12:48:10	711.55	106	1676	386	736	763	28	9.68	1.63	0.27	8.16	8.47	0.62	125.91	91.61	0.87
12:48:18	711.81	105	1683	382	736	763	28	9.72	1.67	0.31	8.12	8.4	0.69	116.58	91.85	0.87
12:48:24	712.06	105	1669	382	738	763	28	9.73	1.65	0.27	8.12	8.39	0.57	136.86	92.13	0.87
12:48:32	712.31	104	1663	379	735	748	28	9.68	1.63	0.25	8.16	8.35	0.57	122.18	92.38	0.88
12:48:40	712.56	105	1649	384	736	763	32	9.62	1.65	0.3	8.23	8.5	0.5	112.96	92.65	0.88
12:48:47	712.81	105	1647	382	738	763	28	9.65	1.64	0.25	8.19	8.5	0.65	124.67	92.85	0.88
12:48:55	713.06	105	1656	384	738	767	36	9.65	1.64	0.26	8.16	8.45	0.53	114.51	93.11	0.88
12:49:02	713.31	105	1666	387	738	761	36	9.68	1.65	0.28	8.20	8.4	0.48	120.57	93.38	0.88
12:49:10	713.56	103	1678	376	736	763	28	9.67	1.64	0.25	8.17	8.43	0.53	126.09	93.6	0.89
12:49:17	713.81	105	1661	386	736	763	32	9.67	1.64	0.26	8.15	8.43	0.6	119.06	93.86	0.89
12:49:24	714.06	104	1661	377	736	748	24	9.69	1.64	0.24	8.15	8.43	0.62	131.04	94.13	0.89
12:49:32	714.31	104	1674	378	736	763	28	9.66	1.64	0.26	8.17	8.43	0.55	115.23	94.38	0.89
12:49:39	714.56	105	1669	381	736	763	28	9.66	1.63	0.24	8.18	8.45	0.53	135.84	94.6	1
12:49:47	714.81	106	1684	385	738	763	28	9.68	1.66	0.28	8.15	8.47	0.67	118.48	94.88	1
12:49:54	715.06	106	1678	384	738	763	28	9.69	1.66	0.28	8.15	8.43	0.55	122.66	95.11	1
12:50:01	715.31	106	1678	385	738	763	28	9.71	1.65	0.27	8.13	8.4	0.6	129.64	95.35	1
12:50:52	718.31	84	-6	206	744	765	61	17.66	2.07	0.67	8.04	3.26	6.68	42.53	98.48	1.01

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/22/96								
Starting Depth =	633.52		Bit Type =	Walker McDonnald MP6SH					
Ending Depth =	1031.19		Bit Size =	4.75					
Total Depth Drilled	497.27		Bit Nozzles =		9, 9, 10, 12				
Hours On Bit =	4.09		Mud Type =		Water Based				
Average ROP =	99.58		Mud Weight (lbs/gal) =		9.00				
Drillstring (ft) =	960.49		Pipe (ft) =	251.81		Collar (ft)	408.80		

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
12:57:26	715.47	107	1736	369	742	757	41	18.91	1.91	0.2	1.84	3.4	3.63	100.74	95.53	1.01
12:57:35	715.78	103	1697	375	745	761	77	12.84	1.83	0.24	5.49	8.28	5.03	99.71	95.78	1.01
12:57:43	715.98	102	1612	373	742	757	28	9.06	1.86	0.25	8.87	9.46	1.41	125.34	96.05	1.02
12:57:48	716.23	103	1658	375	741	753	24	8.43	1.86	0.27	9.52	9.79	0.62	141.96	96.3	1.02
12:57:55	716.48	103	1728	375	741	757	32	8.4	1.83	0.25	9.59	9.77	0.45	137.16	96.54	1.02
12:58:01	716.73	103	1791	375	741	757	32	8.4	1.85	0.31	9.54	9.79	0.57	138.50	96.8	1.02
12:58:07	716.98	103	1778	375	741	757	32	8.46	1.9	0.37	9.48	9.79	0.67	160.53	97.06	1.02
12:58:13	717.23	104	1807	378	742	757	32	8.48	1.87	0.31	9.47	9.74	0.6	141.60	97.25	1.02
12:58:20	717.48	104	1790	378	740	753	28	8.45	1.88	0.29	9.56	9.81	0.56	149.09	97.53	1.03
12:58:25	717.73	103	1780	375	741	757	32	8.46	1.85	0.31	9.49	9.74	0.48	154.93	97.8	1.03
12:58:33	717.98	104	1786	380	741	757	32	8.43	1.84	0.28	9.52	9.74	0.43	136.80	98.05	1.03
12:58:38	718.23	105	1760	386	741	757	28	8.39	1.85	0.28	9.56	9.79	0.45	141.01	98.29	1.03
12:58:45	718.48	105	1754	383	741	757	28	8.38	1.85	0.26	9.60	9.85	0.5	133.22	98.53	1.03
12:58:52	718.73	103	1747	376	741	757	17	8.36	1.86	0.28	9.59	9.85	0.5	128.57	98.78	1.04
12:58:58	718.99	104	1746	379	742	757	28	8.34	1.85	0.26	9.61	9.85	0.48	135.82	99.04	1.04
12:59:06	719.24	103	1764	377	741	757	32	8.35	1.83	0.26	9.60	9.84	0.48	124.66	99.29	1.04
12:59:12	719.49	104	1779	378	742	757	28	8.33	1.84	0.26	9.61	9.81	0.43	146.67	99.54	1.04
12:59:19	719.74	101	1765	370	742	757	28	8.33	1.85	0.26	9.62	9.69	0.5	133.57	99.78	1.04
12:59:25	719.99	104	1751	378	742	757	32	8.33	1.85	0.26	9.63	9.86	0.48	128.43	100.03	1.04
12:59:33	720.24	105	1756	382	742	757	28	8.37	1.85	0.29	9.59	9.79	0.5	142.04	100.28	1.05
12:59:39	720.49	106	1763	385	743	757	28	8.33	1.85	0.29	9.61	9.89	0.45	136.25	100.53	1.05
12:59:46	720.74	103	1753	374	742	757	28	8.33	1.86	0.26	9.62	9.86	0.56	137.39	100.8	1.05
12:59:53	720.99	105	1741	383	741	757	32	8.31	1.85	0.26	9.65	9.89	0.5	136.44	101.04	1.05
13:00:00	721.24	103	1729	377	743	757	28	8.3	1.87	0.31	9.65	9.89	0.43	137.46	101.29	1.05
13:00:07	721.5	105	1721	382	743	757	28	8.31	1.84	0.25	9.64	9.86	0.5	134.28	101.54	1.06
13:00:14	721.75	103	1730	375	743	757	28	8.33	1.83	0.26	9.63	9.89	0.48	124.41	101.79	1.06
13:00:21	722	103	1717	375	742	757	28	8.31	1.86	0.3	9.63	9.86	0.45	133.27	102.04	1.06
13:00:28	722.25	104	1719	378	743	757	28	8.31	1.83	0.25	9.64	9.91	0.5	129.99	102.29	1.06
13:00:35	722.5	104	1728	378	741	757	32	8.33	1.87	0.31	9.62	9.89	0.53	130.25	102.55	1.06
13:00:42	722.75	103	1721	375	742	757	28	8.32	1.84	0.29	9.62	9.89	0.5	135.98	102.82	1.07
13:00:48	723	104	1722	378	742	757	28	8.33	1.84	0.29	9.61	9.93	0.57	125.86	103.06	1.07
13:00:55	723.25	101	1726	370	743	757	28	8.35	1.89	0.32	9.60	9.84	0.48	141.46	103.3	1.07
13:01:02	723.5	105	1715	382	742	757	28	8.34	1.9	0.34	9.58	9.81	0.55	125.87	103.55	1.07
13:01:09	723.75	105	1724	381	741	757	28	8.36	1.82	0.23	9.58	9.81	0.48	131.65	103.8	1.07

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 9/22/95				
Starting Depth =	623.92	Bit Type =	Walker McDonald MP58H		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 13		
Hours On Bit =	4.08	Mud Type =	Water Based		
Average ROP =	99.56	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	660.48	Pipe (ft) =	251.81	Collar (ft) =	408.69

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
13:01:16	720	104	1721	378	740	753	28	8.34	1.85	0.28	9.81	9.86	0.48	126.18	104.04	1.08
13:01:23	724.25	106	1730	385	740	757	32	8.35	1.83	0.25	9.60	9.84	0.5	124.88	104.31	1.08
13:01:29	724.5	105	1749	380	741	753	24	8.39	1.83	0.25	9.56	9.84	0.5	144.07	104.55	1.08
13:01:36	724.75	104	1749	380	742	757	28	8.36	1.85	0.28	9.59	9.81	0.48	131.60	104.8	1.08
13:01:43	725	103	1746	375	742	757	28	8.37	1.85	0.28	9.58	9.86	0.48	133.63	105.06	1.08
13:01:49	725.25	103	1751	375	742	757	28	8.36	1.85	0.31	9.58	9.81	0.48	139.82	105.32	1.08
13:01:57	725.5	106	1743	385	741	757	28	8.35	1.84	0.28	9.59	9.84	0.53	122.45	105.56	1.08
13:02:04	725.75	103	1739	378	741	767	28	8.33	1.85	0.27	9.61	9.86	0.5	133.63	105.81	1.08
13:02:11	726	106	1741	387	742	757	28	8.35	1.84	0.27	9.66	9.84	0.48	127.68	106.04	1.08
13:02:17	726.26	106	1763	384	742	757	28	8.38	1.85	0.31	9.57	9.85	0.65	115.46	106.32	1.09
13:02:24	726.51	103	1768	377	742	753	24	8.35	1.85	0.33	9.59	9.91	0.57	134.63	106.57	1.09
13:02:31	726.76	103	1784	377	741	753	24	8.38	1.87	0.33	9.55	9.93	0.59	137.68	106.83	1.1
13:02:37	727.01	103	1759	375	742	757	33	8.39	1.88	0.33	9.55	9.84	0.62	144.18	107.08	1.1
13:02:44	727.26	103	1771	378	742	757	28	8.41	1.87	0.31	9.53	9.88	0.65	138.31	107.3	1.1
13:02:50	727.51	106	1769	384	743	757	28	8.39	1.86	0.31	9.56	9.84	0.6	137.35	107.57	1.1
13:02:57	727.76	105	1747	382	743	757	24	8.35	1.88	0.32	9.59	9.91	0.57	137.27	107.81	1.1
13:03:04	728.01	104	1769	378	742	757	28	8.4	1.86	0.33	9.54	9.91	0.72	131.78	108.07	1.11
13:03:10	728.26	106	1757	385	741	757	28	8.39	1.88	0.33	9.55	9.86	0.6	142.77	108.3	1.11
13:03:17	728.51	106	1738	384	743	757	28	8.35	1.85	0.35	9.59	9.85	0.69	131.86	108.55	1.11
13:03:24	728.76	104	1738	380	743	757	28	8.36	1.87	0.31	9.58	9.84	0.57	132.47	108.81	1.11
13:03:30	729.01	105	1742	383	743	757	28	8.36	1.9	0.38	9.58	9.91	0.65	140.57	109.05	1.11
13:03:37	729.26	103	1787	377	743	757	24	8.44	1.89	0.33	9.49	9.77	0.5	135.08	109.31	1.11
13:03:43	729.51	106	1777	388	741	753	24	8.4	1.91	0.39	9.54	9.91	0.65	142.74	109.56	1.12
13:03:50	729.76	104	1751	380	742	757	28	8.31	1.91	0.39	9.63	9.98	0.72	129.63	109.81	1.12
13:03:57	730.01	105	1747	382	742	757	28	8.31	1.88	0.37	9.63	9.91	0.57	128.13	110.07	1.12
13:04:04	730.26	106	1756	386	742	757	28	8.33	1.91	0.39	9.62	9.96	0.62	134.21	110.32	1.12
13:04:11	730.52	106	1796	386	741	757	28	8.4	1.9	0.35	9.54	9.81	0.57	130.25	110.58	1.13
13:04:17	730.77	104	1787	386	741	757	28	8.36	1.88	0.33	9.58	9.86	0.6	139.12	110.84	1.13
13:04:24	731.02	107	1756	389	742	757	28	8.39	1.86	0.3	9.54	9.79	0.48	134.34	111.08	1.13
13:04:31	731.27	104	1721	377	743	757	24	8.31	1.86	0.29	9.63	9.91	0.53	129.71	111.33	1.13
13:04:38	731.52	104	1728	378	744	757	24	8.26	1.85	0.28	9.63	9.96	0.57	125.02	111.58	1.13
13:04:45	731.77	105	1743	383	743	757	28	8.32	1.85	0.28	9.62	9.89	0.6	121.80	111.83	1.13
13:04:53	732.02	104	1717	379	743	757	24	8.3	1.83	0.26	9.63	9.86	0.48	128.13	112.07	1.14
13:05:00	732.27	105	1735	384	743	757	24	8.35	1.85	0.28	9.59	9.84	0.53	131.05	112.31	1.14

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96				
Starting Depth =	629.82	Bit Type =	Walker McDonnald MP65H		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	401.37	Bit Nozzles =	9, 9, 12, 12		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	98.58	Mud Weight (lbs/gal) =	9.06		
Drillstring (ft) =	660.49	Pipe (ft) =	351.81	Collar (ft)	408.68

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
13:05:07	732.53	105	1725	383	743	757	28	8.35	1.85	0.28	9.58	9.91	0.62	132.39	112.86	1.14
13:05:13	732.77	106	1735	384	744	757	28	8.36	1.83	0.24	9.58	9.85	0.6	137.64	112.82	1.14
13:05:20	733.02	105	1746	381	744	757	24	8.37	1.84	0.27	9.57	9.84	0.53	123.46	113.07	1.14
13:05:27	733.27	104	1721	379	744	761	28	8.34	1.85	0.29	9.60	9.84	0.5	132.89	113.31	1.15
13:05:34	733.52	106	1724	385	744	761	36	8.34	1.83	0.24	9.59	9.91	0.57	133.82	113.58	1.15
13:05:41	733.77	105	1721	383	744	757	24	8.33	1.85	0.25	9.61	9.86	0.5	124.15	113.82	1.15
13:05:48	734.02	106	1686	387	744	757	24	8.28	1.82	0.23	9.64	9.91	0.46	126.92	114.08	1.16
13:05:55	734.28	105	1676	383	743	757	28	8.28	1.85	0.25	9.66	9.96	0.53	116.26	114.33	1.16
13:06:03	734.53	106	1679	392	743	757	24	8.3	1.82	0.23	9.64	9.86	0.5	130.03	114.58	1.16
13:06:10	734.78	104	1639	379	744	757	28	8.24	1.85	0.21	9.69	10.03	0.55	124.23	114.82	1.16
13:06:17	735.03	103	1742	377	742	757	28	8.35	1.83	0.26	9.58	9.84	0.5	124.15	115.08	1.16
13:06:24	735.28	104	1631	381	742	757	24	8.38	1.81	0.21	9.56	9.84	0.6	140.66	115.35	1.16
13:06:31	735.53	105	1629	383	741	753	24	8.36	1.81	0.21	9.58	9.91	0.6	123.01	115.59	1.16
13:06:37	735.78	106	1628	393	743	757	24	8.36	1.83	0.21	9.55	9.86	0.57	138.23	115.84	1.16
13:06:44	736.03	106	1632	387	744	757	28	8.36	1.84	0.23	9.57	9.84	0.6	134.57	116.08	1.17
13:06:51	736.28	105	1614	387	744	757	24	8.28	1.83	0.21	9.65	9.96	0.62	122.70	116.33	1.17
13:06:58	736.53	105	1615	381	744	757	24	8.27	1.81	0.19	9.65	9.96	0.57	128.00	116.57	1.17
13:07:04	736.78	104	1666	380	744	757	28	8.75	1.84	0.35	9.14	9.77	1.01	170.59	116.83	1.17
13:07:10	737.03	105	1653	382	744	757	24	8.54	1.87	0.3	9.39	9.74	0.67	154.72	117.1	1.17
13:07:16	737.28	106	1649	387	744	757	28	8.46	1.85	0.26	9.48	9.74	0.6	145.83	117.33	1.18
13:07:22	737.53	106	1613	391	743	757	24	8.41	1.85	0.26	9.52	9.84	0.6	135.51	117.58	1.18
13:07:28	737.79	107	1661	388	743	757	28	8.45	1.82	0.22	9.48	9.72	0.55	152.96	117.83	1.18
13:07:35	738.04	107	1613	390	744	757	24	8.43	1.84	0.22	9.51	9.81	0.79	131.35	118.1	1.18
13:07:42	738.29	106	1646	385	743	757	28	8.41	1.84	0.25	9.52	9.91	0.62	134.59	118.34	1.19
13:07:49	738.54	105	1589	386	743	757	28	8.38	1.85	0.27	9.55	9.91	0.65	137.35	118.59	1.19
13:07:57	738.79	105	1638	385	744	757	28	8.15	1.84	0.25	9.77	10.2	0.93	107.08	118.84	1.19
13:08:04	739.04	105	1668	384	744	761	28	8.03	1.84	0.26	9.91	10.36	1.05	99.98	119.1	1.19
13:08:10	739.28	105	1692	382	744	757	28	8.1	1.83	0.27	9.83	10.2	0.89	98.68	119.34	1.19
13:08:23	739.54	107	1649	389	742	757	24	8.16	1.85	0.28	9.77	10.08	0.67	119.47	119.61	1.19
13:08:30	739.79	104	1632	379	744	757	24	8.25	1.85	0.27	9.68	10.05	0.86	126.41	119.85	1.2
13:08:38	740.04	103	1667	375	744	757	24	8.19	1.85	0.25	9.74	10.05	0.77	112.77	120.09	1.2
13:08:45	740.29	106	1667	385	744	757	24	8.32	1.86	0.3	9.61	9.93	0.86	138.71	120.34	1.2
13:08:52	740.54	101	1678	368	744	757	24	8.43	1.88	0.35	9.5	9.84	0.72	153.24	120.62	1.2
13:08:59	740.8	102	1687	372	743	757	28	8.49	1.88	0.29	9.44	9.84	0.79	151.77	120.85	1.2

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 9/22/98				
Starting Depth =	623.82	Bit Type =	Walker McDonald MP63K		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 12		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	99.58	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	580.48	Pipe (ft) =	251.81	Collar (ft)	466.60

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
13:09:04	741.05	107	1839	388	743	757	28	8.47	1.81	0.18	9.45	9.84	0.77	151.33	121.1	1.21
13:09:10	741.3	106	1789	384	743	757	24	8.53	1.83	0.19	9.46	9.77	0.69	149.76	121.35	1.21
13:09:15	741.55	108	1793	386	744	757	24	8.56	1.81	0.15	9.37	9.72	0.65	153.72	121.6	1.21
13:09:21	741.8	107	1885	388	744	757	24	8.86	1.8	0.14	9.38	9.74	0.81	147.51	121.85	1.21
13:09:26	742.05	105	1693	381	744	757	28	8.33	1.8	0.15	9.60	10.08	0.93	136.98	122.12	1.21
13:09:39	742.3	107	1653	386	743	757	28	7.93	1.79	0.12	10.01	10.25	0.72	82.97	122.34	1.22
13:09:48	742.55	106	1690	387	743	757	28	8.12	1.81	0.17	9.81	10.29	1.01	100.74	122.62	1.22
13:09:54	742.8	104	1728	377	742	757	28	8.46	1.8	0.16	9.45	9.84	0.77	151.14	122.85	1.22
13:10:01	743.05	107	1689	388	744	757	24	8.39	1.81	0.15	9.54	9.89	0.65	128.58	123.11	1.22
13:10:07	743.3	107	1673	388	744	757	24	8.47	1.81	0.15	9.46	9.78	0.81	148.79	123.34	1.22
13:10:13	743.55	104	1788	378	744	757	24	8.4	1.81	0.16	9.53	9.98	0.84	136.69	123.63	1.22
13:10:20	743.8	102	1840	372	744	757	24	8.61	1.82	0.19	9.42	9.77	0.69	149.63	123.87	1.23
13:10:26	744.05	103	1820	378	743	757	28	8.65	1.81	0.18	9.28	9.67	0.74	175.78	124.13	1.23
13:10:33	744.3	106	1762	386	743	757	24	8.26	1.8	0.13	9.54	10.17	1.24	114.74	124.34	1.23
13:10:42	744.55	104	1695	376	743	757	24	8.08	1.8	0.14	9.85	10.32	0.93	103.25	124.6	1.23
13:10:49	744.8	104	1704	378	744	757	28	8.16	1.79	0.12	9.76	10.1	0.69	114.05	124.85	1.23
13:10:55	745.05	106	1736	387	743	757	24	8.52	1.8	0.14	9.41	9.84	0.81	138.46	125.09	1.24
13:11:02	745.3	104	1759	380	743	757	24	8.52	1.81	0.17	9.49	9.77	0.79	154.34	125.35	1.24
13:11:08	745.55	106	1696	388	743	757	28	8.49	1.79	0.13	9.45	9.74	0.69	149.32	125.6	1.24
13:11:14	745.81	103	1679	375	743	757	24	8.54	1.8	0.14	9.39	9.74	0.74	157.69	125.86	1.24
13:11:20	746.06	105	1858	384	743	757	24	8.5	1.79	0.12	9.42	9.77	0.67	149.29	126.11	1.24
13:11:27	746.31	105	1691	381	743	758	24	8.42	1.8	0.14	9.51	9.91	0.78	132.03	126.35	1.25
13:11:33	746.56	106	1656	386	742	753	24	8.44	1.8	0.13	9.48	9.79	0.65	145.14	126.6	1.25
13:19:24	747.08	69	808	257	743	781	49	13.98	1.87	0.31	4.35	10.17	9.07	39.94	127.13	1.26
13:19:35	747.33	64	1144	240	744	757	24	6.49	2.06	0.64	11.84	15.88	3.9	86.92	127.38	1.26
13:19:43	747.58	63	1144	238	744	757	24	5.67	1.85	0.44	12.57	14.05	2.42	110.63	127.64	1.26
13:19:50	747.83	60	1218	225	745	781	28	5.89	1.97	0.49	11.74	12.89	0.8	132.18	127.86	1.26
13:19:56	748.08	62	1267	233	749	758	49	6.84	4.05	4.03	11.49	12.83	5.74	108.93	128.13	1.27
13:20:21	748.33	68	775	252	743	765	69	16.5	2.09	0.64	1.78	7.35	6.82	36.48	128.37	1.27
13:20:32	748.58	65	970	241	745	761	28	8.64	1.64	0.22	8.67	11.13	6.15	82.89	128.64	1.27
13:21:05	748.83	55	1632	206	744	757	28	8.6	1.58	0.49	11.72	14	10.58	31.48	128.88	1.28
13:21:14	749.08	67	807	251	743	757	28	12.42	1.98	0.33	5.85	7.97	3.76	87.80	129.12	1.28
13:21:23	749.33	64	1105	241	742	753	24	8.2	1.83	0.32	10.11	11.93	4.07	92.77	129.37	1.29
13:21:33	749.58	60	1287	224	742	757	28	9.59	1.87	0.3	12.74	13.5	1.75	90.00	129.62	1.29

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/89				
Starting Depth =	623.92	Bit Type =	Walker McDonald MP58H		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	8, 8, 12, 13		
Hours On Bit =	4.06	Mud Type =	Water Based		
Average ROP =	99.58	Mud Weight (lbs/gal) =	8.60		
Drillstring (ft) =	660.89	Pipe (ft) =	251.81	Collar (ft)	409.80

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
13:21:44	749.83	58	1399	218	743	757	28	5.27	1.88	0.35	13.08	14.31	1.89	81.66	129.89	1.29
13:21:53	750.08	62	1288	232	741	757	28	5.28	1.9	0.32	12.98	13.92	0.77	103.69	130.13	1.3
13:22:03	750.34	60	1292	234	743	757	28	5.76	1.92	0.37	12.97	13	0.69	91.39	130.38	1.3
13:22:13	750.59	59	1252	220	743	757	28	5.81	1.92	0.39	13.03	12.81	0.55	108.19	130.66	1.3
13:22:22	750.84	62	1239	231	743	757	28	5.71	1.94	0.37	12.62	12.93	0.62	90.39	130.89	1.3
13:22:31	751.09	58	1296	217	743	757	28	5.74	1.89	0.31	12.59	12.85	0.65	96.43	131.13	1.31
13:22:41	751.34	62	1177	236	743	757	28	5.62	1.87	0.27	12.71	12.97	0.53	88.15	131.38	1.31
13:22:85	751.59	63	1181	236	743	757	28	5.63	1.89	0.29	12.86	13.07	0.53	88.38	131.64	1.31
13:23:07	751.84	63	1186	237	743	761	26	5.51	1.87	0.25	12.82	13.14	0.65	70.49	131.89	1.32
13:23:25	752.09	61	1235	228	743	757	28	5.43	1.92	0.37	12.85	13.38	0.88	50.35	132.12	1.32
13:23:38	752.34	63	1212	234	741	753	26	5.59	1.86	0.31	12.78	13.12	0.65	72.79	132.4	1.33
13:23:51	752.59	63	1168	237	742	757	28	5.64	1.88	0.3	12.78	13.09	0.62	70.42	132.66	1.33
13:24:06	752.84	63	1185	238	743	757	28	5.44	1.88	0.26	12.88	13.24	0.73	59.63	132.89	1.33
13:24:26	753.09	61	1156	234	743	757	28	5.33	1.89	0.27	12.99	13.36	0.85	45.29	133.13	1.34
13:24:42	753.34	63	1217	237	743	757	28	5.47	1.9	0.3	12.93	13.17	0.6	56.91	133.38	1.34
13:24:56	753.59	60	1278	225	742	757	24	5.46	1.91	0.31	12.97	13.31	0.77	52.98	133.64	1.35
13:25:11	753.84	60	1264	229	743	757	28	5.48	1.91	0.31	12.95	13.45	0.98	50.63	133.89	1.35
13:25:28	754.09	62	1292	233	742	757	28	5.45	1.9	0.33	13.05	13.4	0.56	65.67	134.15	1.35
13:25:55	754.36	59	1382	220	743	761	41	8.24	2.12	0.65	10.07	13.69	3.36	20.44	134.32	1.35
13:26:23	754.41	64	1051	235	744	757	28	11.39	1.92	0.41	6.96	13.29	14.37	18.35	134.46	1.37
13:26:53	754.66	64	1141	238	743	757	28	6.52	1.92	0.32	11.78	12.76	5.39	31.96	134.72	1.38
13:27:14	754.91	64	1111	240	743	757	28	5.97	1.9	0.3	12.35	12.71	0.62	43.51	134.96	1.38
13:27:44	755.15	66	1044	246	740	757	32	5.9	1.85	0.24	12.42	12.73	0.57	27.56	135.18	1.38
13:28:14	755.37	66	1018	246	741	757	28	5.85	1.84	0.23	12.46	12.78	0.65	28.58	135.41	1.4
13:28:35	755.62	65	1070	242	739	753	24	5.95	1.84	0.24	12.37	12.69	0.6	41.09	135.67	1.41
13:28:58	755.87	65	1093	243	740	753	28	5.97	1.83	0.19	12.34	12.56	0.67	39.08	135.92	1.41
13:29:21	756.12	65	1082	241	740	757	32	5.7	1.83	0.21	12.61	13.45	1.29	40.08	136.16	1.42
13:29:48	756.37	61	1250	228	741	757	32	6.86	1.94	0.35	11.36	13.91	6.97	33.97	136.41	1.43
13:30:15	756.62	63	1149	235	743	757	28	5.94	1.9	0.3	12.35	12.78	0.81	32.90	136.67	1.43
13:30:46	756.8	62	1270	232	740	757	32	6.17	1.87	0.34	12.14	13.09	3.9	21.01	136.85	1.44
13:31:16	756.85	66	908	244	741	769	85	16.23	2.11	0.67	2.03	9.45	10.27	6.34	136.9	1.45
13:31:46	757.06	66	944	245	741	757	32	9.34	1.85	0.32	8.95	10.7	5.46	24.78	137.1	1.46
13:32:07	757.31	62	1086	232	742	757	32	7.88	1.88	0.27	10.42	10.8	0.67	43.86	137.36	1.46
13:32:37	757.49	65	999	243	742	757	32	7.72	1.85	0.33	10.67	10.98	0.84	21.91	137.54	1.47

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96				
Starting Depth =	628.92	Bit Type =	Walker McDonald MP6SH		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	402.27	Bit Nozzles =	9, 9, 13, 12		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	98.58	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	660.45	Pipe (ft) =	251.81	Collar (ft)	408.60

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
13:33:07	787.64	65	932	244	741	757	32	7.71	1.88	0.23	10.58	10.92	0.8	17.65	137.59	1.48
13:33:37	787.64	60	1162	237	742	761	32	9.45	3.03	0.64	8.88	11.08	11.64	0.26	137.9	1.49
13:33:51	787.69	68	716	255	743	757	29	16.19	1.8	0.15	2.07	5.33	7.01	63.43	137.94	1.49
13:34:21	788.09	66	905	246	743	757	28	9.22	1.83	0.22	8.08	10.65	4.62	24.16	138.14	1.5
13:34:51	788.32	63	1063	235	744	757	28	9.1	1.86	0.26	8.18	10.6	2.91	27.09	138.36	1.51
13:35:19	788.57	64	1153	238	744	761	28	10.14	1.87	0.32	8.14	8.52	1.34	32.06	138.62	1.52
13:35:36	788.82	67	1220	246	743	757	28	10.18	1.85	0.34	8.10	8.4	0.66	54.48	138.86	1.52
13:35:50	789.07	65	1219	241	743	757	28	10.24	1.91	0.35	8.04	8.35	0.6	60.83	139.12	1.52
13:36:06	789.32	65	1231	246	741	757	41	10	1.86	0.28	8.39	9.55	1.75	58.07	139.37	1.53
13:36:21	789.57	63	1394	227	736	753	26	8.15	1.93	0.34	10.13	10.77	1.51	60.26	139.62	1.53
13:36:51	789.71	65	1260	244	741	821	97	12.8	1.93	0.58	5.48	11.01	10.84	17.72	139.76	1.54
13:37:17	790.97	69	989	257	743	761	36	12.68	1.84	0.2	5.67	8.27	2.27	39.62	140.01	1.55
13:37:46	790.22	67	1123	250	740	757	32	10.84	1.87	0.29	7.44	8.31	2.37	40.47	140.26	1.55
13:37:53	790.47	66	1242	245	740	757	28	10.33	1.87	0.27	7.95	8.25	0.5	67.61	140.52	1.56
13:38:07	790.72	67	1216	248	740	757	32	10.34	1.83	0.23	7.94	8.19	0.5	64.28	140.75	1.56
13:38:26	790.97	68	1151	252	739	757	32	10.22	1.83	0.21	8.06	8.35	0.65	47.35	141.01	1.57
13:38:40	791.22	67	1188	251	739	757	32	10.27	1.82	0.13	8.01	8.26	0.51	62.21	141.27	1.57
13:38:54	791.47	64	1325	240	739	753	28	10.34	1.86	0.28	7.93	8.38	0.86	53.36	141.53	1.58
13:39:08	791.72	68	1215	252	739	753	28	10.34	1.87	0.24	7.95	8.21	0.57	68.33	141.76	1.58
13:39:22	791.97	66	1303	245	739	757	32	10.32	1.84	0.21	7.96	8.21	0.55	64.08	142.01	1.58
13:39:37	792.22	68	1210	251	739	753	28	10.32	1.86	0.23	7.95	8.19	0.55	60.19	142.27	1.59
13:39:50	792.47	66	1212	246	739	753	28	10.33	1.85	0.22	7.95	8.39	0.5	66.17	142.52	1.59
13:40:05	792.72	66	1200	244	739	757	32	10.3	1.86	0.26	7.98	8.31	0.62	60.01	142.78	1.6
13:40:20	792.97	68	1196	251	738	753	28	10.31	1.86	0.23	7.96	8.19	0.5	63.17	143.01	1.6
13:40:34	793.22	68	1160	253	739	757	32	10.33	1.82	0.19	7.95	8.23	0.57	64.18	143.27	1.6
13:40:48	793.47	67	1175	249	738	753	28	10.33	1.85	0.22	7.94	8.19	0.53	69.78	143.52	1.61
13:41:03	793.72	68	1186	253	738	753	28	10.29	1.88	0.35	7.98	8.43	0.8	61.26	143.78	1.61
13:41:17	793.97	69	1156	257	738	753	28	10.33	1.85	0.29	7.95	8.23	0.55	69.76	144.02	1.62
13:41:32	794.22	67	1226	248	740	757	32	10.3	1.85	0.22	7.96	8.36	0.53	68.24	144.27	1.62
13:41:46	794.47	68	1183	255	740	753	28	10.34	1.85	0.21	7.93	8.21	0.57	65.53	144.53	1.62
13:42:05	794.72	67	1215	250	741	757	32	10.2	1.83	0.18	8.07	8.33	0.62	47.85	144.78	1.63
13:42:20	794.97	68	1238	252	740	753	28	10.27	1.86	0.23	8.00	8.38	0.78	61.41	145.02	1.63
13:42:35	795.22	67	1210	249	741	757	32	10.26	1.85	0.23	7.89	8.38	0.72	56.75	145.27	1.64
13:43:02	795.47	66	1085	257	741	757	32	10.09	1.83	0.17	8.18	8.47	0.5	33.95	145.52	1.64

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																	
Starting Depth =	623.82				Bit Type =	Walker McDonald MP68H												
Ending Depth =	1031.18				Bit Size =	4.75												
Total Depth Drilled	407.27				Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.68				Mud Type =		Water Based											
Average ROP =	93.59				Mud Weight (lbs/gal) =		9.00											
DeString (ft) =	668.43				Pipe (ft) =	251.81				Collar (ft)	408.62							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
13:43:25	765.73	66	1147	257	741	757	28	10.12	1.86	0.31	8.11	8.45	0.74	38.20	145.76	1.65
13:43:45	765.98	68	1175	264	741	753	28	10.19	1.85	0.21	8.08	8.4	0.72	46.20	146.01	1.66
13:44:08	766.23	67	1152	250	740	757	32	10.13	1.84	0.21	8.13	8.43	0.65	39.72	146.27	1.66
13:44:27	766.48	68	1170	253	740	757	32	10.18	1.83	0.21	8.08	8.38	0.6	47.30	146.52	1.67
13:44:44	766.73	68	1170	263	740	757	32	10.21	1.83	0.18	8.06	8.31	0.5	51.95	146.78	1.67
13:45:02	766.98	69	1102	256	740	753	28	10.21	1.84	0.2	8.06	8.35	0.6	51.24	147.02	1.68
13:45:18	767.23	67	1133	250	739	753	28	10.26	1.84	0.19	8.02	8.25	0.56	53.68	147.27	1.68
13:45:35	767.48	69	1096	256	740	753	28	10.21	1.83	0.21	8.05	8.33	0.57	52.94	147.53	1.68
13:45:49	767.73	67	1184	248	739	753	28	10.36	1.86	0.21	7.91	8.19	0.55	67.27	147.78	1.69
13:46:03	767.98	68	1162	255	739	753	28	10.3	1.83	0.21	7.97	8.23	0.6	60.92	148.02	1.69
13:46:17	768.23	69	1124	255	739	758	28	10.31	1.84	0.22	7.96	8.21	0.53	64.67	148.28	1.7
13:46:32	768.48	67	1162	260	739	753	28	10.33	1.84	0.2	7.94	8.21	0.53	63.17	148.53	1.7
13:46:45	768.73	67	1204	249	739	753	28	10.31	1.84	0.21	7.96	8.23	0.55	67.32	148.78	1.71
13:47:00	768.98	66	1185	245	739	753	28	10.29	1.85	0.22	7.97	8.31	0.6	61.35	149.02	1.71
13:47:14	769.23	70	1150	259	739	753	28	10.3	1.82	0.18	7.96	8.28	0.6	61.91	149.28	1.71
13:47:30	769.48	67	1193	249	739	753	28	10.25	1.83	0.19	8.01	8.31	0.6	59.07	149.53	1.72
13:47:46	769.73	68	1225	257	739	753	28	10.27	1.84	0.22	7.99	8.33	0.67	55.47	149.79	1.72
13:48:01	769.98	66	1216	248	739	753	28	10.25	1.83	0.2	8.02	8.35	0.62	60.51	150.02	1.73
13:48:16	770.23	68	1201	253	738	757	32	10.28	1.86	0.24	7.98	8.33	0.65	60.06	150.28	1.73
13:48:29	770.48	67	1213	251	737	753	32	10.33	1.84	0.24	7.93	8.26	0.6	67.68	150.53	1.73
13:48:42	770.73	67	1179	259	738	753	28	10.36	1.84	0.23	7.96	8.19	0.62	71.36	150.77	1.74
13:48:58	770.98	67	1166	248	737	753	28	10.28	1.85	0.21	7.98	8.31	0.65	65.62	151.02	1.74
13:49:13	771.23	67	1158	259	736	753	28	10.33	1.82	0.19	7.93	8.23	0.6	73.01	151.28	1.75
13:49:28	771.48	69	1150	255	739	758	28	10.25	1.84	0.19	8.01	8.26	0.6	59.88	151.53	1.75
13:49:45	771.73	67	1228	246	736	753	25	10.18	1.86	0.21	8.08	8.35	0.69	47.87	151.79	1.75
13:49:58	771.98	67	1231	248	739	753	28	10.27	1.85	0.24	8.00	8.33	0.74	63.20	152.03	1.76
13:50:17	772.23	68	1213	248	739	753	28	10.21	1.83	0.2	8.05	8.35	0.65	50.44	152.28	1.76
13:50:33	772.48	67	1185	248	738	753	28	10.21	1.84	0.2	8.05	8.43	0.74	55.03	152.54	1.77
13:50:48	772.73	67	1165	251	739	753	28	10.27	1.83	0.19	7.99	8.33	0.65	59.79	152.79	1.77
13:51:03	772.99	67	1149	248	738	753	28	10.27	1.84	0.2	7.99	8.33	0.5	61.69	153.05	1.78
13:51:18	773.24	68	1159	247	739	757	32	10.27	1.85	0.2	7.99	8.36	0.57	61.22	153.28	1.78
13:51:33	773.49	67	1169	248	738	753	28	10.28	1.81	0.18	7.99	8.21	0.46	58.82	153.54	1.78
13:51:47	773.74	68	1207	248	738	753	28	10.26	1.82	0.18	8.00	8.26	0.57	65.85	153.79	1.79
13:52:01	773.99	69	1154	256	739	753	32	10.27	1.83	0.17	7.99	8.23	0.57	63.37	154.05	1.79

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/22/96						
Starting Depth =	623.52	Bit Type =	Walker McDonald MP58H				
Ending Depth =	1031.19	Bit Size =	4.75				
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	4.09	Mud Type =	Water Based				
Average ROP =	99.68	Mud Weight (lbs/gal) =	9.00				
Drillstring (ft) =	665.49	Pipe (ft) =	251.81	Collar (ft)	406.60		

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	Gs	Gs	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
13:52:16	774.24	68	1175	252	738	757	32	10.28	1.83	0.19	8.09	8.33	0.57	59.67	154.29	1.6
13:52:30	774.49	68	1182	253	737	757	32	10.28	1.81	0.15	7.98	8.23	0.53	64.44	154.54	1.6
13:52:45	774.74	68	1169	254	738	753	28	10.28	1.84	0.2	7.96	8.23	0.6	61.76	154.78	1.61
13:52:58	774.99	67	1184	249	736	753	28	10.28	1.81	0.16	7.98	8.23	0.5	69.63	155.03	1.61
13:53:12	775.24	66	1189	246	737	753	28	10.29	1.82	0.18	7.97	8.16	0.45	65.24	155.28	1.61
13:53:27	775.49	67	1193	250	738	753	28	10.28	1.81	0.18	7.98	8.23	0.5	60.66	155.54	1.62
13:53:42	775.74	68	1174	252	738	753	28	10.34	1.82	0.17	8.01	8.56	0.55	59.50	155.79	1.62
13:53:58	775.99	67	1184	249	738	753	28	10.26	1.83	0.19	8.09	8.36	0.55	56.63	156.03	1.62
13:54:13	776.24	68	1185	254	738	753	28	10.26	1.82	0.16	7.99	8.23	0.5	62.66	156.29	1.62
13:54:31	776.49	67	1196	249	738	753	28	10.16	1.82	0.18	8.16	8.4	0.57	48.96	156.54	1.64
13:54:45	776.74	66	1214	246	737	753	28	10.3	1.83	0.19	7.96	8.26	0.63	62.18	156.8	1.64
13:54:57	776.99	65	1244	244	738	753	28	10.37	1.86	0.2	7.88	8.14	0.57	82.44	157.03	1.64
13:55:09	777.24	66	1266	248	739	753	28	10.38	1.83	0.19	7.88	8.16	0.5	71.43	157.28	1.65
13:55:21	777.49	64	1321	256	739	753	28	10.37	1.86	0.27	7.88	8.16	0.5	78.74	157.54	1.65
13:55:33	777.74	64	1298	239	738	753	28	10.34	1.83	0.19	7.91	8.19	0.53	71.25	157.8	1.65
13:55:47	777.99	64	1285	241	738	753	28	10.35	1.87	0.22	7.91	8.14	0.5	67.62	158.04	1.66
13:55:59	778.24	65	1323	241	739	757	32	10.36	1.85	0.22	7.85	8.16	0.57	74.07	158.29	1.66
14:01:23	778.32	107	1157	360	740	753	24	17.32	1.85	0.26	1.66	3.23	0.49	21.33	158.38	1.66
14:01:35	778.58	108	1428	362	739	753	28	15.23	1.98	0.42	3.12	3.42	0.63	80.08	158.61	1.66
14:01:45	778.83	106	1566	365	739	753	28	13.86	1.94	0.38	4.58	5.27	0.58	86.22	158.88	1.67
14:01:52	779.09	107	1736	368	740	757	28	12.43	2.02	0.53	5.81	6.2	0.57	134.35	159.13	1.67
14:02:00	779.33	107	1712	368	740	753	24	12.44	1.99	0.44	5.81	6.3	0.67	112.53	159.37	1.67
14:02:08	779.58	104	1727	360	740	757	32	12.45	2.02	0.49	5.89	6.28	0.62	124.79	159.63	1.67
14:02:15	779.83	105	1737	363	739	757	32	12.51	1.96	0.5	5.84	6.13	0.62	121.10	159.88	1.67
14:02:22	780.08	104	1752	378	740	753	28	12.53	1.98	0.48	5.83	6.18	0.62	128.11	160.12	1.68
14:02:29	780.33	104	1744	380	740	757	28	12.51	2.06	0.52	5.83	6.1	0.57	135.18	160.37	1.68
14:02:37	780.58	106	1720	387	741	757	28	12.4	1.94	0.45	5.95	6.27	0.58	106.67	160.63	1.68
14:02:44	780.83	104	1807	380	741	753	24	12.48	2.07	0.58	5.87	6.15	0.62	140.02	160.88	1.68
14:02:52	781.08	105	1664	381	741	753	28	12.41	1.93	0.37	5.93	6.2	0.65	109.03	161.13	1.68
14:03:00	781.33	107	1686	389	738	753	28	12.38	1.96	0.47	5.96	6.2	0.62	107.78	161.37	1.69
14:03:07	781.58	104	1729	379	739	753	28	12.45	1.91	0.41	5.90	6.13	0.5	128.56	161.63	1.69
14:03:15	781.83	105	1728	383	740	753	28	12.47	1.96	0.46	5.87	6.18	0.55	111.46	161.85	1.69
14:03:23	782.08	104	1746	380	740	753	24	12.46	2	0.51	5.85	6.15	0.6	125.51	162.14	1.69
14:03:30	782.33	104	1725	379	740	753	24	12.46	2.04	0.56	5.88	6.1	0.6	123.19	162.39	1.6

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/23/96				
Starting Depth =	623.92	Bit Type =	Walker McDonnels MP68H		
Ending Depth =	1631.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 13		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	99.58	Mud Weight (lbs/gal) =	9.65		
Drillstring (ft) =	660.49	Pipe (ft) =	251.81	Collar (ft) =	408.69

TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	RRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
14:03:37	782.55	105	1777	382	741	753	24	12.53	2.12	0.63	5.82	6.1	0.6	128.69	162.63	1.9
14:03:45	782.84	104	1808	379	740	757	28	12.46	1.99	0.53	5.89	6.3	0.77	126.53	162.88	1.9
14:03:52	783.06	103	1808	375	741	753	24	12.46	2.03	0.57	5.85	6.13	0.53	124.76	163.14	1.9
14:03:59	783.34	105	1775	384	740	753	28	12.53	1.98	0.54	5.82	6.18	0.6	134.18	163.38	1.9
14:04:06	783.59	105	1742	381	740	753	28	12.46	1.98	0.45	5.88	6.18	0.6	115.89	163.65	1.91
14:04:14	783.84	106	1715	385	740	753	24	12.43	1.94	0.44	5.80	6.27	0.69	116.74	163.89	1.91
14:04:21	784.09	107	1714	381	741	757	28	12.45	1.97	0.48	5.90	6.18	0.6	128.13	164.14	1.91
14:04:29	784.34	106	1713	386	740	753	28	12.47	1.96	0.47	5.87	6.18	0.58	114.51	164.38	1.91
14:04:36	784.59	105	1748	383	741	753	24	12.5	2.03	0.54	5.84	6.13	0.62	128.41	164.63	1.91
14:04:43	784.84	107	1756	390	741	757	28	12.53	1.95	0.51	5.83	6.13	0.58	123.68	164.91	1.92
14:04:51	785.09	107	1742	389	740	757	32	12.53	2.02	0.5	5.81	6.08	0.5	124.14	165.15	1.92
14:04:57	785.34	105	1739	383	741	757	28	12.52	1.99	0.46	5.82	6.13	0.51	133.02	165.38	1.92
14:05:05	785.59	106	1755	385	742	758	24	12.52	1.97	0.49	5.82	6.1	0.67	119.15	165.65	1.92
14:05:12	785.84	105	1744	382	741	753	24	12.5	2.01	0.51	5.84	6.1	0.53	128.61	165.89	1.92
14:05:19	786.09	106	1740	384	741	757	28	12.5	1.94	0.41	5.84	6.08	0.57	118.68	166.15	1.93
14:05:27	786.34	105	1735	383	739	757	32	12.47	1.96	0.48	5.87	6.15	0.58	119.17	166.4	1.93
14:05:34	786.59	107	1722	390	741	757	28	12.44	1.95	0.44	5.90	6.22	0.55	128.70	166.66	1.93
14:05:42	786.84	107	1723	389	741	753	24	12.45	1.89	0.42	5.89	6.13	0.53	119.46	166.89	1.93
14:05:49	787.09	106	1701	386	741	753	24	12.41	2	0.51	5.93	6.25	0.65	121.03	167.16	1.93
14:05:58	787.34	106	1682	387	740	757	36	12.37	1.84	0.4	5.97	6.22	0.53	104.36	167.42	1.94
14:06:07	787.59	107	1634	386	741	757	28	12.31	1.88	0.31	6.03	6.32	0.53	108.42	167.68	1.94
14:06:15	787.84	106	1660	385	740	753	24	12.31	1.85	0.42	6.03	6.3	0.53	114.12	167.89	1.94
14:06:24	788.1	106	1643	387	740	753	24	12.21	1.9	0.3	6.13	6.68	0.91	97.37	168.14	1.94
14:06:31	788.35	107	1676	388	740	753	24	11.39	1.91	0.31	6.89	7.3	0.89	125.21	168.39	1.95
14:06:39	788.6	106	1674	383	740	753	28	11.27	1.9	0.36	7.07	7.35	0.53	115.46	168.64	1.95
14:06:47	788.85	106	1658	385	741	753	24	11.28	1.96	0.34	7.06	7.3	0.5	117.63	168.9	1.95
14:06:54	789.1	105	1694	384	740	753	28	11.28	1.88	0.35	7.05	7.32	0.6	126.02	169.14	1.95
14:07:02	789.35	105	1643	382	740	753	28	11.27	1.93	0.37	7.07	7.3	0.65	112.11	169.39	1.95
14:07:09	789.6	106	1646	386	740	757	28	11.23	1.89	0.35	7.11	7.4	0.53	126.29	169.64	1.96
14:07:17	789.85	107	1658	390	740	753	28	11.27	1.92	0.36	7.07	7.32	0.62	114.31	169.9	1.96
14:07:24	790.1	105	1725	382	741	753	24	11.31	1.96	0.45	7.03	7.35	0.65	121.61	170.14	1.96
14:07:31	790.35	107	1663	390	740	753	24	11.29	1.88	0.36	7.05	7.35	0.65	130.57	170.39	1.96
14:07:39	790.6	107	1693	390	740	753	28	11.28	1.93	0.4	7.07	7.37	0.6	114.17	170.65	1.96
14:07:47	790.85	106	1728	386	740	753	24	11.24	1.94	0.4	7.11	7.4	0.65	124.42	170.9	1.97

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/22/96																	
Starting Depth =	623.62			Bit Type =	Walker McDonnald MP58H													
Ending Depth =	1031.19			Bit Size =	4.75													
Total Depth Drilled	407.27			Bit Nozzles =		8, 8, 12, 12												
Hours On Bit =	4.09			Mud Type =		Water Based												
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.60												
Drillstring (lb) =	660.49			Pipe (lb) =	251.81				Collar (lb)	408.60								
TIME	BIT DEPTH	FLOW	PRES.	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:07:54	791.1	106	1723	385	740	753	24	11.35	1.93	0.44	7.08	7.42	0.77	115.13	171.18	1.97
14:08:02	791.35	105	1713	382	740	753	25	11.29	2	0.58	7.05	7.42	0.69	117.30	171.4	1.97
14:08:09	791.5	106	1705	387	740	753	24	11.3	1.93	0.4	7.04	7.37	0.67	127.31	171.55	1.97
14:08:17	791.85	107	1698	390	736	753	26	11.29	1.91	0.38	7.07	7.37	0.6	105.98	171.9	1.98
14:08:25	792.1	106	1717	387	738	753	26	11.27	1.94	0.4	7.07	7.47	0.74	120.72	172.18	1.98
14:08:33	792.36	105	1724	393	740	753	26	11.31	1.94	0.44	7.02	7.4	0.69	118.64	172.4	1.98
14:08:40	792.61	107	1710	390	741	753	24	11.29	1.94	0.44	7.05	7.42	0.72	118.12	172.65	1.98
14:08:47	792.86	106	1711	385	739	753	24	11.3	1.94	0.45	7.04	7.47	0.66	124.47	172.9	1.98
14:08:55	793.11	104	1723	379	741	757	28	11.29	1.99	0.52	7.05	7.42	0.74	114.31	173.15	1.99
14:09:03	793.36	107	1733	385	740	753	24	11.29	1.93	0.4	7.03	7.37	0.67	133.84	173.4	1.99
14:09:10	793.61	107	1736	386	741	753	24	11.32	2.03	0.55	7.02	7.32	0.65	118.29	173.65	1.99
14:09:18	793.86	107	1694	386	739	753	26	11.32	1.95	0.42	7.02	7.39	0.65	122.43	173.92	1.99
14:09:25	794.11	106	1722	387	740	753	24	11.31	1.94	0.42	7.03	7.4	0.79	128.84	174.16	1.99
14:09:33	794.36	105	1715	382	740	757	32	11.33	1.95	0.44	7.01	7.4	0.74	112.94	174.42	2
14:09:39	794.61	107	1711	388	741	781	96	11.31	1.94	0.43	7.04	7.4	0.65	139.05	174.65	2
14:09:47	794.86	106	1706	389	741	757	28	11.3	1.95	0.53	7.04	7.42	0.69	120.68	174.91	2
14:09:54	795.11	105	1708	385	740	757	32	11.3	1.94	0.44	7.04	7.37	0.67	116.36	175.16	2
14:10:02	795.36	105	1678	383	740	753	28	11.26	1.96	0.44	7.07	7.44	0.72	122.68	175.4	2
14:10:10	795.61	107	1693	390	740	753	28	11.24	1.93	0.38	7.09	7.37	0.6	110.61	175.65	2.01
14:10:17	795.86	106	1688	383	740	753	24	11.27	1.94	0.44	7.07	7.32	0.67	122.81	175.90	2.01
14:10:25	796.11	107	1694	388	740	753	25	11.27	1.95	0.44	7.07	7.37	0.65	118.95	176.17	2.01
14:10:33	796.36	106	1687	395	740	753	24	11.25	1.96	0.41	7.08	7.37	0.67	114.31	176.4	2.01
14:10:40	796.61	107	1680	390	741	757	28	11.28	2	0.5	7.05	7.37	0.67	129.46	176.66	2.01
14:10:48	796.86	107	1654	390	740	753	24	11.24	1.93	0.4	7.08	7.37	0.6	109.78	176.91	2.02
14:10:56	797.11	107	1645	388	738	757	28	11.21	1.92	0.44	7.12	7.56	0.72	114.06	177.16	2.02
14:11:04	797.37	107	1648	389	739	753	24	11.19	1.9	0.38	7.14	7.42	0.67	107.65	177.4	2.02
14:11:13	797.62	107	1638	388	740	753	24	11.15	1.94	0.46	7.17	7.52	0.65	101.09	177.66	2.02
14:11:21	797.87	108	1661	393	739	753	28	11.17	1.93	0.42	7.16	7.44	0.62	111.69	177.91	2.03
14:11:30	798.12	107	1650	388	739	753	28	11.16	1.94	0.44	7.15	7.54	0.72	103.02	178.17	2.03
14:11:38	798.37	108	1629	392	737	753	32	11.13	1.9	0.34	7.21	7.61	0.72	101.19	178.44	2.03
14:11:46	798.62	107	1655	388	738	753	28	11.16	2.03	0.51	7.17	7.56	0.81	100.41	178.66	2.03
14:11:57	798.87	107	1654	388	739	753	28	11.15	1.93	0.39	7.18	7.54	0.74	101.61	178.91	2.04
14:12:05	799.12	108	1667	393	739	753	24	11.17	1.94	0.4	7.17	7.54	0.72	111.42	179.17	2.04
14:12:14	799.37	107	1668	388	739	753	24	11.13	1.94	0.38	7.21	7.61	0.81	99.14	179.42	2.04

DOE high power mortar test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																	
Starting Depth =	623.92			Bit Type =	Walker McDonald MP6SH													
Ending Depth =	1031.19			Bit Size =	6.75													
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	4.09			Mud Type =		Water Based												
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00												
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.60								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:12:24	798.62	108	1609	364	739	763	28	11.68	1.92	0.43	7.23	7.66	0.74	94.21	179.66	2.04
14:12:34	799.67	107	1605	366	739	763	28	11.65	1.92	0.33	7.29	7.73	0.79	91.36	179.91	2.05
14:12:45	800.12	108	1604	367	738	763	24	11.62	1.91	0.39	7.32	7.66	0.74	91.43	180.17	2.05
14:12:56	800.87	108	1573	362	739	763	28	10.94	1.88	0.32	7.39	7.73	0.67	78.26	180.42	2.05
14:13:06	800.62	107	1585	361	740	763	28	10.99	1.9	0.35	7.36	7.71	0.67	79.62	180.66	2.06
14:13:20	800.87	108	1579	365	738	763	28	10.81	1.89	0.31	7.42	7.85	0.79	74.85	180.91	2.06
14:13:31	801.12	108	1638	366	739	763	24	10.98	1.89	0.32	7.35	7.83	0.98	78.95	181.17	2.06
14:13:43	801.37	105	1518	364	738	763	28	11	1.94	0.37	7.33	7.68	0.72	79.79	181.43	2.07
14:13:54	801.62	108	1567	365	739	763	28	10.82	1.87	0.36	7.50	7.86	0.65	77.64	181.68	2.07
14:14:10	801.87	108	1636	363	738	767	32	10.86	1.88	0.27	7.48	7.86	0.79	68.37	181.92	2.07
14:14:25	802.12	107	1573	360	740	763	28	10.56	1.9	0.3	7.77	8.25	2.13	59.83	182.17	2.08
14:14:37	802.37	107	1572	358	736	763	28	8.95	1.89	0.34	9.39	9.85	1.32	70.83	182.43	2.08
14:14:48	802.62	106	1714	359	740	763	24	9.18	1.91	0.31	9.18	9.72	1.23	102.09	182.67	2.08
14:14:54	802.88	106	1664	358	739	763	28	9.15	1.87	0.3	9.20	9.6	0.84	113.17	182.93	2.08
14:15:04	803.13	107	1642	359	738	763	28	9.11	1.91	0.35	9.23	9.69	1.08	85.06	183.17	2.09
14:15:13	803.38	107	1662	360	739	763	28	9.02	1.9	0.32	9.31	9.69	0.81	93.94	183.42	2.09
14:15:24	803.63	108	1585	364	739	763	28	8.99	1.89	0.31	9.34	9.81	0.96	84.81	183.68	2.09
14:15:35	803.88	107	1585	361	739	763	28	8.96	1.88	0.27	9.36	9.81	1.06	79.26	183.93	2.1
14:15:47	804.13	106	1558	357	739	763	28	8.9	1.87	0.28	9.43	9.91	1.03	79.43	184.19	2.1
14:15:58	804.38	106	1595	357	738	763	28	8.96	1.88	0.28	9.35	9.91	1.05	80.59	184.42	2.1
14:16:10	804.63	108	1565	363	739	763	28	8.9	1.89	0.25	9.43	9.89	0.85	75.39	184.68	2.11
14:16:19	804.88	106	1566	357	738	763	28	9.08	1.9	0.3	9.26	9.81	1.01	84.24	184.92	2.11
14:16:27	805.13	105	1720	362	736	763	28	9.26	1.93	0.38	9.07	9.56	0.83	113.09	185.17	2.11
14:16:36	805.38	105	1550	364	736	763	28	11.27	1.84	0.25	7.06	9.43	4.45	102.53	185.43	2.11
14:16:47	805.63	106	1572	367	737	763	28	10.99	1.91	0.31	7.33	7.9	1.06	85.23	185.69	2.12
14:16:54	805.88	108	1534	363	738	763	28	10.7	1.91	0.32	7.62	8.23	1.24	132.86	185.94	2.12
14:17:02	806.13	108	1547	361	738	763	24	10.13	1.91	0.31	8.19	8.67	0.93	119.35	186.17	2.12
14:17:10	806.38	107	1542	360	738	763	24	10.11	1.9	0.39	8.21	8.67	0.88	113.51	186.44	2.12
14:17:17	806.63	107	1545	361	738	763	24	10.14	1.91	0.33	8.20	8.67	1.1	127.74	186.68	2.13
14:17:25	806.88	107	1643	365	738	763	28	10.04	1.92	0.4	8.30	8.71	0.86	103.66	186.93	2.13
14:17:33	807.13	106	1727	362	738	763	28	10.19	1.89	0.39	8.14	8.52	0.89	128.13	187.18	2.13
14:17:40	807.38	105	1703	363	739	763	24	10.19	1.9	0.31	8.13	8.56	0.96	127.99	187.43	2.13
14:17:47	807.63	104	1838	378	736	763	24	10.26	1.95	0.43	8.08	8.57	1.08	125.50	187.68	2.13
14:17:53	807.88	104	1840	380	739	763	28	10.34	1.96	0.44	7.99	8.5	0.98	150.51	187.94	2.14

DOE high power motor test Amaco Catoosa Test Site

Well No. 23	Date: 3/22/96																		
Starting Depth =	823.95				Bit Type =	Walker McDonald MP5DH													
Ending Depth =	1831.19				Bit Size =	4.75													
Total Depth Drilled	407.27				Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	4.09				Mud Type =		Water Based												
Average ROP =	99.58				Mud Weight (lbs/gal) =		9.00												
Drillstring (ft) =	660.49				Pipe (ft) =	251.81				Collar (ft)	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
14:18:01	808.13	103	2115	393	661	766	397	10.15	2.1	0.58	8.17	9.91	4.5	197.06	188.18	2.14
14:18:15	808.38	108	1530	394	738	753	49	15.5	1.87	0.29	2.80	5.41	4.26	59.75	185.43	2.14
14:18:30	808.64	107	1451	389	738	753	28	15.25	1.86	0.21	3.05	5.3	0.95	66.47	183.68	2.15
14:18:46	808.89	108	1448	393	739	753	38	15	1.9	0.25	3.30	5.27	2.44	58.53	183.93	2.15
14:18:54	809.14	105	1584	394	739	752	24	13.28	1.94	0.36	5.03	5.36	0.85	103.56	189.19	2.15
14:19:03	809.39	105	1600	392	738	753	28	13.26	1.95	0.34	5.05	5.36	0.82	95.86	189.42	2.16
14:19:13	809.64	106	1562	395	738	753	24	13.23	1.94	0.33	5.08	5.36	0.55	90.68	189.68	2.16
14:19:23	809.89	107	1551	391	738	753	32	13.24	1.91	0.33	5.07	5.36	0.98	96.19	189.93	2.16
14:24:36	810.08	106	1238	357	740	753	24	16.17	1.82	0.15	2.53	4.38	4.69	182.43	190.13	2.16
14:24:45	810.33	105	1489	354	740	753	24	13.76	1.81	0.12	4.97	5.8	1.46	91.47	190.37	2.16
14:24:56	810.58	104	1586	379	741	757	28	12.69	1.83	0.16	6.04	6.61	1.2	112.75	190.64	2.17
14:25:04	810.83	104	1606	380	741	757	28	11.85	1.84	0.15	6.86	7.37	1.13	113.13	190.88	2.17
14:25:11	811.08	105	1579	384	741	753	24	11.43	1.83	0.38	7.31	7.54	0.8	127.78	191.14	2.17
14:25:18	811.33	105	1594	381	741	753	24	11.38	1.83	0.39	7.36	7.56	0.43	121.13	191.37	2.17
14:25:26	811.58	105	1701	383	740	753	24	11.39	1.84	0.19	7.34	7.56	0.45	122.51	191.65	2.17
14:25:32	811.84	105	1735	385	741	753	24	11.4	1.85	0.21	7.34	7.58	0.45	135.32	191.9	2.18
14:25:39	812.09	105	1806	382	740	753	24	11.46	1.84	0.21	7.27	7.52	0.53	130.97	192.14	2.18
14:25:45	812.34	104	1822	378	741	753	24	11.5	1.9	0.24	7.24	7.48	0.57	145.87	192.37	2.18
14:25:52	812.59	107	1820	388	741	753	24	11.48	1.87	0.23	7.25	7.52	0.57	133.43	192.63	2.18
14:25:59	812.84	105	1824	383	741	757	28	11.48	1.87	0.25	7.24	7.54	0.57	124.95	192.88	2.18
14:26:06	813.09	104	1932	379	741	753	24	11.49	1.88	0.26	7.24	7.59	0.67	135.56	193.14	2.19
14:26:13	813.34	103	1905	376	740	753	24	11.5	1.88	0.25	7.24	7.52	0.67	139.94	193.39	2.19
14:26:20	813.59	104	1916	379	739	753	28	11.48	1.88	0.31	7.25	7.64	0.72	135.56	193.63	2.19
14:26:26	813.84	105	1888	382	740	753	28	11.51	1.88	0.22	7.23	7.47	0.57	139.96	193.89	2.19
14:26:33	814.09	104	1908	381	740	753	28	11.57	1.87	0.22	7.17	7.47	0.6	178.67	194.16	2.19
14:26:40	814.34	105	1872	383	740	753	24	11.51	1.86	0.25	7.22	7.52	0.57	136.89	194.4	2.2
14:26:46	814.59	104	1877	378	740	753	24	11.54	1.9	0.28	7.20	7.84	0.72	146.12	194.63	2.2
14:26:52	814.84	103	1857	383	739	753	24	11.51	1.84	0.19	7.22	7.49	0.6	130.29	194.89	2.2
14:26:59	815.09	105	1937	381	740	753	28	11.52	1.85	0.2	7.21	7.44	0.53	139.26	195.14	2.2
14:27:06	815.34	106	1931	385	740	753	24	11.47	1.82	0.18	7.25	7.49	0.49	130.58	195.4	2.21
14:27:12	815.59	104	1816	378	740	753	24	11.44	1.83	0.17	7.29	7.52	0.5	136.66	195.63	2.21
14:27:19	815.84	106	1810	388	740	753	24	11.45	1.84	0.2	7.28	7.44	0.5	126.52	195.89	2.21
14:27:26	816.09	106	1814	388	740	753	28	11.48	1.82	0.15	7.28	7.49	0.49	134.86	196.15	2.21
14:27:33	816.34	106	1792	385	740	753	24	11.35	1.89	0.24	7.41	8.11	1.13	128.58	196.39	2.21

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.92			Bit Type =	Walker McDonald MP68K												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
14:27:40	816.59	105	1807	383	740	753	24	10.76	1.86	0.21	7.98	8.39	0.74	124.56	196.59	2.21
14:27:47	816.84	107	1775	380	740	753	28	10.88	1.82	0.17	7.85	8.07	0.6	135.95	196.88	2.21
14:27:54	817.08	105	1782	383	738	753	24	10.92	1.85	0.21	7.83	8.02	0.43	129.16	197.14	2.22
14:28:00	817.34	103	1782	375	738	753	24	10.92	1.83	0.19	7.81	8.02	0.45	142.85	197.4	2.22
14:28:07	817.58	106	1757	385	740	753	24	10.89	1.83	0.16	7.85	8.09	0.43	128.24	197.65	2.22
14:28:15	817.86	105	1783	383	739	753	24	10.85	1.81	0.14	7.88	8.07	0.41	129.20	197.91	2.22
14:28:21	818.1	106	1754	385	740	757	28	10.86	1.81	0.13	7.87	8.11	0.53	136.05	198.14	2.22
14:28:29	818.35	106	1749	387	739	753	28	10.84	1.97	0.16	7.89	8.09	0.61	123.12	198.39	2.23
14:28:36	818.6	106	1739	387	739	753	24	10.85	1.83	0.17	7.88	8.11	0.45	128.00	198.67	2.23
14:28:43	818.85	106	1739	386	740	753	24	10.88	1.82	0.14	7.85	8.09	0.43	135.48	198.89	2.23
14:28:50	819.1	106	1745	384	740	753	24	10.89	1.82	0.16	7.85	8.08	0.53	125.28	199.14	2.23
14:28:57	819.35	106	1763	386	739	753	28	10.86	1.81	0.13	7.87	8.11	0.48	137.22	199.4	2.23
14:29:04	819.6	105	1767	383	740	753	25	10.86	1.82	0.16	7.87	8.09	0.5	122.85	199.65	2.24
14:29:11	819.85	107	1763	388	738	753	28	10.87	1.81	0.14	7.85	8.09	0.48	131.61	199.89	2.24
14:29:18	820.1	108	1739	391	738	753	24	10.82	1.83	0.16	7.91	8.14	0.53	126.93	200.14	2.24
14:29:25	820.35	108	1771	392	740	753	28	10.86	1.83	0.16	7.87	8.16	0.53	131.61	200.42	2.24
14:29:32	820.6	105	1760	383	739	753	28	10.84	1.82	0.13	7.89	8.16	0.53	130.83	200.66	2.24
14:29:40	820.85	105	1745	387	739	753	24	10.82	1.86	0.19	7.91	8.21	0.55	119.17	200.89	2.25
14:29:47	821.1	107	1742	388	740	753	28	10.83	1.82	0.14	7.90	8.11	0.48	139.75	201.14	2.25
14:29:54	821.35	107	1758	391	739	753	24	10.87	1.82	0.15	7.86	8.16	0.69	127.44	201.4	2.25
14:30:01	821.6	107	1743	388	739	753	28	10.84	1.85	0.18	7.88	8.14	0.48	119.58	201.67	2.25
14:30:08	821.85	106	1732	389	740	753	28	10.81	1.82	0.16	7.92	8.19	0.6	137.66	201.91	2.25
14:30:15	822.1	106	1761	385	740	753	24	10.85	1.83	0.18	7.88	8.11	0.5	121.50	202.17	2.26
14:30:23	822.35	107	1742	389	738	753	28	10.87	1.83	0.17	7.86	8.11	0.6	128.78	202.4	2.26
14:30:30	822.61	108	1730	391	737	753	28	10.83	1.84	0.18	7.89	8.23	0.65	125.58	202.65	2.26
14:30:38	822.85	105	1723	383	738	753	28	10.8	1.83	0.17	7.93	8.21	0.57	115.07	202.91	2.26
14:30:45	823.11	107	1725	389	739	748	28	10.79	1.84	0.18	7.94	8.19	0.48	135.85	203.15	2.26
14:30:53	823.36	109	1737	396	740	753	28	10.78	1.82	0.14	7.96	8.23	0.6	116.30	203.4	2.27
14:31:01	823.61	106	1730	385	740	753	24	10.75	1.83	0.17	7.98	8.33	0.79	113.30	203.65	2.27
14:31:08	823.85	105	1709	385	740	753	24	10.8	1.85	0.19	7.92	8.21	0.93	120.50	203.91	2.27
14:31:16	824.11	108	1717	386	740	753	28	10.8	1.84	0.19	7.93	8.33	0.6	116.92	204.17	2.27
14:31:24	824.36	105	1729	384	740	753	24	10.73	1.84	0.19	7.98	8.31	0.65	115.75	204.42	2.27
14:31:32	824.61	108	1707	393	740	753	24	10.69	1.86	0.2	8.04	8.35	0.72	107.59	204.66	2.28
14:31:40	824.86	107	1744	388	740	757	28	10.77	1.86	0.2	7.95	8.26	0.65	112.69	204.91	2.28

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																	
Starting Depth =	823.92			Bit Type =	Walker McDonald MP66R													
Ending Depth =	1031.19			Bit Size =	4.75													
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	4.09			Mud Type =		Water Based												
Average ROP =	99.58			Mud Weight (lbs/gal) =		8.80												
Drillstring (ft) =	660.48			Pipe (ft) =	261.81			Collar (ft)	406.80									

TIME	BIT DEPTH	FLOW	PRES.	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:31:48	825.11	106	1738	387	740	753	24	10.73	1.87	0.23	7.95	8.28	0.62	113.58	205.15	2.26
14:31:57	825.36	106	1741	385	740	753	24	10.73	1.84	0.2	8.00	8.28	0.62	105.85	205.4	2.26
14:32:06	825.61	108	1729	392	740	753	24	10.61	1.84	0.21	8.12	8.5	0.74	98.37	205.66	2.26
14:32:15	825.86	106	1747	385	740	753	24	10.7	1.87	0.23	8.03	8.38	0.65	104.53	205.92	2.26
14:32:23	826.11	107	1711	391	740	753	24	10.7	1.83	0.17	8.03	8.31	0.65	104.35	206.19	2.26
14:32:32	826.36	108	1685	392	740	753	28	10.63	1.86	0.18	8.09	8.5	0.72	98.55	206.4	2.26
14:32:42	826.62	105	1732	382	740	757	32	10.68	1.83	0.17	8.05	8.38	0.69	92.18	206.66	2.3
14:32:51	826.87	105	1703	383	739	753	28	10.61	1.82	0.16	8.11	8.38	0.67	98.91	206.91	2.3
14:33:02	827.12	107	1648	390	740	753	24	10.48	1.83	0.16	8.25	8.57	0.67	78.41	207.17	2.3
14:33:12	827.37	109	1652	396	740	753	24	10.58	1.84	0.17	8.14	8.45	0.62	90.75	207.4	2.3
14:33:21	827.62	108	1665	393	740	753	24	10.64	1.86	0.18	8.09	8.35	0.6	103.13	207.66	2.31
14:33:31	827.87	109	1681	395	740	753	24	10.63	1.86	0.18	8.15	8.52	0.72	94.85	207.92	2.31
14:33:40	828.13	107	1682	389	740	753	24	10.62	1.84	0.18	8.15	8.4	0.6	98.77	208.17	2.31
14:33:50	828.37	107	1644	389	738	748	24	10.53	1.85	0.17	8.19	8.62	0.79	85.84	208.41	2.31
14:34:01	828.62	108	1636	394	738	753	28	10.5	1.81	0.13	8.22	8.5	0.6	90.07	208.66	2.32
14:34:13	828.87	106	1635	387	740	753	28	10.48	1.83	0.16	8.24	8.62	0.69	79.78	208.91	2.32
14:34:36	829.12	109	1679	395	740	757	32	10.52	1.82	0.13	8.41	8.67	0.65	53.24	209.17	2.33
14:34:42	829.37	108	1660	390	738	753	28	10.42	1.85	0.18	8.30	8.74	0.79	74.59	209.41	2.33
14:34:52	829.62	107	1650	389	738	753	28	10.51	1.85	0.19	8.21	8.47	0.53	84.73	209.66	2.33
14:35:53	829.87	107	1713	390	737	753	28	10.54	1.83	0.17	8.19	8.45	0.55	84.39	209.94	2.34
14:35:18	830.12	110	1699	395	740	757	28	10.43	1.82	0.15	8.39	8.69	0.81	75.53	210.17	2.34
14:35:28	830.37	108	1690	392	740	753	24	10.44	1.83	0.18	8.28	8.55	0.62	88.33	210.46	2.34
14:35:38	830.62	107	1726	390	740	753	28	10.51	1.83	0.18	8.21	8.62	0.69	86.75	210.66	2.34
14:35:48	830.87	107	1742	390	738	757	32	10.55	1.83	0.17	8.17	8.4	0.5	90.63	210.92	2.35
14:36:02	831.12	108	1710	395	738	753	28	10.4	1.83	0.16	8.33	8.59	0.65	65.73	211.17	2.35
14:36:14	831.37	108	1727	392	740	757	28	10.44	1.83	0.18	8.28	8.62	0.62	76.32	211.43	2.36
14:36:26	831.62	108	1713	392	740	753	28	10.46	1.82	0.14	8.27	8.55	0.57	71.35	211.67	2.36
14:36:40	831.87	109	1681	395	740	753	24	10.38	1.83	0.18	8.34	8.62	0.72	67.67	211.92	2.36
14:36:53	832.12	109	1707	396	740	753	24	9.97	1.84	0.16	8.75	9.34	1.17	69.73	212.18	2.37
14:37:01	832.38	107	1775	391	739	753	43	9.86	1.94	0.18	8.88	9.22	0.78	107.13	212.42	2.37
14:37:12	832.63	109	1673	396	739	753	32	9.64	1.82	0.16	9.08	9.36	0.79	85.53	212.68	2.37
14:37:23	832.88	110	1657	395	740	753	28	9.65	1.84	0.17	9.07	9.36	0.6	78.68	212.93	2.37
14:37:34	833.13	109	1631	397	740	753	24	9.65	1.81	0.15	9.10	9.36	0.53	82.68	213.19	2.38
14:37:43	833.38	109	1684	396	740	753	28	9.42	1.83	0.15	9.31	10.27	1.53	95.73	213.43	2.38

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	823.92			Bit Type =	Walker McDonald MP68H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	497.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:37:51	833.63	107	1707	388	739	753	24	8.58	1.84	0.2	10.14	10.51	0.84	114.54	213.68	2.38
14:38:03	833.68	106	1674	387	740	753	24	8.49	1.85	0.18	10.25	10.51	0.82	100.82	213.92	2.38
14:38:10	834.13	106	1718	385	739	753	24	8.49	1.84	0.2	10.23	10.56	0.89	94.96	214.18	2.39
14:38:17	834.38	105	1784	381	739	753	28	8.84	1.85	0.19	10.09	10.41	0.74	125.26	214.43	2.39
14:38:24	834.63	105	1776	384	741	753	24	8.63	1.85	0.19	10.10	10.44	0.74	119.32	214.67	2.39
14:38:35	834.88	106	1771	384	741	753	24	8.39	1.84	0.18	10.34	10.6	0.69	88.37	214.92	2.39
14:38:43	835.13	106	1756	386	740	753	24	8.44	1.85	0.19	10.28	10.58	0.85	101.12	215.18	2.4
14:38:54	835.38	107	1770	386	740	753	24	8.36	1.84	0.17	10.37	10.63	0.82	82.57	215.43	2.4
14:39:04	835.63	106	1768	385	739	753	24	8.39	1.82	0.14	10.34	10.6	0.85	93.90	215.69	2.4
14:39:15	835.88	106	1776	386	740	753	24	8.34	1.84	0.16	10.38	10.65	0.6	81.94	215.93	2.4
14:39:25	836.13	107	1773	385	739	753	24	8.39	1.85	0.17	10.33	10.63	0.81	88.51	216.18	2.41
14:39:36	836.38	106	1771	385	739	753	28	8.35	1.82	0.14	10.37	10.7	0.91	87.10	216.43	2.41
14:39:58	836.63	106	1693	380	740	753	24	8.24	1.82	0.13	10.48	10.72	0.48	63.85	216.68	2.41
14:40:01	836.88	106	1734	387	740	753	24	8.28	1.85	0.15	10.45	10.8	0.74	75.83	216.93	2.42
14:40:11	837.13	107	1738	388	739	753	28	8.41	1.82	0.13	10.33	10.68	0.53	91.72	217.18	2.42
14:40:21	837.38	106	1716	387	739	753	24	8.36	1.82	0.15	10.36	10.65	0.6	87.13	217.43	2.42
14:40:33	837.63	107	1664	390	740	753	28	8.24	1.81	0.12	10.48	10.7	0.5	73.34	217.68	2.43
14:40:47	837.88	107	1653	391	739	753	28	8.26	1.81	0.12	10.47	10.77	0.6	84.78	217.94	2.43
14:40:56	838.14	107	1838	388	738	753	28	8.51	1.87	0.22	10.22	10.58	1.17	107.83	218.2	2.43
14:41:36	838.32	107	1595	396	732	1698	1357	16.21	1.98	0.47	2.48	11.49	12.08	22.24	218.42	2.44
14:41:45	838.57	108	1332	398	1078	1781	1053	16.26	1.92	0.11	2.44	5.84	5.6	48.65	218.61	2.45
14:42:02	838.82	107	1458	386	740	753	24	12.21	1.83	0.13	6.49	6.8	1.1	33.21	218.86	2.45
14:42:11	839.07	104	1600	380	740	753	28	12.54	1.84	0.15	6.16	6.46	0.65	95.09	219.12	2.45
14:42:20	839.32	105	1601	383	740	751	20	12.6	1.82	0.14	6.11	6.42	0.6	104.79	219.37	2.46
14:42:29	839.57	106	1573	387	741	753	24	12.48	1.81	0.12	6.23	6.53	0.57	102.86	219.61	2.46
14:42:39	839.82	107	1567	389	740	753	28	12.47	1.83	0.15	6.24	6.51	0.65	86.03	219.86	2.46
14:42:49	840.07	106	1544	391	740	753	24	11.84	1.82	0.14	6.86	6.28	2.23	86.26	220.12	2.46
14:42:59	840.32	106	1594	393	739	753	28	10.81	1.81	0.12	7.90	8.23	0.69	92.05	220.38	2.47
14:43:11	840.58	107	1619	390	741	753	24	10.77	1.82	0.12	7.94	8.21	0.55	76.82	220.63	2.47
14:43:21	840.83	106	1621	395	741	757	28	10.78	1.81	0.12	7.93	8.26	0.67	83.69	220.85	2.47
14:43:31	841.08	107	1585	388	739	753	28	10.93	1.51	0.14	7.78	8.09	0.62	92.14	221.12	2.48
14:43:38	841.33	107	1614	390	739	758	20	11.13	1.82	0.14	7.57	7.95	0.86	126.89	221.38	2.48
14:43:06	841.77	107	3264	389	740	753	24	16.67	1.98	0.23	2.53	2.78	1.84	59.07	221.81	2.48
14:43:17	842.02	108	1372	394	740	753	28	14.48	1.94	0.37	4.73	7.78	5.46	75.13	222.05	2.49

DOE high power motor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/95				Bit Type =	Walker McDonald MP66H												
Starting Depth =	823.82				Bit Size =	4.75												
Ending Depth =	1231.19				Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled	407.27				Mud Type =		Water Based											
Hours On Bit =	4.09				Mud Weight (lbs/gal) =		9.68											
Average ROP =	99.58																	
Drillstring (ft) =	960.49				Pipe (ft) =	251.81				Collar (ft)	468.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:49:28	842.27	106	1569	382	739	753	24	10.71	1.93	0.36	8.53	9.85	2.49	105.17	222.31	2.49
14:49:34	842.52	107	1604	389	739	753	24	9.88	1.9	0.27	8.36	9.86	0.85	101.48	222.56	2.49
14:49:40	842.77	106	1682	384	738	748	20	9.23	1.94	0.37	10.01	10.38	0.55	152.86	222.83	2.5
14:49:46	843.02	106	1704	386	739	748	20	8.87	1.92	0.3	10.37	10.65	0.53	113.18	223.08	2.5
14:49:52	843.27	106	1713	388	739	753	28	8.88	1.9	0.32	10.36	10.65	0.67	123.13	223.34	2.5
14:50:04	843.52	106	1678	388	740	753	24	8.89	1.91	0.31	10.55	10.87	0.69	167.56	223.57	2.5
14:50:10	843.77	107	1635	388	740	753	24	8.84	1.91	0.31	10.59	10.92	0.93	97.65	223.83	2.51
14:50:22	844.02	105	1646	382	740	753	24	8.88	1.95	0.36	10.56	10.94	0.98	185.63	224.06	2.51
14:50:32	844.27	107	1649	386	740	753	24	8.69	1.93	0.35	10.55	10.87	0.78	90.73	224.32	2.51
14:50:39	844.52	105	1684	384	741	753	24	8.95	1.93	0.34	10.27	10.63	0.81	132.83	224.58	2.51
14:50:47	844.77	107	1623	381	739	753	24	8.96	1.92	0.33	10.68	11.39	1.2	109.13	224.82	2.51
14:50:55	845.02	104	1732	378	736	753	24	8.08	1.96	0.4	11.16	11.57	0.5	107.52	226.08	2.52
14:51:12	845.27	106	2079	386	839	1871	847	12.03	2.18	0.91	7.18	12.59	9.57	62.56	225.31	2.52
14:51:27	845.52	107	1664	386	740	753	41	13.48	2	0.44	5.76	6.2	1.17	59.63	225.59	2.53
14:51:38	845.77	105	1748	381	740	753	24	13.44	2.01	0.49	5.74	6.1	0.77	81.49	225.81	2.53
14:51:46	846.02	104	1713	378	740	757	28	13.67	1.93	0.38	5.69	5.84	0.62	109.69	226.07	2.53
14:51:56	846.27	105	1717	383	739	753	28	13.61	2.02	0.5	5.88	5.94	0.53	95.79	226.34	2.53
14:52:04	846.52	105	1738	382	741	753	24	13.5	1.96	0.4	5.88	5.94	0.57	106.79	226.58	2.54
14:52:14	846.77	106	1671	386	740	753	28	13.49	1.9	0.32	5.69	5.94	0.5	93.95	226.82	2.54
14:52:24	847.02	107	1656	388	739	753	24	13.48	1.93	0.35	5.76	6.01	0.55	85.82	227.07	2.54
14:52:33	847.28	108	1541	384	740	753	24	13.47	1.9	0.27	5.75	5.96	0.55	109.12	227.33	2.54
14:52:43	847.53	108	1549	384	741	758	24	13.41	1.89	0.25	5.78	7.09	1.7	90.83	227.57	2.55
14:52:50	847.78	108	1618	382	740	753	24	10.83	1.92	0.31	8.38	10.01	3.11	119.97	227.82	2.55
14:52:58	848.03	108	1696	387	740	758	28	9.39	1.94	0.31	9.89	10.68	0.5	119.56	228.07	2.55
14:53:11	848.28	107	1735	386	741	753	24	8.5	1.93	0.34	10.29	10.75	1.03	66.41	228.31	2.56
14:53:20	848.53	108	1829	384	740	753	28	9.16	1.85	0.38	10.04	10.81	0.77	103.83	228.59	2.56
14:53:32	848.78	108	1787	385	740	753	24	9.53	1.96	0.4	10.15	10.36	0.84	77.85	228.84	2.56
14:53:44	849.03	107	1760	390	740	753	28	8.89	1.95	0.41	10.25	10.68	0.72	73.12	229.07	2.56
14:54:00	849.28	105	1747	383	740	753	24	8.89	1.98	0.42	10.39	10.75	0.88	58.21	229.33	2.57
14:54:11	849.53	106	1735	386	740	753	28	9.02	2	0.47	10.17	10.51	0.72	77.72	229.58	2.57
14:54:21	849.78	106	1737	386	741	753	24	9.11	1.96	0.44	10.09	10.36	0.72	94.39	229.84	2.57
14:54:30	850.03	105	1643	381	739	753	24	9.25	2.04	0.53	9.94	10.32	0.72	100.64	230.08	2.58
14:54:36	850.28	104	1917	386	740	753	24	9.44	2.06	0.62	9.74	10.34	1.05	136.18	230.34	2.58
14:54:47	850.53	105	1825	396	740	753	28	9.13	1.98	0.38	10.05	10.41	0.89	85.82	230.61	2.58

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96															
Starting Depth =	823.92			Bit Type =	Walker McDonald MP68H											
Ending Depth =	1031.19			Bit Size =	4.75											
Total Depth Drilled	207.27			Bit Nozzles =		9, 9, 12, 12										
Hours On Bit =	4.09			Mud Type =		Water Based										
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00										
Drillstring (ft) =	860.49			Pipe (ft) =	351.81				Collar (ft)	408.60						

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:54:50	850.78	107	1774	389	740	753	24	9.18	1.94	0.36	10.01	10.41	0.74	94.97	230.83	2.59
14:55:08	851.03	106	1718	386	740	757	28	8.99	1.86	0.41	10.23	10.63	1.05	78.90	231.08	2.59
14:55:23	851.28	107	1716	388	740	753	24	8.94	1.86	0.44	10.24	10.65	1.06	81.26	231.34	2.59
14:55:34	851.54	107	1710	390	741	753	24	9.04	2.08	0.55	10.14	10.63	0.91	84.07	231.61	2.59
14:55:43	851.79	107	1719	388	740	753	24	9.13	1.83	0.38	10.05	10.46	0.91	91.47	231.86	2.6
14:55:52	852.04	106	1811	384	739	783	28	9.39	2.04	0.59	9.75	10.27	1.72	111.30	232.09	2.6
14:56:01	852.29	106	1815	386	738	753	28	10.41	1.97	0.44	8.77	9.19	0.79	96.34	232.33	2.6
14:56:09	852.54	106	1779	383	740	753	24	10.65	1.93	0.41	8.82	9.83	0.67	112.39	232.59	2.6
14:56:16	852.79	106	1848	382	740	753	24	10.68	1.98	0.44	8.51	8.9	0.93	126.17	232.83	2.61
14:56:23	853.04	107	1694	390	740	753	24	10.88	1.95	0.37	8.39	8.76	0.86	139.74	233.1	2.61
14:56:28	853.29	107	1738	390	739	753	24	11.13	1.98	0.46	8.84	8.83	1.48	170.05	233.34	2.61
14:56:35	853.54	106	1802	386	740	753	24	10.6	1.94	0.38	8.58	8.96	0.77	121.06	233.59	2.61
14:56:44	853.79	106	1853	384	740	753	24	10.59	1.99	0.48	8.59	9.02	0.91	107.65	233.84	2.61
14:56:52	854.04	106	1936	379	741	753	24	10.47	2.01	0.5	8.71	9.14	0.77	106.62	234.08	2.62
14:57:01	854.29	104	2005	378	740	757	28	10.47	2.03	0.54	8.71	9.05	0.79	98.05	234.34	2.62
14:57:11	854.54	103	1999	377	739	753	28	10.47	2.1	0.65	8.71	9.05	0.69	96.07	234.59	2.62
14:57:19	854.79	105	2010	381	740	753	24	10.47	2.1	0.5	8.71	9.07	0.72	104.25	234.85	2.62
14:57:27	855.04	103	1902	379	740	757	28	10.56	2.07	0.55	8.52	9.38	0.91	115.28	235.06	2.63
14:57:35	855.29	107	1756	388	740	753	24	10.56	1.97	0.45	8.61	9	0.73	112.64	235.34	2.63
14:57:42	855.54	106	1734	387	740	753	24	10.73	1.98	0.43	8.44	8.81	0.74	126.69	235.58	2.63
14:57:56	855.79	107	1728	390	740	753	24	10.21	1.93	0.47	8.96	9.43	1.24	85.04	235.85	2.63
14:58:12	856.05	107	1746	388	739	753	24	10.13	1.99	0.45	9.05	9.38	0.77	96.21	236.1	2.64
14:58:26	856.3	108	1766	390	739	757	32	10.2	2.02	0.48	8.96	9.29	0.77	56.83	236.34	2.64
14:58:36	856.55	107	1733	390	739	753	28	10.3	2	0.48	8.87	9.17	0.67	81.82	236.59	2.65
14:58:46	856.8	107	1784	388	740	753	24	10.44	2.06	0.58	8.74	9.1	0.72	94.75	236.85	2.65
14:58:55	857.05	105	1817	391	739	753	24	10.57	1.97	0.42	8.59	8.9	0.67	109.22	237.09	2.65
14:59:04	857.3	105	1785	394	739	753	24	10.59	1.96	0.46	8.58	8.95	0.89	120.67	237.35	2.65
14:59:12	857.55	107	1795	388	739	753	24	10.57	2.01	0.44	8.60	8.98	0.79	104.35	237.6	2.66
14:59:19	857.8	105	1798	393	739	753	24	10.53	2.01	0.48	8.55	8.95	0.79	130.06	237.85	2.66
14:59:27	858.05	108	1768	393	738	753	24	10.71	2.04	0.47	8.47	8.91	0.69	125.25	238.11	2.66
14:59:34	858.3	108	1753	391	739	757	28	10.67	1.99	0.44	8.56	8.92	0.74	119.63	238.34	2.66
14:59:41	858.55	107	1771	389	740	753	24	10.61	2.01	0.51	8.57	8.93	0.77	121.36	238.6	2.66
14:59:49	858.8	108	1858	385	740	753	24	10.73	2	0.5	8.44	8.88	0.84	125.07	238.86	2.67
14:59:56	859.05	103	1846	377	739	753	24	10.63	2.07	0.56	8.48	8.9	0.79	132.82	239.09	2.67

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	823.92			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 8, 12, 12											
Hours On Bit =	4.66			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit	
15:00:03	858.3	104	1874	380	738	753	24	10.62	2.02	0.48	8.56	8.86	0.72	120.35	239.36	2.67	
15:00:11	858.55	105	1794	381	739	753	28	10.65	1.95	0.52	8.52	8.9	0.81	117.67	239.6	2.67	
15:00:18	858.8	107	1796	380	739	753	28	10.63	2.01	0.47	8.56	8.9	0.81	125.04	239.85	2.67	
15:00:26	859.05	106	1810	387	739	753	24	10.67	1.98	0.48	8.58	8.9	0.84	117.28	240.11	2.68	
15:00:33	859.3	106	1786	386	739	753	28	10.63	1.96	0.44	8.54	8.93	0.81	126.69	240.35	2.68	
15:00:41	859.56	106	1783	385	740	753	32	10.64	1.99	0.44	8.54	8.88	0.69	114.84	240.6	2.68	
15:00:48	859.81	107	1782	391	739	757	28	10.61	1.99	0.44	8.56	8.88	0.72	115.67	240.86	2.68	
15:00:56	861.06	106	1778	388	739	753	28	10.6	1.95	0.42	8.57	8.9	0.69	123.61	241.11	2.68	
15:01:04	861.31	107	1789	389	737	749	24	10.61	1.98	0.44	8.56	8.9	0.69	111.77	241.37	2.68	
15:01:11	861.56	105	1781	383	738	753	28	10.61	1.99	0.48	8.56	8.88	0.77	133.89	241.6	2.69	
15:01:19	861.81	106	1813	387	740	757	28	10.66	2	0.5	8.61	8.88	0.74	118.06	241.86	2.69	
15:01:26	862.06	107	1883	388	740	753	24	10.73	2.06	0.63	8.44	8.81	0.74	129.41	242.1	2.69	
15:01:33	862.31	103	1924	375	740	753	28	10.61	2.04	0.56	8.56	8.88	0.99	127.58	242.37	2.69	
15:01:40	862.56	105	1885	382	739	753	28	10.68	2	0.5	8.49	8.9	0.86	116.08	242.61	2.7	
15:01:47	862.81	106	1840	386	739	753	24	10.73	1.93	0.53	8.43	8.79	0.79	133.59	242.86	2.7	
15:01:54	863.06	104	1901	380	738	753	28	10.77	2.07	0.66	8.49	8.81	0.89	132.67	243.1	2.7	
15:02:01	863.31	103	1899	382	738	753	24	10.76	2.08	0.61	8.49	8.93	0.86	128.66	243.37	2.7	
15:02:07	863.56	105	1856	381	738	753	28	10.78	2.02	0.58	8.59	8.83	0.91	144.07	243.61	2.7	
15:02:14	863.81	107	1837	389	739	753	24	10.75	1.98	0.52	8.42	8.79	0.76	137.91	243.88	2.71	
15:02:21	864.06	104	1821	379	740	753	24	10.71	2.01	0.56	8.45	8.79	0.72	130.72	244.1	2.71	
15:02:28	864.31	105	1837	381	739	753	24	10.75	2.03	0.53	8.41	8.88	0.89	135.13	244.36	2.71	
15:02:35	864.56	107	1862	390	739	753	24	10.7	1.98	0.51	8.47	8.83	0.69	132.57	244.61	2.71	
15:02:49	864.91	104	2105	380	677	1364	636	12.99	2.16	0.61	6.18	10.01	5.14	65.14	244.88	2.72	
15:03:00	865.06	107	1556	390	738	753	28	14.27	1.94	0.34	4.67	5.94	3.81	76.57	245.12	2.72	
15:03:09	865.31	107	1685	391	739	753	28	12.49	2.01	0.55	6.68	7.04	0.72	108.67	245.37	2.73	
15:03:17	865.56	107	1701	388	738	753	28	12.51	1.94	0.37	6.65	6.94	0.67	108.56	245.64	2.73	
15:03:28	865.82	107	1715	389	739	753	28	12.52	1.96	0.42	6.64	6.96	0.72	104.68	245.89	2.73	
15:03:33	866.07	114	1855	418	738	753	28	12.54	2.01	0.47	6.62	7.04	0.81	121.27	246.12	2.73	
15:03:43	866.32	114	1907	413	737	753	32	12.35	2.06	0.55	6.81	7.28	1.15	87.58	246.36	2.73	
15:03:57	866.57	114	1849	415	737	749	24	12.19	1.97	0.45	6.96	7.37	1.05	66.16	246.53	2.73	
15:04:09	866.82	116	1864	419	737	749	24	12.27	2.05	0.56	6.89	7.3	1.03	75.60	246.87	2.74	
15:04:26	867.07	114	1872	414	738	753	28	12.29	2.21	0.64	6.87	7.28	1.08	78.36	247.12	2.74	
15:04:28	867.32	114	1838	416	739	749	24	12.38	2.03	0.56	6.77	7.3	1.2	67.94	247.36	2.74	
15:04:41	867.57	116	1845	420	737	749	24	12.28	2.03	0.56	6.87	7.32	1.1	75.81	247.84	2.75	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.52			Bit Type =	Walker McDonnald MP56H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.89			Mud Type =		Water Based											
Average ROP =	83.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	580.49			Pipe (ft) =	251.81				Collar (ft)	405.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit	
15:04:46	867.82	113	1842	412	737	753	28	12.71	1.95	0.5	6.45	6.85	0.89	135.92	247.66	2.73	
15:04:56	868.07	113	1809	410	737	748	24	12.66	1.97	0.43	6.49	6.92	0.91	126.56	248.11	2.73	
15:05:02	868.32	114	1860	413	737	748	24	12.77	1.96	0.45	6.39	6.82	1.1	138.39	248.37	2.75	
15:05:06	868.57	115	1830	416	736	753	28	12.76	1.93	0.43	6.44	6.77	1.03	150.11	248.62	2.75	
15:05:16	868.82	116	1799	422	737	753	28	12.6	1.92	0.35	6.55	6.97	0.89	118.69	248.87	2.76	
15:05:23	869.07	115	1788	417	737	753	28	12.65	1.9	0.31	6.63	6.94	0.74	118.12	249.11	2.76	
15:05:31	869.32	114	1787	416	737	753	28	12.58	1.9	0.31	6.63	6.93	0.72	116.67	249.36	2.76	
15:05:39	869.57	116	1791	421	737	753	28	12.58	1.98	0.33	6.57	6.89	0.75	112.91	249.64	2.76	
15:05:46	869.82	115	1791	419	736	753	24	12.56	1.92	0.31	6.58	6.98	0.74	121.49	249.86	2.76	
15:05:54	870.07	116	1794	421	737	748	24	12.57	1.94	0.31	6.58	6.92	0.72	114.17	250.13	2.77	
15:06:02	870.33	116	1793	419	737	753	28	12.56	1.9	0.32	6.58	6.97	0.81	116.47	250.37	2.77	
15:06:10	870.58	115	1791	418	736	753	28	12.55	1.9	0.32	6.59	6.94	0.67	115.39	250.62	2.77	
15:06:18	870.83	116	1796	420	736	753	28	12.56	1.93	0.31	6.58	6.94	0.68	116.41	250.9	2.77	
15:06:25	871.08	115	1802	417	737	748	24	12.56	1.92	0.31	6.59	6.94	0.74	112.27	251.13	2.78	
15:06:33	871.33	117	1805	423	736	748	24	12.57	1.98	0.37	6.58	6.94	0.84	117.24	251.39	2.78	
15:06:41	871.58	116	1805	419	737	753	28	12.55	1.94	0.31	6.59	6.94	0.72	114.51	251.62	2.78	
15:06:49	871.83	117	1807	424	737	748	24	12.55	1.91	0.34	6.59	6.93	0.67	116.12	251.88	2.78	
15:06:57	872.08	116	1811	418	737	753	28	12.55	1.92	0.3	6.59	6.97	0.68	110.21	252.13	2.78	
15:07:04	872.33	116	1810	422	737	753	28	12.55	1.95	0.34	6.62	6.97	0.69	122.69	252.39	2.79	
15:07:12	872.58	116	1809	420	738	753	28	12.55	1.95	0.35	6.60	6.94	0.74	112.68	252.63	2.79	
15:07:20	872.83	116	1810	420	738	748	28	12.55	1.92	0.3	6.60	6.94	0.62	116.18	252.88	2.79	
15:07:27	873.08	109	1743	396	736	753	45	12.56	1.97	0.42	6.56	6.69	1.27	126.15	253.14	2.79	
15:12:52	873.35	115	1647	418	741	757	28	14.58	1.91	0.31	4.56	4.96	2.35	100.84	253.4	2.79	
15:13:01	873.6	116	1759	429	965	1579	851	14.49	1.93	0.34	4.66	4.81	0.65	65.60	253.65	2.79	
15:13:09	873.85	115	1760	427	743	757	24	14.5	1.94	0.34	4.58	4.85	0.67	115.42	253.91	2.8	
15:13:17	874.1	116	1830	428	743	757	28	13.64	1.93	0.3	5.45	6.37	1.99	158.66	254.16	2.8	
15:13:33	874.35	115	1846	417	743	757	28	12.83	1.95	0.36	6.26	6.53	0.57	144.66	254.4	2.8	
15:13:30	874.6	116	1852	417	743	757	24	12.21	1.96	0.35	6.69	7.73	1.6	134.57	254.65	2.8	
15:13:36	874.85	112	1904	405	743	757	28	10.87	1.94	0.37	8.34	8.74	1.44	150.00	254.92	2.8	
15:13:41	875.1	113	1961	410	743	757	24	10.7	1.98	0.44	8.49	8.62	0.45	171.00	255.16	2.81	
15:13:47	875.35	113	1960	409	743	757	24	10.71	2.03	0.42	8.39	8.67	0.57	154.34	255.39	2.81	
15:13:53	875.6	113	1939	411	742	757	28	10.7	1.97	0.4	8.40	8.82	0.43	172.27	255.65	2.81	
15:13:58	875.85	113	1941	413	744	757	24	10.62	1.99	0.4	8.49	8.81	0.57	159.87	255.92	2.81	
15:14:04	876.1	113	1965	409	744	757	24	10.69	1.95	0.4	8.01	8.57	1.08	160.55	256.16	2.81	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	823.93			Bit Type =	Walker McDonald MP68R												
Ending Depth =	1231.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.05			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit	
15:14:09	826.38	113	1969	411	744	757	24	9.79	1.99	0.45	9.33	9.83	0.43	176.96	258.42	3.81	
15:14:14	826.81	111	2011	403	744	757	24	9.79	1.96	0.37	9.33	9.6	0.57	151.82	258.66	3.82	
15:14:20	826.88	113	2012	411	744	757	24	9.84	1.97	0.42	9.37	9.5	0.57	173.84	256.91	3.82	
15:14:25	827.31	115	1969	417	743	757	28	9.86	1.94	0.37	9.28	9.65	0.81	167.17	257.16	3.82	
15:14:31	827.36	115	1917	416	741	753	24	9.6	1.96	0.44	9.51	9.84	0.67	149.62	257.4	3.82	
15:14:36	827.61	114	2003	412	742	757	24	9.55	2.02	0.5	9.39	9.86	0.67	148.07	257.65	3.82	
15:14:44	827.86	114	2054	413	742	753	24	9.66	1.96	0.41	9.44	9.79	0.68	150.40	257.91	3.82	
15:14:49	828.11	115	1981	416	742	753	24	9.84	1.94	0.38	9.38	9.55	0.63	172.64	258.18	3.82	
15:14:54	828.38	113	2022	412	741	757	28	9.78	2.07	0.55	9.32	9.72	0.74	162.88	258.4	3.83	
15:15:00	828.61	115	1979	417	741	753	24	9.69	1.94	0.39	9.41	9.67	0.55	152.38	258.67	3.83	
15:15:07	828.86	114	1978	415	973	2041	1313	9.73	1.95	0.42	9.39	9.62	0.53	182.28	258.94	3.83	
15:15:12	829.11	113	1964	418	944	1425	693	9.72	1.93	0.43	9.38	9.74	0.67	202.67	259.16	3.83	
15:15:17	829.36	115	1947	418	742	757	24	9.7	1.94	0.41	9.41	9.79	0.68	169.39	259.42	3.83	
15:15:23	829.62	115	1968	417	742	757	28	9.74	1.97	0.42	9.37	9.65	0.57	162.18	259.65	3.83	
15:15:28	829.87	116	1981	420	742	757	24	9.71	1.98	0.49	9.39	9.69	0.62	161.05	259.92	3.84	
15:15:34	830.13	115	2027	417	741	753	24	9.71	2.03	0.57	9.39	9.72	0.67	161.61	260.19	3.84	
15:15:40	830.37	114	2041	416	739	753	24	9.79	2.03	0.54	9.35	9.72	0.69	158.38	260.43	3.84	
15:15:45	830.62	111	2131	408	831	1170	442	9.7	2.1	0.74	9.38	10.05	1.15	178.19	260.66	3.84	
15:15:50	830.87	111	2235	404	736	753	25	9.78	2.26	0.97	9.28	9.91	1.15	167.65	260.93	3.84	
15:15:56	831.13	114	2447	414	829	1628	899	13.18	2.39	1.3	5.88	11.06	0.02	77.28	261.16	3.85	
15:16:11	831.37	119	1758	431	740	753	25	15.51	1.68	0.28	3.53	4.55	2.03	99.44	261.41	3.85	
15:16:19	831.62	116	1834	423	740	753	24	14.78	1.99	0.38	4.27	4.62	0.62	115.69	261.69	3.85	
15:16:25	831.87	114	1875	415	737	746	24	14.54	1.91	0.45	4.59	5.22	1.1	132.59	261.92	3.85	
15:16:31	832.12	113	1909	411	740	753	24	14.18	2.02	0.54	4.66	5.19	0.85	157.47	262.17	3.85	
15:16:38	832.37	112	1921	408	738	753	28	13.53	2.06	0.54	5.51	5.84	0.96	141.97	262.42	3.86	
15:16:43	832.62	114	1916	414	736	753	28	13.44	1.94	0.42	5.68	6.01	0.81	160.89	262.67	3.86	
15:16:49	832.87	114	1932	414	738	748	24	13.43	2	0.44	5.81	5.91	0.65	146.23	262.91	3.86	
15:16:56	833.12	114	1937	413	737	748	48	13.43	2.05	0.48	5.62	5.85	0.53	148.02	263.17	3.86	
15:17:02	833.37	115	1969	417	1311	3315	1616	13.5	1.99	0.42	5.58	5.86	0.85	185.53	263.42	3.86	
15:17:07	833.62	113	1999	418	832	1180	482	13.5	2	0.5	5.54	5.91	0.79	183.44	263.67	3.86	
15:17:12	833.87	113	1996	408	739	753	24	13.54	2	0.54	5.51	5.79	0.68	185.78	263.91	3.86	
15:17:18	834.12	115	1967	417	736	753	28	13.48	2.06	0.56	5.56	5.91	0.72	163.47	264.17	3.87	
15:17:24	834.38	113	1973	411	738	783	28	13.23	2.06	0.54	5.61	7.64	1.84	157.72	264.43	3.87	
15:17:29	834.63	113	2105	410	737	753	28	12.26	2.17	0.7	6.77	7.16	0.64	172.86	264.7	3.87	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 9/22/83				
Starting Depth =	823.92	Bit Type =	Walker McDonald MP88H		
Ending Depth =	1531.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	8, 9, 12, 12		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	99.58	Mud Weight (lbs/gal) =	9.00		
DnString (ft) =	860.49	Pipe (ft) =	251.81	Collar (ft)	408.50

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
15:17:20	884.88	113	2104	412	739	748	24	12.46	2.14	0.71	6.58	6.94	0.77	181.74	284.02	2.87
15:17:40	885.13	112	2116	408	889	1178	454	12.36	2.93	0.58	6.68	7.37	1.24	174.82	285.19	2.87
15:17:45	885.38	114	2083	413	738	763	25	12.11	2.11	0.69	6.83	7.54	1.1	167.09	285.44	2.87
15:17:51	885.63	114	2172	413	738	748	24	11.72	2.12	0.8	7.32	7.68	0.79	174.81	285.69	2.88
15:17:56	885.85	112	2179	406	738	748	23	11.71	2.2	0.87	7.35	7.73	0.77	175.76	285.93	2.88
15:18:01	886.13	112	2191	406	738	748	25	11.75	2.25	0.96	7.29	7.85	1.22	168.85	286.18	2.88
15:18:06	886.36	112	2163	409	737	763	26	11.75	2.31	0.84	7.35	7.85	1.1	184.75	286.44	2.88
15:18:11	886.63	112	2161	407	737	748	23	11.75	2.23	0.89	7.31	7.88	0.98	171.72	286.67	2.88
15:18:17	886.88	114	2165	415	737	748	25	11.75	2.95	0.66	7.29	7.88	0.84	164.75	286.93	2.88
15:18:22	887.13	116	2176	415	737	748	24	11.76	2.07	0.74	7.28	7.73	0.89	177.56	287.18	2.88
15:18:27	887.38	112	2163	409	736	748	24	11.76	2.11	0.8	7.28	7.66	0.81	160.13	287.44	2.89
15:18:32	887.64	113	2153	410	737	763	26	11.76	2.15	0.81	7.27	7.73	0.96	180.43	287.67	2.89
15:18:40	887.89	114	2108	415	1509	2523	1819	11.72	2.15	0.76	7.37	7.83	1.05	124.39	287.97	2.89
15:18:45	888.14	114	2162	413	1517	2357	1888	11.8	2.18	0.79	7.28	7.68	0.86	175.02	288.21	2.89
15:18:48	888.39	113	2177	410	918	1236	802	11.77	2.19	0.84	7.28	7.78	0.91	248.46	288.46	2.89
15:18:54	888.64	115	2157	416	738	763	26	11.76	2.13	0.72	7.28	7.61	0.84	167.02	288.7	2.89
15:19:59	888.89	115	2154	416	736	748	24	11.76	2.11	0.71	7.28	7.68	0.79	181.01	288.93	2.89
15:19:04	889.14	113	2164	410	737	748	30	11.75	2.01	0.63	7.30	7.59	0.6	170.01	289.18	2.9
15:19:10	889.39	114	2158	415	737	763	26	11.73	2.13	0.7	7.32	7.66	0.79	166.39	289.44	2.9
15:19:15	889.64	113	2161	410	737	748	24	11.74	2.08	0.65	7.31	7.73	0.79	178.54	289.72	2.9
15:19:20	889.9	113	2170	411	736	748	24	11.77	2.04	0.57	7.28	7.54	0.69	183.29	289.96	2.9
15:19:25	890.15	112	2170	408	736	763	28	11.77	2.05	0.68	7.28	7.66	0.77	182.39	290.19	2.9
15:19:30	890.4	114	2165	416	738	763	28	11.77	2.08	0.53	7.27	7.61	0.77	172.13	290.44	2.9
15:19:36	890.65	114	2163	414	736	748	24	11.76	2.1	0.61	7.27	7.59	0.79	175.07	290.7	2.9
15:19:41	890.9	113	2150	411	736	763	28	11.74	2.03	0.44	7.30	7.64	0.65	179.02	290.94	2.91
15:19:46	891.15	112	2149	408	736	748	24	11.77	2.02	0.57	7.28	7.71	0.89	166.23	291.2	2.91
15:19:51	891.4	113	2139	416	736	763	28	11.74	2	0.49	7.30	7.71	0.84	175.91	291.46	2.91
15:19:56	891.65	114	2136	414	736	763	28	11.74	2.04	0.56	7.30	7.76	0.91	176.43	291.7	2.91
15:20:02	891.9	113	2123	411	737	748	41	11.78	2.03	0.58	7.27	7.64	0.81	161.48	291.95	2.91
15:20:08	892.15	115	2123	417	1703	2616	1884	11.8	2.06	0.59	7.29	7.64	0.74	145.82	292.22	2.91
15:20:13	892.4	113	2116	411	920	1384	682	11.75	2.07	0.67	7.29	7.64	0.72	216.50	292.45	2.91
15:20:17	892.65	114	2105	416	739	763	24	11.73	2.2	0.88	7.31	7.73	0.91	179.11	292.72	2.92
15:20:23	892.9	114	2110	414	738	763	28	11.74	2.08	0.69	7.31	7.83	0.98	170.86	292.94	2.92
15:20:28	893.15	114	2114	414	738	763	28	11.71	2.1	0.7	7.33	7.71	0.79	160.55	293.21	2.92

DOE high power morter test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/95				
Starting Depth =	623.82	Bit Type =	Walker McDonald MP-5H		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 12		
Hours On Bit =	4.05	Mud Type =	Water Based		
Average ROP =	98.58	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	860.49	Pipe (ft) =	251.81	Collar (ft)	408.60

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HHMMSS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Orbit	Orbit
15:20:33	893.41	113	2106	410	737	748	24	11.69	9.1	0.71	7.34	7.71	0.72	176.42	273.47	2.92
15:20:39	893.86	113	2110	412	738	748	24	11.69	2.05	0.66	7.36	7.78	0.86	152.98	273.7	2.92
15:20:44	893.91	113	2148	411	737	748	24	11.79	2.12	0.76	7.25	7.71	1.03	181.36	273.96	2.92
15:20:48	894.18	115	2161	418	738	748	24	11.81	2.12	0.8	7.24	7.66	1.05	179.32	274.2	2.92
15:20:55	894.41	113	2139	412	735	748	24	11.73	2.04	0.69	7.31	7.73	0.98	161.07	274.47	2.93
15:21:02	894.66	113	2064	409	738	748	24	11.34	3.03	0.62	7.76	8.21	1.27	131.96	274.7	2.93
15:21:10	894.91	116	2018	420	737	763	28	11.36	1.97	0.35	7.76	8.16	0.93	115.21	274.98	2.93
15:21:16	895.16	115	2083	417	736	748	24	11.43	1.97	0.45	7.61	7.87	0.81	142.59	275.21	2.93
15:21:23	895.41	116	2052	420	738	748	24	11.34	2.01	0.52	7.69	8.09	0.84	130.33	275.48	2.93
15:21:33	895.66	114	2032	415	1253	2219	1515	11.35	2	0.53	7.72	8.19	1.2	91.56	275.73	2.94
15:21:36	895.91	114	2137	415	1071	1891	851	11.78	2.06	0.56	7.36	7.71	0.86	364.02	275.96	2.94
15:21:43	896.17	113	2141	411	1659	2587	1845	11.77	1.98	0.56	7.36	7.83	1.13	127.09	276.22	2.94
15:21:47	896.42	113	2132	411	944	1372	840	11.76	2.04	0.61	7.27	7.71	0.98	251.21	276.47	2.94
15:21:52	896.67	112	2116	407	737	748	24	11.73	2.07	0.65	7.32	7.8	0.91	165.49	276.73	2.94
15:21:58	896.92	114	2119	413	736	753	28	11.67	1.98	0.44	7.36	7.78	0.93	152.68	276.98	2.94
15:22:04	897.17	115	2118	417	736	748	24	11.69	2	0.46	7.35	7.66	0.98	170.89	277.22	2.95
15:22:09	897.43	114	2129	415	736	748	24	11.74	2.01	0.54	7.31	7.78	1.03	155.01	277.46	2.95
15:22:15	897.67	114	2127	414	736	748	24	11.69	1.97	0.45	7.35	7.78	0.98	170.05	277.71	2.95
15:22:20	897.92	114	2133	415	736	748	24	11.69	2.03	0.49	7.35	7.8	0.98	167.43	277.96	2.95
15:22:26	898.17	113	2140	416	735	748	24	11.74	2.03	0.53	7.38	7.71	0.89	163.64	278.22	2.95
15:22:30	898.42	114	2178	416	736	753	28	10.74	2.15	0.9	8.39	9.19	2.42	190.76	278.48	2.95
15:22:46	898.67	114	2157	415	861	1579	855	14.82	2.15	0.7	4.19	10.7	11.49	62.37	278.72	2.96
15:22:51	898.92	115	1926	427	738	753	28	13.43	2	0.59	5.60	6.34	2.66	144.04	278.96	2.96
15:22:57	899.17	115	2065	422	1383	2385	1873	13.05	2.04	0.61	6.02	6.49	0.98	157.71	279.23	2.96
15:23:02	899.42	117	2070	424	745	838	109	13.03	2.06	0.61	6.00	6.51	1.01	166.06	279.47	2.96
15:23:07	899.67	117	2076	424	811	1056	812	13.02	1.97	0.54	6.03	6.46	0.96	177.24	279.74	2.96
15:23:13	899.92	115	2061	418	736	753	28	13.01	2.02	0.55	6.02	6.51	1.03	160.16	279.98	2.96
15:23:18	900.18	115	2049	416	736	753	28	13.01	1.96	0.44	6.01	6.44	0.98	171.39	280.23	2.97
15:23:24	900.43	115	2021	417	738	753	28	13	1.95	0.49	6.02	6.49	0.93	165.21	280.48	2.97
15:23:30	900.68	115	1986	416	738	748	20	12.98	2	0.52	6.11	6.61	1.03	152.85	280.73	2.97
15:23:36	900.93	117	1836	426	738	753	28	11.99	1.93	0.33	7.09	8	2.06	134.31	280.98	2.97
15:23:44	901.18	115	1543	416	737	753	28	11.02	2.02	0.45	8.02	9.48	2.15	122.67	281.24	2.97
15:23:49	901.43	115	1901	417	737	748	24	9.51	1.95	0.42	9.54	10.58	1.65	161.48	281.48	2.97
15:23:55	901.68	115	1958	416	737	753	28	9.83	2.01	0.52	10.21	10.53	0.67	154.85	281.73	2.98

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/99																
Starting Depth =	823.82			Bit Type =	Walker McDonald MP56H												
Ending Depth =	1931.19			Bit Size =	4.75												
Total Depth Drilled	407.37			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	291.81				Collar (ft)	468.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
15:24:01	901.93	115	1987	416	738	748	34	9.3	2.04	0.54	10.15	10.58	0.78	156.66	281.97	2.96
15:24:06	902.16	114	2005	412	738	753	34	8.99	2.03	0.53	10.15	10.48	0.59	165.58	282.23	2.96
15:24:13	902.43	114	1950	416	739	753	36	8.81	1.98	0.5	10.23	10.58	0.66	134.89	282.46	2.96
15:24:19	902.68	115	1932	416	739	753	36	8.12	1.94	0.38	10.93	12.33	2.32	146.81	282.73	2.96
15:24:25	902.93	114	2039	413	738	753	36	8.36	1.99	0.43	12.70	13.67	1.84	161.82	282.99	2.96
15:24:30	903.19	113	2061	412	738	753	38	8.65	1.98	0.43	13.16	13.48	0.64	165.06	283.25	2.96
15:24:35	903.43	115	2059	418	738	753	24	8.62	2.01	0.43	13.14	13.48	0.67	166.80	283.48	2.85
15:24:41	903.69	114	2113	414	737	757	32	8.99	2.05	0.45	13.08	13.96	0.67	162.43	283.76	2.85
15:24:46	903.94	113	2103	411	738	748	30	8	1.96	0.35	13.08	13.33	0.62	183.89	283.98	2.85
15:24:51	904.19	112	2103	408	738	753	34	8.99	1.96	0.41	13.02	13.96	0.57	172.05	284.23	2.99
15:24:57	904.44	112	2108	408	738	753	29	8.64	1.94	0.33	13.03	13.31	0.86	171.33	284.51	2.99
15:25:03	904.69	115	1975	418	739	757	41	10.58	1.92	0.29	8.47	13.17	9.34	133.46	284.74	2.99
15:31:39	903.45	116	1823	421	739	753	24	19.34	1.9	0.33	8.06	8.53	0.93	158.58	284.76	3
15:31:44	903.7	115	1851	417	739	753	24	19.32	1.88	0.34	0.09	0.5	0.81	163.72	284.75	3
15:32:03	904.96	115	1761	418	737	748	28	11.73	1.84	0.4	7.64	9.34	9.01	122.69	285	3
15:32:09	905.21	115	1893	417	736	753	24	10.3	2.01	0.5	9.14	9.67	1.01	141.11	285.25	3
15:32:15	905.46	114	1911	416	740	753	24	10.31	2	0.54	9.14	9.65	0.81	151.04	285.51	3.01
15:32:22	905.71	115	1905	419	739	758	28	10.32	1.99	0.48	9.13	9.67	0.84	127.15	285.78	3.01
15:32:28	905.96	115	1923	419	740	753	24	10.29	1.94	0.41	9.15	9.48	0.77	150.84	286.02	3.01
15:32:35	906.21	116	1911	422	739	758	24	10.29	2.03	0.47	9.16	9.53	0.64	134.05	286.28	3.01
15:32:42	906.46	115	1901	419	739	753	28	10.27	1.95	0.39	9.16	9.6	0.86	138.38	286.51	3.01
15:32:48	906.71	117	1927	424	739	753	24	10.34	1.94	0.37	9.09	9.5	0.81	150.07	286.75	3.02
15:32:54	906.96	116	1951	421	739	753	24	10.37	2.03	0.48	9.07	9.46	0.81	139.77	287.01	3.02
15:33:00	907.21	115	1961	419	740	753	24	10.39	2.03	0.54	9.05	9.45	0.84	155.08	287.26	3.02
15:33:06	907.46	117	1929	423	738	753	28	10.37	1.98	0.46	9.08	9.55	0.91	144.93	287.53	3.02
15:33:13	907.71	115	1909	418	739	753	28	10.23	1.99	0.49	9.21	9.74	0.96	133.50	287.76	3.02
15:33:19	907.96	115	1925	418	739	758	24	9.95	1.94	0.4	9.46	9.84	0.69	156.88	288.02	3.02
15:33:25	908.21	114	1908	418	738	753	28	9.88	1.96	0.44	9.55	9.93	0.74	133.31	288.27	3.03
15:33:32	908.46	115	1900	422	739	753	28	9.75	1.99	0.47	9.65	10.56	1.29	140.73	288.52	3.03
15:33:38	908.71	114	1962	415	739	753	28	8.25	2	0.38	11.16	11.68	1.98	148.25	288.76	3.03
15:33:43	908.97	114	2054	413	739	753	24	7.99	1.94	0.33	11.46	11.75	0.85	184.67	289.01	3.03
15:33:49	909.22	113	2066	410	739	753	24	8	1.95	0.36	11.43	11.73	0.57	169.47	289.27	3.03
15:33:54	909.47	113	2073	412	739	753	24	8.01	2.03	0.46	11.43	11.71	0.85	159.25	289.52	3.03
15:34:00	909.72	114	2077	413	739	753	24	8.03	1.94	0.4	11.41	11.71	0.8	174.95	289.76	3.04

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																	
Starting Depth =	625.92			Bit Type =	Walker McDonnald MF58H													
Ending Depth =	1031.19			Bit Size =	4.75													
Total Depth Drilled	407.27			Bit Nozzles =		8, 8, 12, 12												
Hours On Bit =	4.09			Mud Type =		Water Based												
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00												
Drillstring (ft) =	680.49			Pipe (ft) =	291.81				Collar (ft)	408.80								

TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
15:34:05	909.97	113	2067	409	740	753	24	8.02	1.93	0.36	11.42	11.68	0.55	162.45	290.01	3.04
15:34:11	910.22	113	2053	412	739	757	29	8.01	1.97	0.47	11.43	11.78	0.69	155.53	290.37	3.04
15:34:16	910.47	114	2048	413	740	753	24	7.98	1.98	0.42	11.47	11.78	0.72	165.68	290.52	3.04
15:34:23	910.72	113	2028	411	739	763	24	7.9	1.95	0.45	11.54	11.9	0.6	141.83	290.8	3.04
15:34:28	910.97	114	2059	414	739	763	24	7.66	1.99	0.46	11.46	11.92	0.75	161.75	291.03	3.04
15:34:34	911.22	113	2037	412	736	763	41	7.83	1.94	0.49	11.56	11.87	0.67	157.64	291.29	3.04
15:34:40	911.48	114	2034	414	736	748	24	7.92	2	0.43	11.56	11.85	0.65	150.16	291.52	3.05
15:34:45	911.73	113	2039	410	736	748	24	7.91	2.03	0.56	11.53	11.9	0.69	166.54	291.78	3.05
15:34:51	911.98	114	2045	413	736	748	28	7.92	2	0.54	11.89	11.9	0.65	153.36	292.02	3.05
15:34:57	912.23	112	2041	408	736	748	24	7.89	2.06	0.46	11.51	11.85	0.72	163.72	292.28	3.05
15:35:02	912.48	114	2053	413	736	748	24	7.9	2.01	0.48	11.50	11.9	0.81	157.36	292.53	3.06
15:35:08	912.73	114	2060	415	736	748	24	7.95	2.01	0.52	11.48	11.9	0.64	154.83	292.8	3.06
15:35:13	912.98	113	2042	409	736	753	28	7.83	1.94	0.42	11.47	11.8	0.77	178.74	293.02	3.06
15:35:20	913.23	114	2024	414	736	753	28	7.85	2.04	0.46	11.54	11.94	0.84	141.64	293.27	3.06
15:35:26	913.48	115	2024	416	737	748	24	7.85	1.97	0.42	11.55	11.87	0.84	156.94	293.52	3.06
15:35:32	913.73	114	2017	416	736	748	24	7.85	1.99	0.47	11.53	11.92	0.77	146.73	293.78	3.06
15:35:38	913.98	114	2031	415	737	748	24	7.87	2.01	0.54	11.53	11.87	0.81	146.97	294.02	3.06
15:35:43	914.23	112	2053	406	737	748	24	7.87	1.96	0.48	11.53	11.87	0.84	166.89	294.27	3.06
15:35:49	914.48	115	2047	419	736	753	28	7.86	1.97	0.43	11.53	11.94	0.81	145.88	294.53	3.07
15:35:55	914.73	113	2040	411	736	748	28	7.79	1.97	0.48	11.61	12.06	0.91	153.53	294.78	3.07
15:36:02	914.98	114	2041	412	736	753	28	7.79	2.01	0.49	11.61	12.02	0.81	142.56	295.04	3.07
15:36:08	915.23	115	1996	416	736	748	24	7.74	2	0.46	11.66	12.06	0.84	152.12	295.3	3.07
15:36:15	915.48	114	2012	415	736	748	24	7.8	1.96	0.44	11.60	11.97	0.77	148.91	295.53	3.07
15:36:21	915.73	115	2049	416	737	748	24	7.94	1.98	0.46	11.46	11.92	1.48	141.35	295.78	3.07
15:36:27	915.98	115	1996	418	736	748	24	9	1.98	0.44	10.40	11.86	2.61	138.53	296.02	3.08
15:36:34	916.23	115	2023	417	736	748	24	7.75	2.02	0.48	11.66	12.09	0.88	146.02	296.28	3.08
15:36:41	916.49	116	2015	417	738	748	24	7.69	1.94	0.4	11.72	12.09	0.72	125.36	296.53	3.08
15:36:47	916.74	113	2043	411	738	748	24	7.71	2.06	0.5	11.70	12.14	0.68	150.91	296.78	3.08
15:36:53	916.99	113	2030	410	738	748	24	7.69	2.02	0.53	11.71	12.09	0.74	132.56	297.06	3.08
15:37:00	917.24	115	2020	419	738	748	24	7.68	2.01	0.44	11.73	12.06	0.74	138.17	297.27	3.08
15:37:07	917.49	114	2017	414	738	748	24	7.67	1.98	0.41	11.73	12.11	0.78	133.79	297.55	3.08
15:37:14	917.74	116	1996	419	736	748	24	7.64	1.98	0.42	11.76	12.18	0.84	123.15	297.79	3.09
15:37:21	917.99	114	2001	414	736	748	28	7.62	1.98	0.42	11.78	12.14	0.81	134.56	298.04	3.09
15:37:28	918.24	114	2006	413	736	748	28	7.66	1.98	0.41	11.73	12.09	0.72	125.84	298.33	3.09

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/22/99																
Starting Depth =	523.92			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1931.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		8, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.50											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled	
15:37:35	918.49	113	2033	418	735	748	24	7.69	1.94	0.39	11.78	12.86	0.72	139.41	295.54	3.1	
15:37:41	918.74	114	2044	413	735	748	28	7.74	1.98	0.41	11.67	12.09	0.84	138.44	295.79	3.1	
15:37:48	918.99	114	2043	414	734	748	28	7.75	1.97	0.4	11.65	12.02	0.79	133.24	299.04	3.1	
15:37:54	919.25	114	2022	413	735	748	24	7.65	1.94	0.36	11.74	12.02	0.62	144.46	298.3	3.1	
15:38:01	919.5	114	2064	413	736	748	24	7.68	1.96	0.44	11.72	12.06	0.77	128.69	299.55	3.1	
15:38:08	919.75	115	2074	418	735	748	24	7.7	1.94	0.41	11.78	12.04	0.72	137.55	299.79	3.1	
15:38:14	920	115	2082	418	735	748	24	7.68	1.97	0.38	11.72	12.02	0.65	135.25	300.04	3.11	
15:38:21	920.25	117	2071	424	735	748	24	7.73	1.99	0.42	11.68	12.06	0.74	135.03	300.3	3.11	
15:38:28	920.5	115	2063	413	735	748	24	7.67	2	0.43	11.73	12.09	0.78	140.12	300.55	3.11	
15:38:35	920.75	115	2022	418	736	748	28	7.62	1.95	0.41	11.78	12.11	0.74	128.18	300.81	3.11	
15:38:42	921	114	2011	414	734	753	33	7.57	1.94	0.33	11.82	12.16	0.79	126.62	301.06	3.11	
15:38:48	921.25	115	2003	417	735	748	28	7.57	1.95	0.42	11.83	12.23	0.84	125.03	301.3	3.12	
15:38:57	921.5	115	2039	417	735	748	24	7.58	1.99	0.43	11.81	12.21	0.74	117.24	301.56	3.12	
15:39:04	921.75	113	2030	410	733	744	24	7.62	1.94	0.37	11.77	12.18	0.96	133.76	301.81	3.12	
15:39:11	922	115	1965	416	736	748	28	7.58	1.93	0.31	11.83	12.16	0.74	117.34	302.05	3.12	
15:39:18	922.25	116	1945	419	735	744	20	7.68	1.94	0.34	11.71	12.06	0.74	134.57	303.3	3.12	
15:39:25	922.5	115	1987	416	735	748	24	7.56	2.01	0.44	11.83	12.21	0.86	134.72	302.56	3.13	
15:39:32	922.75	115	2037	416	735	748	24	7.65	1.97	0.35	11.73	12.04	0.69	127.58	302.79	3.13	
15:39:39	923	114	2036	413	735	748	24	7.66	1.94	0.37	11.74	12.09	0.67	139.46	303.05	3.13	
15:39:47	923.25	115	1980	419	734	748	28	7.54	1.92	0.33	11.85	12.26	0.81	112.04	303.3	3.13	
15:39:54	923.51	114	2004	413	733	744	20	7.61	1.94	0.41	11.78	12.23	0.93	128.52	303.56	3.13	
15:40:01	923.76	115	1993	418	734	744	20	7.54	1.94	0.41	11.86	12.23	0.74	119.77	303.81	3.14	
15:40:09	924.01	114	2015	412	736	748	24	7.58	1.93	0.41	11.81	12.23	0.86	116.62	304.05	3.14	
15:40:16	924.26	115	2016	416	734	744	24	7.64	1.96	0.38	11.79	12.14	0.69	127.32	304.3	3.14	
15:40:22	924.51	111	2196	406	734	748	28	7.89	2.33	1.04	11.56	12.18	1.56	148.53	304.55	3.14	
15:40:28	924.76	114	2004	416	734	748	24	8.36	2	0.48	11.03	11.44	0.91	127.33	304.8	3.14	
15:40:35	925.01	116	1939	420	735	748	24	8.37	2.02	0.48	11.02	11.39	0.69	128.38	305.06	3.15	
15:40:42	925.26	113	2008	412	734	744	24	8.48	2.01	0.49	10.90	11.35	0.86	146.26	305.32	3.15	
15:40:47	925.51	115	2025	418	734	744	20	8.83	1.93	0.4	10.55	11.08	1.15	206.97	305.58	3.15	
15:40:54	925.76	116	2010	420	735	748	24	8.34	3.08	0.59	11.15	11.66	1.29	124.78	305.8	3.15	
15:41:02	926.01	115	2064	418	734	748	28	8.09	2.09	0.59	11.29	11.53	0.72	115.61	306.06	3.15	
15:41:10	926.26	115	2036	416	735	748	28	8.1	2.05	0.63	11.28	11.8	1.01	114.23	306.32	3.15	
15:41:16	926.51	113	2066	409	735	748	24	8.42	2.09	0.58	10.97	11.42	0.91	140.47	306.57	3.15	
15:41:22	926.76	116	2041	416	735	748	24	8.35	1.98	0.46	11.04	11.42	0.84	154.36	306.81	3.15	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/23/98																
Starting Depth =	623.82			Bit Type =	Walker McDonnald MP66H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.37			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.03			Mud Type =		Water Based											
Average ROP =	96.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
15:41:28	927.02	114	2065	414	733	744	24	8.4	2.08	0.58	10.99	11.42	0.91	141.11	307.08	3.18
15:41:35	927.27	113	2058	409	734	744	24	8.26	2.04	0.6	11.13	11.96	0.81	136.81	307.33	3.18
15:41:43	927.52	114	2054	414	734	748	28	8.19	2.02	0.5	11.20	11.58	0.75	131.38	307.57	3.18
15:41:51	927.77	115	2026	418	733	748	28	8.01	1.98	0.39	11.36	11.71	0.74	181.71	307.83	3.17
15:41:59	928.02	113	2057	409	733	748	28	8.05	1.94	0.39	11.34	11.71	0.85	111.34	308.06	3.17
15:42:08	928.37	115	2036	416	734	748	24	8.08	1.98	0.39	11.33	11.73	0.85	166.69	308.32	3.17
15:42:14	928.52	114	2035	415	735	748	24	8.33	1.96	0.4	11.08	11.44	0.79	142.18	308.58	3.17
15:42:22	928.77	113	2039	411	735	748	28	8.19	2.03	0.48	11.20	11.54	0.69	120.78	308.82	3.17
15:42:29	929.02	114	2034	413	736	744	20	8.35	2.03	0.56	11.03	11.51	1.08	132.62	309.07	3.16
15:42:34	929.27	115	2045	416	736	748	28	8.42	1.99	0.45	10.96	11.32	0.84	166.56	309.32	3.16
15:42:40	929.52	113	2055	413	735	744	20	8.35	2.04	0.5	11.03	11.44	0.81	149.73	309.58	3.16
15:42:47	929.77	115	2056	416	735	744	24	8.36	1.99	0.47	11.03	11.44	0.79	143.72	309.83	3.16
15:42:53	930.02	114	2070	414	736	748	28	8.32	1.98	0.4	11.07	11.42	0.77	141.76	310.07	3.16
15:43:00	930.27	113	2103	416	734	744	24	8.34	1.98	0.43	11.05	11.51	0.86	134.66	310.32	3.19
15:43:06	930.52	114	2057	415	734	748	28	8.26	1.97	0.46	11.13	11.54	0.69	142.53	310.57	3.19
15:43:13	930.77	114	2053	414	735	750	28	8.33	1.96	0.42	11.05	11.39	0.75	137.94	310.81	3.19
15:43:19	931.02	116	2042	422	736	753	28	8.34	1.95	0.38	11.06	11.39	0.79	150.95	311.07	3.19
15:43:26	931.27	115	2052	416	735	748	28	8.28	1.94	0.49	11.11	11.54	0.65	136.21	311.34	3.19
15:43:33	931.53	115	2024	417	734	748	24	8.36	2.04	0.52	11.03	11.42	0.56	132.05	311.58	3.19
15:43:39	931.78	113	2031	415	734	748	28	8.24	1.95	0.37	11.15	11.59	0.54	142.66	311.83	3.2
15:43:46	932.03	115	2016	416	735	748	28	8.21	1.94	0.42	11.18	11.54	0.72	135.52	312.07	3.2
15:43:53	932.28	114	2022	413	735	753	28	8.28	1.93	0.38	11.11	11.51	0.64	134.36	312.32	3.2
15:43:59	932.53	115	2022	418	735	748	24	8.28	1.96	0.37	11.11	11.49	0.66	141.42	312.58	3.2
15:44:07	932.78	116	2015	422	736	744	20	8.28	1.92	0.35	11.10	11.42	0.69	133.65	312.82	3.2
15:44:13	933.03	115	2016	417	736	748	24	8.28	1.92	0.4	11.10	11.47	0.69	143.67	313.07	3.21
15:44:20	933.28	116	2001	422	735	748	24	8.28	1.91	0.33	11.11	11.51	0.79	134.15	313.33	3.21
15:44:27	933.53	115	1987	421	735	748	28	8.21	1.93	0.31	11.18	11.54	0.72	123.31	313.6	3.21
15:44:34	933.78	113	1997	433	733	748	28	8.21	1.88	0.32	11.18	11.49	0.65	126.25	313.84	3.21
15:44:42	934.03	115	1979	427	735	748	24	8.17	1.93	0.33	11.21	11.59	0.84	117.34	314.09	3.21
15:44:49	934.28	115	1985	427	734	748	24	8.2	1.95	0.39	11.19	11.54	0.69	128.38	314.33	3.22
15:44:56	934.53	117	1991	426	735	748	24	8.15	2.01	0.47	11.23	11.54	0.74	124.03	314.58	3.22
15:45:04	934.79	114	1982	412	734	748	28	8.1	1.83	0.32	11.28	11.75	0.69	112.12	314.84	3.22
15:45:12	935.04	116	1921	419	736	748	24	8.04	1.91	0.28	11.34	11.56	0.6	112.75	315.07	3.22
15:45:22	935.29	116	1998	420	733	744	24	7.97	1.93	0.3	11.41	11.68	0.65	93.95	315.34	3.22

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 3/22/96																
Starting Depth =	825.92			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	497.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	680.49			Pipe (ft) =	251.81			Collar (ft)	428.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit	
15:49:31	935.94	116	1875	419	733	748	24	7.9	1.91	0.29	11.46	11.8	0.65	84.90	315.5	3.23	
15:49:41	936.79	117	1875	423	733	748	24	7.92	1.91	0.3	11.46	11.73	0.57	83.64	315.84	3.23	
15:49:51	936.64	116	1870	422	734	748	26	7.9	2.01	0.47	11.47	11.71	0.57	86.33	316.08	3.23	
15:49:01	936.79	116	1897	420	734	744	20	7.66	2.02	0.5	11.42	11.78	0.72	86.99	316.33	3.24	
15:51:01	936.97	116	1439	420	738	753	24	16.22	1.86	0.23	3.61	6.97	6.53	121.03	316.62	3.24	
15:51:06	936.82	114	1706	415	739	753	28	10.48	1.84	0.31	9.37	11.32	4.62	102.72	316.86	3.25	
15:51:15	937.07	113	1900	411	738	753	28	7.7	1.86	0.38	12.17	13.17	2.27	139.77	317.11	3.25	
15:51:24	937.32	114	1925	412	739	753	28	6.76	1.87	0.38	13.09	13.52	0.79	105.73	317.36	3.25	
15:51:31	937.57	115	1918	416	739	753	28	6.76	1.88	0.38	13.12	13.46	0.72	116.38	317.63	3.25	
15:51:40	937.82	115	1918	416	739	753	28	6.76	1.84	0.34	13.11	13.4	0.66	104.40	317.87	3.25	
15:51:45	938.07	115	1968	418	738	757	32	6.82	1.84	0.33	13.06	13.36	0.66	114.85	318.13	3.26	
16:01:31	939.9	113	1947	410	737	748	24	6.86	1.86	0.47	10.71	11.97	6.51	132.46	319.94	3.29	
16:01:36	940.15	114	2001	413	736	748	24	9.23	2.07	0.56	10.32	11.08	1.51	176.09	320.19	3.29	
16:01:42	940.4	115	2010	416	734	748	26	9.33	3.03	0.53	10.23	10.72	1.22	151.82	320.44	3.29	
16:01:48	940.65	115	1973	417	736	753	28	9.48	1.98	0.4	10.08	10.53	0.96	151.89	320.69	3.29	
16:01:53	940.9	113	2024	412	736	748	24	9.48	2.06	0.53	10.19	10.53	0.96	164.48	320.94	3.29	
16:02:00	941.15	116	1993	420	736	748	24	9.43	1.98	0.44	10.12	10.56	0.96	139.33	321.22	3.3	
16:02:07	941.4	115	1914	416	736	748	24	9.45	2.03	0.51	10.19	10.69	1.1	144.77	321.47	3.3	
16:02:13	941.65	113	2025	413	734	748	26	9.52	2.06	0.57	10.33	10.8	0.89	150.39	321.71	3.3	
16:02:19	941.9	114	2003	414	735	748	24	9.2	2.08	0.62	10.39	10.8	0.86	146.41	321.96	3.3	
16:02:25	942.15	115	2025	417	735	748	24	9.18	2.02	0.49	10.38	10.87	0.96	153.21	322.2	3.3	
16:02:32	942.4	115	1995	415	735	748	24	9.27	1.98	0.43	10.29	10.7	0.81	137.43	322.46	3.31	
16:02:38	942.65	115	1993	418	734	748	26	9.23	2.09	0.61	10.13	10.8	0.89	143.78	322.72	3.31	
16:02:45	942.91	113	1997	415	735	748	24	9.27	2.03	0.51	10.29	10.82	0.96	133.92	322.95	3.31	
16:02:51	943.16	115	1964	417	735	748	26	9.24	2.05	0.52	10.31	10.72	0.84	166.65	323.2	3.31	
16:02:58	943.41	114	1978	413	735	748	24	9.22	1.98	0.43	10.34	10.72	0.84	142.67	323.46	3.31	
16:03:10	943.86	115	1856	419	736	748	33	8.78	3	0.44	10.79	11.2	1.01	76.34	323.71	3.32	
16:03:19	943.91	113	1857	412	735	748	28	8.11	3	0.39	11.44	12.15	1.58	86.44	323.95	3.32	
16:03:28	944.16	114	1917	413	735	748	24	7.61	1.99	0.41	11.86	12.38	0.81	97.11	324.2	3.32	
16:03:40	944.41	115	1872	419	735	753	28	7.47	1.93	0.35	12.09	12.82	0.93	78.75	324.46	3.32	
16:03:46	944.66	114	2021	412	735	748	24	7.9	2.12	0.63	11.65	12.18	1.99	136.61	324.7	3.33	
16:03:52	944.91	114	2006	414	734	744	24	10.52	1.89	0.46	9.92	10.17	1.89	149.39	324.97	3.33	
16:03:59	945.16	115	1965	417	734	744	24	9.53	1.94	0.54	10.03	10.8	1.75	140.73	325.2	3.33	
16:04:05	945.41	114	3012	414	738	748	24	9.38	2.12	0.74	10.19	19.64	1.8	146.01	325.45	3.33	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/22/96																
Starting Depth =	633.92			Bit Type =	Walker McDonnald MF58H												
Ending Depth =	1631.19			Bit Size =	4.75												
Total Depth Drilled	497.27			Bit Nozzles =	9, 9, 12, 12												
Hours On Bit =	4.09			Mud Type =	Water Based												
Average ROP =	99.59			Mud Weight (lbs/gal) =	8.00												
Drillstring (ft) =	660.49			Pipe (ft) =	291.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
16:04:11	945.66	115	1994	419	734	748	24	10	1.99	0.35	9.59	10.17	1.2	148.41	325.7	3.33
16:04:17	945.91	115	1945	418	730	748	24	9.66	1.94	0.35	9.89	10.27	0.79	145.44	325.96	3.33
16:04:25	946.16	115	1958	416	734	748	24	9.59	1.98	0.38	9.98	10.36	0.86	122.30	326.23	3.34
16:04:31	946.41	115	1979	416	734	744	24	9.66	1.95	0.35	9.97	10.41	0.81	136.51	326.47	3.34
16:04:38	946.67	115	1963	417	734	748	24	9.66	1.99	0.4	9.99	10.34	0.77	124.38	326.71	3.34
16:04:45	946.92	113	1942	411	734	748	24	9.61	1.93	0.39	9.95	10.38	0.84	128.70	326.96	3.34
16:04:52	947.17	115	1955	418	736	748	24	9.64	1.94	0.41	9.91	10.32	0.86	149.23	327.22	3.34
16:04:59	947.42	115	1934	419	739	748	24	9.59	1.96	0.35	9.96	10.32	0.81	121.06	327.47	3.35
16:05:06	947.67	115	1928	417	736	748	24	9.61	1.93	0.35	9.94	10.38	0.90	134.38	327.71	3.35
16:05:13	947.92	115	1935	419	736	748	24	9.62	1.94	0.35	9.94	10.84	0.84	130.48	327.96	3.35
16:05:19	948.17	114	2017	413	734	748	28	9.87	2.09	0.61	9.68	10.22	1.15	151.65	328.26	3.35
16:05:25	948.42	114	1930	415	733	748	28	9.7	1.96	0.41	9.85	10.25	1.03	150.11	328.49	3.35
16:05:33	948.67	116	1922	420	733	744	24	9.66	2	0.43	10.06	10.48	0.98	117.17	328.75	3.36
16:05:40	948.92	116	1921	421	734	748	24	9.63	1.96	0.37	10.03	10.48	0.91	127.48	328.98	3.36
16:05:47	949.17	115	1932	417	734	748	28	9.66	1.96	0.41	10.01	10.39	0.94	129.81	329.21	3.36
16:05:55	949.42	116	1911	422	735	748	24	9.46	1.95	0.4	10.09	10.48	0.79	108.53	329.46	3.36
16:06:03	949.67	117	1922	424	735	753	33	9.41	1.94	0.36	10.14	10.48	0.74	115.94	329.73	3.36
16:06:11	949.92	114	1987	414	733	748	28	9.62	2.03	0.5	10.02	10.44	0.96	113.02	329.98	3.37
16:06:18	950.18	114	1980	414	734	744	24	9.55	1.97	0.46	10.09	10.48	1.01	122.98	330.22	3.37
16:06:25	950.43	114	1988	413	735	748	24	9.64	1.96	0.42	9.91	10.39	1.01	133.14	330.47	3.37
16:06:31	950.68	113	2046	411	735	744	28	9.79	2.04	0.49	9.79	10.36	1.51	138.56	330.72	3.37
16:06:38	950.93	116	1905	420	736	748	24	10.18	1.99	0.42	9.36	9.86	1.2	146.73	331	3.37
16:06:45	951.18	115	1962	418	736	748	24	10	1.92	0.34	9.55	10.05	1.01	116.09	331.25	3.38
16:06:53	951.43	114	1905	415	735	748	24	9.9	1.94	0.36	9.64	10.01	0.84	117.82	331.5	3.38
16:06:59	951.68	113	2006	412	734	748	24	10.33	2.06	0.65	9.22	9.91	1.27	159.47	331.75	3.38
16:07:05	951.93	114	1958	412	734	744	20	10.2	1.95	0.38	9.04	9.84	1.03	138.60	331.98	3.38
16:07:12	952.18	116	1924	420	734	748	28	10.08	1.94	0.34	9.47	9.84	0.84	119.26	332.23	3.38
16:07:19	952.43	117	1917	424	736	748	24	10.07	1.94	0.38	9.48	10.01	1.01	123.07	332.48	3.39
16:07:26	952.68	115	1917	417	736	748	24	10.07	1.95	0.43	9.47	9.89	0.89	138.56	332.73	3.39
16:07:32	952.93	114	1928	415	736	752	28	10.12	1.94	0.38	9.42	9.89	1.01	136.48	332.98	3.39
16:07:39	953.18	115	1903	419	735	748	24	10.09	1.95	0.45	9.48	9.89	0.96	125.83	333.23	3.39
16:07:46	953.43	113	1918	417	736	748	24	10.06	1.95	0.34	9.45	9.89	0.59	136.09	333.48	3.39
16:07:53	953.68	115	1932	417	734	748	24	10.07	1.95	0.38	9.47	9.89	0.93	125.44	333.73	3.39
16:08:00	953.93	114	1925	415	736	744	24	10.09	1.94	0.37	9.45	9.84	0.84	137.19	333.97	3.4

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.92			Bit Type =	Walker McDonald MF68H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.05			Mud Type =		Water Based											
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
16:08:06	954.18	115	1953	419	733	744	24	10.15	1.94	0.33	9.33	9.91	1.08	141.31	334.23	3.4
16:08:13	954.44	115	1941	419	734	744	24	10.17	2.02	0.47	9.37	9.84	1.2	133.08	334.48	3.4
16:08:15	954.69	114	2661	414	733	748	28	10.51	2.11	0.62	9.63	9.87	1.27	156.29	334.74	3.4
16:08:24	954.94	115	1975	418	734	748	24	10.48	2.02	0.45	9.06	9.63	1.08	133.96	335	3.4
16:08:31	955.19	117	1919	424	736	748	24	10.48	1.93	0.31	9.06	9.48	0.91	129.86	335.26	3.41
16:08:38	955.44	115	1924	417	733	748	25	10.48	2.04	0.44	9.06	9.48	0.95	127.77	335.49	3.41
16:08:46	955.69	115	1880	417	733	748	25	10.48	1.94	0.35	9.06	9.48	0.89	129.18	335.73	3.41
16:08:52	955.94	115	1971	422	734	748	24	10.55	2.04	0.47	9.56	9.5	1.1	143.56	335.99	3.41
16:08:59	956.19	114	1942	419	736	748	24	10.54	1.94	0.34	9.56	9.41	0.93	131.02	336.26	3.41
16:09:06	956.44	114	1973	413	736	748	24	10.53	1.94	0.41	9.61	9.48	1.03	138.28	336.48	3.41
16:09:13	956.69	117	2005	423	736	748	24	10.57	1.99	0.42	9.67	9.48	1.03	130.35	336.73	3.42
16:09:19	956.94	115	1957	421	736	748	24	10.52	1.95	0.35	9.61	9.41	0.93	126.53	336.99	3.42
16:09:25	957.19	114	1951	415	735	748	24	10.59	1.94	0.33	9.66	9.46	1.17	147.05	337.26	3.42
16:09:32	957.44	114	1923	415	736	748	24	10.56	1.94	0.43	9.59	9.43	1.03	138.08	337.5	3.42
16:09:40	957.69	115	1968	422	735	753	28	10.38	1.93	0.33	9.16	9.62	0.96	115.86	337.75	3.42
16:09:47	957.94	115	1958	416	739	748	24	10.51	2.03	0.48	9.62	9.57	1.08	128.65	338.01	3.43
16:09:54	958.19	114	3024	413	735	748	24	10.69	2	0.47	9.66	9.36	1.1	141.14	338.24	3.43
16:09:58	958.44	113	1984	403	736	748	24	10.67	1.96	0.41	9.67	9.36	1.1	153.67	338.5	3.43
16:10:07	958.7	117	1903	423	739	748	24	10.46	1.96	0.35	9.08	9.6	0.93	139.54	338.75	3.43
16:10:14	958.95	115	1977	416	736	748	24	10.53	2	0.55	9.69	9.53	1.29	137.62	339.01	3.43
16:10:21	959.2	113	1988	405	736	748	24	10.51	1.95	0.43	9.62	9.53	1.15	125.89	339.24	3.44
16:10:29	959.45	115	1906	415	736	748	28	10.38	1.97	0.42	9.16	9.65	1.08	169.25	339.53	3.44
16:10:36	959.7	116	1976	420	736	748	24	10.45	2.05	0.5	9.08	9.62	1.17	131.85	339.74	3.44
16:10:43	959.95	115	1950	417	736	753	32	10.5	1.94	0.35	9.04	9.5	1.05	135.21	340.01	3.44
16:10:50	960.2	114	1944	416	736	748	24	10.52	1.97	0.41	8.95	9.38	0.91	137.87	340.27	3.44
16:10:56	960.45	115	1980	418	735	748	24	10.78	1.99	0.48	8.75	9.24	1.08	169.53	340.48	3.45
16:11:03	960.7	115	2031	410	736	748	24	10.76	2.02	0.45	8.77	9.24	1.13	149.13	340.74	3.45
16:11:07	960.95	113	2016	412	736	748	24	10.97	2.02	0.44	8.56	9.14	1.22	168.89	341	3.45
16:11:13	961.2	114	1993	413	736	748	24	11.06	1.97	0.41	8.47	8.92	1.05	152.29	341.24	3.45
16:11:19	961.45	116	1962	419	736	748	24	11	1.95	0.44	8.53	8.95	0.93	147.76	341.51	3.45
16:11:25	961.7	114	1946	416	735	744	20	10.99	1.95	0.35	8.53	9.05	1.08	147.76	341.74	3.45
16:11:32	961.96	116	1931	420	734	748	28	10.98	1.96	0.36	8.55	9	1.01	138.81	342	3.45
16:11:38	962.21	115	1956	418	734	744	24	10.98	1.94	0.37	8.56	9.02	1.01	156.49	342.26	3.46
16:11:44	962.46	117	1934	423	735	753	28	10.97	1.94	0.34	8.57	9.02	1.05	128.87	342.51	3.46

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96				
Starting Depth =	823.92	Bit Type =	Walker McDonald MP66H		
Ending Depth =	1031.19	Bit Size =	4.75		
Total Depth Drilled	207.27	Bit Nozzles =	8, 8, 12, 12		
Hours On Bit =	4.09	Mud Type =	Water Based		
Average ROP =	50.58	Mud Weight (lbs/gal) =	9.00		
Drillstring (ft) =	860.49	Pipe (ft) =	251.81	Collar (ft)	608.68

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
16:11:50	962.71	116	1917	421	734	744	24	10.94	1.96	0.33	5.59	9.07	1.01	148.59	342.75	3.46
16:11:52	962.95	114	1924	416	734	744	24	10.56	1.95	0.44	5.57	9.02	0.93	143.65	343.01	3.46
16:12:08	963.21	116	1969	418	734	744	20	10.58	1.98	0.45	5.55	9.02	0.98	134.85	343.28	3.46
16:12:09	963.46	115	1983	416	735	748	24	10.58	2.01	0.44	5.55	9.05	1.03	181.75	343.51	3.47
16:12:15	963.71	113	1983	412	738	748	24	11.04	1.92	0.36	6.49	8.85	0.85	150.65	343.77	3.47
16:12:21	963.96	113	1938	415	735	744	20	10.99	1.94	0.34	6.55	9.02	0.98	147.41	344.01	3.47
16:12:27	964.21	114	1929	414	738	748	24	10.99	1.95	0.38	6.54	9.02	0.98	151.07	344.26	3.47
16:12:33	964.47	112	1984	408	734	744	20	11.18	2.02	0.43	6.35	8.9	1.35	156.63	344.54	3.47
16:12:37	964.72	115	1951	417	734	744	20	11.51	2	0.49	6.02	8.62	1.15	216.37	344.76	3.47
16:12:42	964.97	113	1937	411	734	748	24	11.34	2.03	0.45	6.19	8.76	1.28	182.34	345.01	3.47
16:12:46	965.22	115	1973	416	734	744	24	11.42	1.94	0.41	6.11	8.62	1.2	197.63	345.26	3.48
16:12:52	965.47	116	1977	417	734	744	20	11.21	1.96	0.43	6.33	8.83	1.15	175.91	345.52	3.48
16:12:58	965.72	115	1945	418	736	748	24	10.92	1.93	0.34	6.61	8.19	1.28	151.13	345.76	3.48
16:13:07	965.97	113	2005	412	738	748	20	10.6	1.95	0.31	6.93	8.36	0.85	110.40	346.02	3.48
16:13:17	966.22	114	1982	416	736	748	24	10.45	1.99	0.44	9.06	9.55	1.15	80.23	346.27	3.48
16:13:27	966.47	116	1990	420	735	744	24	10.5	1.95	0.34	9.03	9.38	1.01	90.43	346.51	3.48
16:13:36	966.72	116	1994	420	735	748	28	10.55	1.96	0.35	8.58	9.46	1.1	68.46	346.77	3.48
16:13:44	966.97	116	1995	421	735	748	28	10.75	1.94	0.38	8.78	9.34	1.17	112.07	347.01	3.48
16:13:53	967.22	116	2013	421	735	748	24	10.89	1.97	0.43	8.64	9.31	1.24	147.10	347.27	3.48
16:13:58	967.47	114	2064	413	735	744	20	11.01	1.98	0.45	8.53	9.02	1.05	143.17	347.52	3.5
16:14:02	967.72	115	2063	417	734	744	20	11.06	2.03	0.52	8.45	8.93	1.05	154.33	347.8	3.5
16:14:08	967.98	114	2030	415	734	748	36	11.17	2	0.39	8.36	8.86	1.31	166.24	348.03	3.5
16:18:03	968.25	116	1905	417	742	753	24	15.97	1.93	0.32	4.03	6.17	4.91	115.69	348.36	3.51
16:18:09	968.5	114	1858	413	742	753	24	13.41	1.99	0.38	6.61	7.81	0.89	142.69	348.54	3.51
16:18:16	968.75	115	1943	418	741	757	28	12.91	2.08	0.56	7.11	7.56	1.1	183.76	348.8	3.52
16:18:22	969	112	1953	408	740	753	28	12.83	2.03	0.44	7.19	7.58	0.96	145.02	349.07	3.52
16:18:27	969.25	114	1922	416	738	753	41	12.9	1.98	0.46	7.11	7.56	0.93	177.33	349.3	3.52
16:18:34	969.5	115	1897	418	737	753	28	12.78	2.02	0.41	7.24	7.68	0.96	140.83	349.56	3.52
16:18:40	969.75	114	1940	414	737	748	24	12.44	2.11	0.62	7.54	7.92	0.81	143.65	349.81	3.53
16:18:46	970	113	2072	409	736	753	28	12.44	2.06	0.52	7.58	7.88	0.65	150.11	350.05	3.53
16:18:52	970.25	113	2036	416	736	753	28	12.86	2.06	0.57	7.31	7.79	1.01	148.39	350.31	3.53
16:18:58	970.5	116	1919	421	737	753	28	12.71	1.99	0.44	7.27	8.11	1.46	154.15	350.56	3.53
16:19:09	970.75	115	1978	418	736	748	24	11.41	1.97	0.38	8.57	9.14	1.46	85.97	350.79	3.53
16:19:17	971	114	1919	415	738	753	28	10.29	3	0.4	9.78	10.48	1.82	110.82	351.05	3.53

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/95			Bit Type =	Walker McDonald MP6BH													
Starting Depth =	623.92			Bit Size =	4.75													
Ending Depth =	1031.19			Bit Nozzles =		9, 8, 10, 13												
Total Depth Drilled	407.27			Mud Type =		Water Based												
Hours On Bit =	4.89			Mud Weight (lbs/gal) =		8.90												
Drillstring (ft) =	680.48			Pipe (ft) =	251.81				Collar (ft)	428.60								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Bear	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
16:19:25	971.25	114	1940	414	738	753	28	9.65	1.95	0.38	10.33	10.77	0.93	193.08	351.3	3.54
16:19:32	971.5	113	1999	412	736	748	24	10.02	2.06	0.47	9.97	10.48	1.03	132.31	351.54	3.54
16:19:37	971.75	113	1998	410	737	748	24	10.3	1.97	0.48	9.65	10.08	0.86	183.58	351.82	3.54
16:19:43	972.01	115	2070	416	738	753	28	10.26	1.98	0.48	9.73	10.03	0.67	156.01	352.06	3.54
16:19:49	972.25	113	2092	408	736	753	24	10.26	2.04	0.53	9.72	10.13	0.75	159.44	352.31	3.54
16:19:54	972.51	113	2058	407	736	753	28	11.53	2.01	0.44	8.45	9.86	2.13	167.93	352.57	3.54
16:20:00	972.75	115	2041	416	738	753	28	11.56	2	0.44	8.43	9.85	0.89	151.03	352.82	3.55
16:20:06	973.01	114	2042	412	736	753	28	11.63	1.95	0.37	8.26	9.71	0.74	178.26	353.08	3.55
16:20:11	973.26	114	2073	413	736	753	28	11.75	1.98	0.44	8.22	9.64	0.84	159.36	353.31	3.55
16:20:17	973.51	114	2046	414	738	753	28	12	1.85	0.36	7.66	9.43	0.91	148.98	353.56	3.55
16:20:23	973.75	113	2056	412	738	753	28	12.14	1.98	0.46	7.83	9.14	0.65	162.17	353.81	3.55
16:20:28	974.01	114	2015	414	738	748	20	12.29	1.98	0.39	7.69	8.97	0.77	147.87	354.07	3.55
16:20:35	974.26	115	2004	419	738	748	20	13.25	1.98	0.47	7.73	8.11	0.79	152.82	354.31	3.55
16:20:41	974.52	115	2020	416	738	753	24	12.27	2.04	0.44	7.76	8.07	0.74	158.16	354.58	3.56
16:20:47	974.77	115	1947	418	737	753	28	12.18	1.95	0.37	7.96	8.23	0.96	135.46	354.83	3.56
16:20:53	975.02	117	1875	424	737	753	28	11.91	1.93	0.34	8.05	8.33	0.55	116.77	355.08	3.56
16:21:04	975.27	116	1861	432	736	753	28	11.86	1.94	0.39	8.12	8.5	0.57	104.35	356.33	3.57
16:21:15	975.52	115	1852	417	738	753	28	11.8	2.05	0.47	8.38	8.88	0.56	77.77	355.56	3.57
16:21:22	975.77	116	1839	430	739	753	28	12.13	1.96	0.43	7.84	8.5	1.03	136.23	355.82	3.57
16:21:27	975.98	116	1958	421	739	753	24	12.62	2.03	0.52	7.36	7.98	0.68	183.37	356.06	3.57
16:21:31	976.27	113	1869	411	736	748	24	12.67	1.96	0.38	7.36	7.71	0.79	209.89	356.31	3.57
16:21:36	976.53	115	1883	417	736	753	24	12.72	1.96	0.39	7.24	7.61	0.77	197.58	356.58	3.57
16:21:40	976.77	116	1906	419	738	753	28	13.89	1.96	0.35	7.09	7.44	0.74	226.32	356.81	3.57
16:21:45	977.02	116	1934	422	739	753	24	12.95	1.99	0.39	7.61	8.26	1.41	162.68	357.07	3.57
16:21:55	977.27	116	1924	417	739	753	28	11.78	2.04	0.48	8.16	8.52	0.91	92.33	357.32	3.58
16:22:08	977.52	116	1891	423	739	753	24	11.56	1.97	0.5	8.41	8.78	0.67	68.97	357.58	3.58
16:22:23	977.77	116	1919	419	738	753	28	11.54	1.98	0.39	8.43	8.76	0.78	58.82	357.81	3.59
16:22:32	978.02	116	1982	420	738	753	28	11.8	2	0.51	8.18	8.79	1.1	101.23	358.09	3.59
16:22:41	978.27	116	2036	421	738	748	24	11.85	2.04	0.51	8.13	8.52	0.69	101.76	358.34	3.59
16:22:48	978.52	114	2100	415	737	753	28	12.11	2.06	0.56	7.87	8.21	0.77	138.53	358.59	3.59
16:22:54	978.77	117	2014	424	737	753	28	12.35	2.08	0.56	7.62	8	0.68	168.40	358.84	3.59
16:22:59	979.03	116	2022	422	736	748	24	12.32	2.11	0.56	7.59	7.97	0.77	184.37	359.07	3.6
16:23:05	979.28	116	2018	423	736	748	24	12.35	1.94	0.37	7.62	7.95	0.74	156.92	359.33	3.6
16:23:11	979.53	117	2011	423	736	748	28	12.37	2.05	0.47	7.65	7.95	0.69	157.66	359.57	3.6

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/02/66																	
Starting Depth =	523.92			Bit Type =	Walker McDonald MPS8H													
Ending Depth =	1031.19			Bit Size =	4.75													
Total Depth Drilled	497.27			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	4.09			Mud Type =		Water Based												
Average ROP =	99.58			Mud Weight (lbs/gal) =		9.00												
Drillstring (ft) =	660.49			Pipe (ft) =	251.81				Collar (ft)	408.50								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
16:23:17	979.78	115	2011	420	738	753	38	12.32	1.94	0.34	7.64	8.04	0.79	141.46	359.82	3.6
16:23:23	980.03	115	1950	432	738	753	28	12.2	1.92	0.37	7.76	8.14	0.83	146.71	360.08	3.6
16:23:31	980.28	116	1891	428	737	753	28	12.07	1.94	0.31	7.60	8.26	0.77	119.94	360.33	3.6
16:23:38	980.53	117	1883	425	737	748	30	12.08	2.02	0.52	7.67	8.28	0.77	129.55	360.58	3.61
16:23:46	980.78	116	1946	422	737	753	28	12.03	1.94	0.33	7.95	8.31	0.79	121.16	360.82	3.61
16:23:54	981.03	116	1917	421	737	753	28	11.98	1.91	0.29	7.88	8.38	0.74	110.48	361.07	3.61
16:24:00	981.28	113	1968	412	737	748	30	12.18	2.02	0.47	7.79	8.26	0.93	144.28	361.33	3.61
16:24:07	981.53	115	1967	418	737	753	28	12.08	1.93	0.31	7.91	8.23	0.81	121.56	361.59	3.61
16:24:16	981.78	115	1923	417	736	748	24	11.91	1.85	0.16	8.05	8.3	0.93	107.55	361.84	3.62
16:24:24	982.03	115	1971	419	737	753	28	11.87	1.97	0.42	8.09	8.5	0.93	104.53	362.07	3.62
16:24:30	982.28	113	1949	420	736	753	28	11.73	1.92	0.3	8.24	8.67	0.84	79.14	362.31	3.62
16:24:43	982.53	114	1985	414	736	748	24	11.86	1.94	0.32	8.02	8.25	0.77	116.73	362.56	3.62
16:24:51	982.78	115	1973	417	737	748	28	12.07	1.94	0.33	7.96	8.28	0.78	120.73	362.83	3.63
16:24:58	983.03	115	1980	417	737	748	24	12.1	1.97	0.36	7.85	8.28	0.77	131.82	363.08	3.63
16:25:04	983.28	115	1981	415	736	748	24	12.09	1.96	0.37	7.89	8.26	0.85	151.63	363.33	3.63
16:25:13	983.54	115	1980	416	737	748	24	12	1.92	0.36	7.97	8.33	0.84	111.57	363.59	3.63
16:25:20	983.79	114	1992	415	737	748	24	11.97	1.93	0.33	8.09	8.35	0.77	119.02	363.83	3.63
16:25:30	984.04	116	1982	422	737	753	28	11.78	1.95	0.37	8.19	8.64	1.05	97.40	364.08	3.64
16:25:46	984.29	115	1936	418	737	748	24	11.83	1.97	0.4	8.44	8.76	0.77	56.86	364.33	3.64
16:25:55	984.54	114	1969	416	737	748	24	11.87	1.98	0.39	8.09	8.62	1.06	104.22	364.61	3.64
16:26:03	984.79	115	1935	419	736	753	28	12	1.95	0.35	7.96	8.36	0.86	113.31	364.87	3.65
16:26:11	985.04	115	1936	419	737	753	28	11.94	2.02	0.51	8.02	8.35	0.77	119.03	365.08	3.65
16:26:23	985.29	116	1864	419	737	753	28	11.65	1.95	0.4	8.32	8.71	1.01	72.23	365.34	3.65
16:26:32	985.54	115	1878	416	737	753	28	11.76	1.94	0.39	8.20	8.69	1.05	89.15	365.59	3.65
16:26:40	985.79	113	1917	412	737	748	24	12.03	2.04	0.58	7.94	8.31	0.81	126.47	365.85	3.66
16:26:48	986.04	114	1918	415	737	748	20	12.02	1.94	0.36	7.94	8.33	0.89	118.26	366.08	3.66
16:26:54	986.29	114	1949	416	737	748	24	12.19	1.94	0.4	7.78	8.14	0.77	147.48	366.34	3.66
16:27:01	986.54	112	2011	406	737	748	24	12.1	2.01	0.51	7.66	8.21	0.81	128.85	366.59	3.66
16:27:07	986.8	114	1959	414	737	753	28	12.26	2.01	0.45	7.67	8.09	0.81	150.14	366.85	3.66
16:27:15	987.05	113	1920	412	737	753	28	11.93	1.95	0.42	8.03	8.57	1.15	112.59	367.1	3.67
16:27:23	987.3	115	1936	419	737	753	28	12.09	1.96	0.41	7.87	8.45	1.01	121.35	367.34	3.67
16:27:29	987.55	115	1957	416	737	753	28	12.11	2	0.43	7.86	8.28	0.89	136.31	367.59	3.67
16:27:39	987.8	116	1936	418	737	753	32	11.82	1.97	0.38	8.15	8.55	0.93	99.26	367.85	3.67
16:27:51	988.05	116	1957	420	737	753	28	11.84	1.91	0.31	8.32	8.67	0.69	72.59	368.1	3.68

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/12/96																		
Starting Depth =	623.92				Bit Type =	Walker McDonald MP68R													
Ending Depth =	1031.19				Bit Size =	4.75													
Total Depth Drilled	407.27				Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	4.09				Mud Type =		Water Based												
Average ROP =	99.58				Mud Weight (lbs/gal) =		8.90												
Drillstring (ft) =	660.49				Pipe (ft) =	251.81				Collar (ft)	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBtr	OnBtr
16:28:00	988.3	116	1918	421	737	763	26	11.53	1.99	0.44	8.08	8.59	1.13	184.83	368.34	3.68
16:28:19	988.65	116	1821	422	737	763	26	11.47	1.89	0.28	8.49	8.9	1.17	46.46	368.61	3.68
16:28:42	988.8	117	1758	424	737	763	26	11.26	1.94	0.31	8.70	9.74	1.44	38.33	368.85	3.69
16:29:09	989.05	116	1807	421	737	763	26	9.4	1.91	0.3	10.56	11.44	2.01	33.58	369.1	3.7
16:29:33	989.3	116	1839	427	736	748	26	9.03	1.91	0.3	10.93	11.35	1.27	37.58	369.36	3.7
16:29:40	989.55	116	2082	420	737	748	24	9.58	2.04	0.9	10.39	11.01	1.39	121.01	369.62	3.71
16:29:47	989.8	113	3161	408	737	748	24	10.78	2.58	0.54	9.38	10.48	3.76	148.44	369.87	3.71
16:29:53	990.05	116	1984	420	736	748	24	13.26	1.94	0.42	6.69	7.49	0.81	148.48	370.11	3.71
16:29:59	990.31	118	1909	428	736	748	26	13.25	1.93	0.33	6.79	7.16	1.85	133.21	370.36	3.71
16:30:28	990.56	118	1758	427	737	763	26	12.41	1.89	0.26	7.64	7.85	1.31	30.51	370.61	3.72
16:30:59	990.75	117	1704	426	737	763	26	12.35	1.9	0.25	7.59	7.9	0.66	23.75	370.81	3.72
16:31:21	991.01	115	1763	415	737	763	26	10.96	1.96	0.41	9.00	12.5	5.52	49.22	371.05	3.72
16:31:23	991.26	113	1972	409	736	748	24	7.76	1.97	0.37	12.21	12.54	0.67	115.32	371.3	3.74
16:31:37	991.51	112	2029	406	739	763	26	7.82	1.98	0.41	12.15	12.54	0.79	113.15	371.55	3.74
16:31:45	991.76	114	2036	412	736	748	24	7.61	1.92	0.36	12.37	12.93	0.91	113.73	371.83	3.74
16:31:52	992.01	111	2104	405	736	748	24	7.93	1.95	0.38	12.04	12.62	1.01	143.44	372.06	3.74
16:32:00	992.26	113	2053	412	738	753	26	7.8	1.94	0.36	12.18	12.59	0.77	111.56	372.31	3.75
16:32:07	992.51	113	2075	409	738	753	26	7.7	1.93	0.32	12.27	12.64	0.69	116.64	372.56	3.75
16:32:15	992.76	113	2106	409	736	753	26	7.77	1.94	0.36	12.20	12.64	1.05	118.61	372.81	3.75
16:32:21	993.01	113	2132	411	737	748	24	8.11	1.94	0.37	11.87	12.25	0.88	155.81	373.06	3.75
16:32:27	993.26	113	2070	413	737	753	26	8.01	1.93	0.32	11.96	12.38	0.91	147.05	373.32	3.75
16:32:34	993.51	114	2004	414	736	748	24	7.83	1.92	0.34	12.15	12.5	0.75	119.97	373.55	3.75
16:32:41	993.76	115	1938	417	738	753	26	7.83	1.91	0.3	12.15	12.47	0.72	133.82	373.82	3.76
16:32:49	994.01	115	1964	419	738	753	26	7.79	1.94	0.32	12.18	12.59	0.79	122.55	374.08	3.76
16:32:56	994.26	114	1971	415	738	748	24	7.73	1.9	0.29	12.23	12.59	0.79	115.34	374.31	3.76
16:33:04	994.51	115	1977	419	738	753	26	7.74	1.93	0.32	12.23	12.57	0.59	116.47	374.56	3.76
16:33:13	994.76	114	1970	416	738	753	26	7.78	1.95	0.32	12.23	12.66	0.51	105.69	374.84	3.77
16:33:20	995.02	115	1987	416	736	748	25	7.78	1.91	0.3	12.20	12.52	0.72	128.06	375.06	3.77
16:33:27	995.27	115	2005	420	736	753	24	7.82	1.96	0.41	12.15	12.54	0.77	124.79	375.31	3.77
16:33:34	995.52	115	1981	420	737	748	24	7.77	1.94	0.31	12.19	12.52	0.69	120.33	375.57	3.77
16:33:41	995.77	114	2029	414	738	748	26	7.89	1.91	0.3	12.08	12.45	0.86	135.94	375.82	3.77
16:33:48	996.02	115	1979	418	738	753	26	7.76	1.96	0.33	12.21	12.5	0.62	110.77	376.06	3.78
16:33:56	996.27	115	1984	416	738	753	26	7.73	1.94	0.33	12.23	12.64	0.65	124.35	376.33	3.78
16:34:04	996.52	114	1966	414	738	753	24	7.71	1.91	0.31	12.27	12.64	0.79	112.31	376.57	3.78

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																	
Starting Depth =	623.82			Bit Type =	Walker McDonald MF88H													
Ending Depth =	1031.19			Bit Size =	8.75													
Total Depth Drilled	407.37			Bit Nozzles =	8, 9, 12, 12													
Hours On Bit =	4.09			Mud Type =	Water Based													
Average ROP =	99.58			Mud Weight (lbs/gal) =	9.00													
Drillstring (ft) =	459.49			Pipe (ft) =	251.81			Collar (ft)	466.68									

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
16:34:12	996.77	115	1986	419	739	753	24	7.76	1.9	0.31	12.30	12.52	0.67	114.34	376.84	3.78
16:34:20	997.02	114	1988	416	739	753	28	7.77	1.97	0.43	12.30	12.5	0.65	121.71	377.05	3.78
16:34:28	997.27	114	1976	415	739	753	24	7.72	1.94	0.34	12.25	12.52	0.77	108.16	377.31	3.78
16:34:36	997.52	116	1981	425	739	753	28	7.73	1.95	0.37	12.24	12.59	0.72	117.29	377.53	3.79
16:34:43	997.77	113	1968	411	739	753	28	7.74	1.96	0.31	12.22	12.54	0.67	124.09	377.83	3.79
16:34:51	998.02	114	1965	414	739	753	24	7.74	1.91	0.36	12.22	12.66	0.79	112.31	378.08	3.79
16:34:59	998.27	115	1974	418	737	748	24	7.73	1.91	0.31	12.24	12.59	0.78	120.64	378.33	3.79
16:35:07	998.52	114	1965	419	738	753	28	7.72	1.95	0.32	12.25	12.62	0.77	107.67	378.57	3.8
16:35:15	998.77	116	1980	420	738	753	28	7.68	1.9	0.33	12.28	12.59	0.67	115.81	378.83	3.8
16:35:23	999.02	115	1998	417	738	753	28	7.82	1.94	0.36	12.15	12.64	1.01	135.20	379.07	3.8
16:35:28	999.07	112	2064	409	736	753	28	7.66	1.94	0.33	11.96	12.4	0.84	136.52	379.34	3.8
16:35:35	999.63	113	2051	411	736	753	28	7.93	1.94	0.35	12.04	12.45	0.77	140.97	379.58	3.8
16:39:16	999.92	112	1712	409	741	753	24	8.86	1.9	0.23	10.28	12.42	0.38	121.86	379.96	3.81
16:39:22	1000.17	113	1852	411	743	757	28	7.41	1.94	0.33	12.75	13.52	1.58	151.32	380.24	3.81
16:39:27	1000.42	113	2060	409	744	757	24	7.33	2.01	0.45	12.93	13.88	1.24	163.13	380.48	3.82
16:39:34	1000.67	112	2079	407	743	757	28	8.49	2.01	0.42	11.66	12.5	2.11	134.73	380.72	3.82
16:45:27	1001.87	113	1955	411	744	757	24	12.92	1.96	0.44	7.21	7.84	0.83	140.12	381.92	3.83
16:45:33	1002.12	113	1962	412	744	757	24	12.85	2.05	0.56	7.27	7.76	0.96	147.01	382.16	3.84
16:45:40	1002.37	113	1924	412	744	761	28	12.82	1.86	0.38	7.36	7.71	0.78	137.50	382.41	3.84
16:45:48	1002.62	114	1985	414	743	757	28	12.89	1.99	0.48	7.43	7.88	0.93	119.43	382.66	3.84
16:45:56	1002.87	115	1927	417	743	757	24	12.83	1.91	0.39	7.55	7.97	0.84	108.31	382.92	3.85
16:46:05	1003.12	114	1933	413	744	757	24	12.49	1.89	0.47	7.83	8.07	1.61	95.07	383.17	3.85
16:46:14	1003.37	114	1916	416	744	757	24	12.54	1.97	0.38	7.59	7.82	0.78	107.72	383.43	3.85
16:46:24	1003.62	115	1912	418	744	757	24	12.44	1.93	0.32	7.65	7.97	0.69	92.74	383.68	3.85
16:46:34	1003.87	116	1845	420	743	757	24	12.47	2.04	0.45	7.65	8	0.64	99.47	383.91	3.86
16:46:47	1004.12	116	1823	422	744	757	28	12.27	1.94	0.31	7.86	8.15	0.79	68.03	384.17	3.86
16:47:04	1004.37	116	1819	418	744	757	28	12.2	1.92	0.32	7.92	8.23	0.77	83.83	384.42	3.87
16:47:15	1004.62	115	1846	417	744	757	28	11.96	2	0.44	8.74	10.08	2.39	77.96	384.68	3.87
16:47:22	1004.87	115	1930	419	744	757	24	10.74	1.95	0.38	9.39	9.72	0.74	138.61	384.93	3.87
16:47:30	1005.12	116	1912	420	744	761	28	10.72	1.88	0.32	9.41	9.74	0.77	119.04	385.18	3.87
16:47:39	1005.38	116	1939	420	744	757	24	10.84	1.95	0.32	9.28	9.6	0.79	143.16	385.45	3.87
16:47:47	1005.63	116	1883	420	744	757	24	11.01	1.84	0.39	9.12	9.59	1.27	149.71	385.69	3.88
16:47:57	1005.88	115	1914	418	744	757	24	11.16	2.01	0.57	8.96	9.48	0.96	172.94	385.92	3.88
16:47:54	1006.13	115	1930	417	743	757	28	10.85	2.04	0.46	9.27	9.81	1.3	124.77	386.2	3.88

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/22/96																
Starting Depth =	823.92			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1231.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		8, 8, 12, 12											
Hours On Bit =	3.69			Mud Type =		Water Based											
Average ROP =	99.53			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	251.93				Collar (ft)	408.60							
TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
16:48:02	1005.39	113	2048	413	743	757	24	11.32	2.02	0.6	8.91	9.84	2.73	120.53	386.40	3.88
16:48:08	1005.63	114	1947	413	744	757	24	13.02	1.99	0.44	7.09	7.46	0.89	180.11	386.67	3.88
16:48:14	1006.88	114	1879	414	744	757	24	12.99	2.06	0.53	7.14	7.81	1.1	147.83	386.92	3.88
16:48:20	1007.13	115	1874	418	744	761	28	12.9	2.01	0.49	7.29	7.81	0.96	152.54	387.2	3.88
16:48:25	1007.38	114	1884	415	744	757	24	12.94	1.99	0.4	7.18	7.61	0.91	156.49	387.42	3.89
16:48:31	1007.63	114	1940	413	743	757	24	12.53	2.01	0.47	7.19	7.56	0.84	146.06	387.67	3.89
16:48:37	1007.88	112	2029	408	744	757	24	12.59	2.1	0.61	7.14	7.59	0.88	168.79	387.93	3.89
16:48:43	1008.13	114	2000	413	743	757	24	12.76	2.12	0.69	7.36	7.95	1.34	105.83	388.18	3.89
16:48:50	1008.38	116	1993	421	744	757	24	12.71	2.15	0.73	7.41	7.78	0.77	69.83	388.45	3.9
16:48:11	1008.63	115	1981	418	744	761	28	12.69	2.12	0.76	7.42	7.78	1.15	71.08	388.68	3.9
16:48:55	1008.88	115	1924	416	868	1773	1041	17.1	2.25	0.83	2.69	8.58	9.34	37.19	388.93	3.91
16:49:45	1009.13	115	1724	416	746	761	32	15.76	2	0.45	3.34	3.93	1.56	89.18	389.18	3.91
16:49:53	1009.38	114	1840	415	745	761	28	15.98	2.09	0.63	4.12	4.8	0.96	117.66	389.45	3.91
16:50:01	1009.63	116	1854	420	746	761	28	15.94	2.01	0.48	4.16	4.92	0.72	117.56	389.68	3.91
16:50:08	1009.88	115	1858	417	746	757	24	15.29	1.97	0.43	4.82	5.31	1.32	128.69	389.92	3.92
16:50:15	1010.14	115	1889	417	745	761	28	15.21	2.01	0.51	4.89	5.29	0.98	121.27	390.18	3.92
16:50:23	1010.39	115	1820	419	746	761	28	15.1	1.96	0.36	5.00	5.48	0.98	118.15	390.43	3.92
16:50:33	1010.64	116	1795	422	746	761	24	14.92	1.95	0.41	5.18	5.65	1.1	90.35	390.69	3.92
16:50:40	1010.89	116	1807	422	746	761	28	15.16	1.96	0.33	4.92	5.29	0.84	123.54	390.95	3.92
16:50:47	1011.14	116	1812	420	746	761	28	15.17	1.96	0.37	4.93	5.34	0.81	125.76	391.2	3.93
16:50:55	1011.39	117	1806	423	747	761	24	15.17	1.95	0.34	4.93	5.29	0.79	117.25	391.44	3.93
16:51:02	1011.64	116	1822	419	747	761	28	14.48	1.96	0.38	5.62	6.53	1.96	129.33	391.69	3.93
16:51:08	1011.89	116	1865	416	747	761	24	14	1.99	0.42	6.11	6.51	0.91	141.49	391.95	3.93
16:51:15	1012.14	113	1883	412	747	761	28	13.95	2.06	0.56	6.15	6.61	0.98	133.24	392.18	3.93
16:51:21	1012.39	114	1908	413	746	757	24	14.01	1.99	0.51	6.16	6.49	0.96	148.05	392.44	3.94
16:51:28	1012.64	116	1924	418	747	761	24	13.98	2.02	0.51	6.15	6.68	1.2	128.32	392.69	3.94
16:51:35	1012.89	115	1923	417	746	761	28	13.96	2.09	0.52	6.15	6.56	0.89	141.43	392.95	3.94
16:51:41	1013.14	116	1870	420	747	761	24	13.94	1.94	0.37	6.16	6.61	0.91	192.73	393.18	3.94
16:51:48	1013.39	116	1846	420	747	761	28	13.9	1.94	0.34	6.21	6.58	0.84	125.45	393.44	3.94
16:51:55	1013.64	115	1891	417	747	761	24	12.74	1.95	0.35	7.38	7.95	2.06	136.82	393.69	3.95
16:52:02	1013.89	115	1923	416	747	761	24	12.68	1.86	0.36	7.53	7.87	0.93	128.11	393.95	3.95
16:52:09	1014.14	114	1949	414	747	761	28	12.53	1.83	0.31	7.55	8.07	0.98	136.87	394.19	3.95
16:52:16	1014.39	114	1927	416	747	761	24	12.45	1.84	0.31	7.66	8.09	0.89	128.56	394.44	3.95
16:52:25	1014.65	115	1893	418	746	761	24	11.93	1.97	0.36	8.15	8.81	1.36	160.62	394.68	3.95

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96						
Starting Depth =	823.92	Bit Type =	Walker McDonald MP65H				
Ending Depth =	1331.19	Bit Size =	8.75				
Total Depth Drilled	407.27	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	4.09	Mud Type =	Water Based				
Average ROP =	99.58	Mud Weight (lbs/gal) =	9.00				
Drillstring (ft) =	660.49	Pipe (ft) =	251.61	Collar (ft)	408.50		

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
16:52:34	1014.9	114	1902	414	747	785	38	11.81	2.07	0.49	8.50	8.99	1.13	97.79	394.98	3.96
16:52:42	1015.15	114	1957	414	747	781	28	11.8	1.98	0.4	8.32	8.69	0.81	112.64	395.21	3.96
16:52:49	1015.4	113	2016	413	747	781	24	11.95	2.03	0.62	8.17	8.82	0.86	141.39	395.44	3.96
16:52:55	1015.65	114	2029	413	746	781	24	12.07	2.09	0.8	8.05	8.52	0.81	146.33	395.69	3.96
16:53:03	1015.9	115	1971	417	747	781	34	11.71	1.95	0.33	8.40	8.93	1.15	105.09	395.94	3.96
16:53:17	1016.15	116	1868	423	746	797	24	11.37	1.91	0.3	8.73	9.05	0.74	64.62	396.19	3.97
16:53:26	1016.4	115	1924	419	748	781	34	11.76	2.04	0.5	8.35	8.95	1.46	165.94	396.49	3.97
16:53:32	1016.65	115	1970	416	748	781	34	11.98	2.01	0.44	8.14	8.86	1.51	167.63	396.7	3.97
16:53:41	1016.9	115	1981	416	748	781	34	11.63	1.98	0.47	8.48	8.88	0.16	66.74	396.94	3.97
16:53:50	1017.15	115	2067	419	749	781	24	11.75	2.01	0.47	8.36	8.88	1.29	111.09	397.2	3.98
16:53:56	1017.4	115	2061	417	749	781	34	11.89	1.98	0.41	8.22	8.64	0.59	134.06	397.45	3.98
16:54:03	1017.65	114	1958	413	749	765	28	12	2.07	0.61	8.12	8.58	0.93	153.31	397.72	3.98
16:54:09	1017.9	113	2016	413	749	781	24	11.98	2.07	0.48	8.12	8.52	0.91	145.18	397.95	3.98
16:54:16	1018.15	113	2081	413	749	781	24	11.9	2.19	0.71	8.21	8.71	1.1	138.67	398.2	3.98
16:54:23	1018.41	114	2015	414	748	781	24	14.28	2.06	0.55	5.82	8.4	3.52	122.81	398.45	3.98
16:54:30	1018.66	116	1916	421	747	781	24	14.6	1.99	0.58	5.49	8.18	1.46	122.68	398.71	3.98
16:54:38	1018.91	115	1916	419	748	781	24	14.32	2.01	0.61	5.78	8.22	0.86	124.59	398.96	3.98
16:54:45	1019.16	116	1933	422	749	765	28	14.27	2.01	0.48	5.83	8.22	0.69	130.38	399.2	3.99
16:54:51	1019.41	115	1944	416	748	781	24	14.31	1.98	0.44	5.79	8.2	0.89	134.41	399.46	3.99
16:54:59	1019.66	116	1938	420	748	781	24	14.38	2	0.54	5.82	8.27	0.89	126.21	399.7	4
16:55:06	1019.91	115	1928	416	748	781	28	14.29	2.01	0.47	5.81	8.22	0.93	131.77	399.97	4
16:55:13	1020.16	115	1948	417	746	781	28	14.29	2.04	0.45	5.81	8.25	0.89	118.26	400.21	4
16:55:20	1020.41	115	1946	419	747	781	28	14.29	2.02	0.43	5.81	8.3	0.91	132.21	400.46	4
16:55:27	1020.66	114	1953	415	748	781	24	14.3	2.03	0.54	5.79	8.22	0.91	131.52	400.72	4
16:55:34	1020.91	114	1977	413	748	765	28	14.3	2.06	0.57	5.79	8.22	0.89	128.63	400.97	4.01
16:55:41	1021.16	114	1954	413	747	781	28	14.32	2.04	0.55	5.77	8.22	0.91	136.81	401.22	4.01
16:55:48	1021.41	115	1948	417	747	781	24	14.29	2.01	0.54	5.81	8.22	0.89	122.03	401.45	4.01
16:55:56	1021.67	116	1939	420	747	781	24	14.26	2.05	0.56	5.84	8.32	0.91	126.15	401.71	4.01
16:56:02	1021.92	114	1974	414	745	781	28	14.26	2.03	0.49	5.84	8.32	1.01	127.53	401.97	4.01
16:56:10	1022.17	115	1940	418	748	781	24	14.31	2.02	0.46	5.78	8.2	0.96	125.64	402.22	4.02
16:56:17	1022.42	115	1948	418	747	781	24	14.16	2.11	0.62	5.93	8.53	1.24	116.72	402.46	4.02
16:56:26	1022.67	114	1962	416	747	781	24	14.19	2.05	0.56	5.90	8.34	0.91	109.14	402.73	4.02
16:56:34	1022.92	114	1957	413	747	781	24	14.1	2.12	0.67	6.00	8.46	0.93	108.95	402.97	4.02
16:56:41	1023.17	114	1972	413	747	781	28	14.24	2.08	0.59	5.86	8.27	0.96	124.14	403.22	4.02

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/22/96																
Starting Depth =	623.82			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1031.19			Bit Size =	4.75												
Total Depth Drilled	407.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	4.09			Mud Type =		Water Based											
Average ROP =	99.56			Mud Weight (lbs/gal) =		9.00											
Drillstring (ft) =	660.49			Pipe (ft) =	351.81				Collar (ft)	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit	
16:56:46	1023.42	115	1948	418	747	781	24	14.32	1.98	0.48	5.78	6.25	1.08	127.76	403.48	4.03	
16:56:55	1023.67	115	1967	419	747	781	28	14.35	1.98	0.44	5.75	6.15	0.89	135.98	403.71	4.03	
16:57:03	1023.92	114	1976	415	747	781	28	14.27	2	0.51	5.82	6.22	0.91	119.84	403.97	4.03	
16:57:09	1024.17	115	1991	417	748	781	24	14.33	2.11	0.58	5.77	6.2	0.89	131.62	404.25	4.03	
16:57:16	1024.42	115	1977	417	747	781	24	14.31	1.94	0.42	5.79	6.22	0.93	138.60	404.47	4.03	
16:57:23	1024.67	115	1974	417	747	781	28	14.27	2.02	0.52	5.83	6.3	0.98	124.67	404.74	4.04	
16:57:30	1024.92	113	1956	412	748	781	28	14.33	2.05	0.55	5.78	6.3	0.93	136.53	404.98	4.04	
16:57:37	1025.17	114	1968	414	748	781	24	14.32	1.99	0.47	5.78	6.3	0.84	125.93	405.23	4.04	
16:57:43	1025.42	115	1962	417	748	781	24	14.32	1.96	0.4	5.77	6.22	0.93	135.16	405.47	4.04	
16:57:50	1025.67	114	1952	414	748	781	24	14.32	1.96	0.4	5.78	6.27	1.03	139.76	405.72	4.04	
16:57:57	1025.93	116	1950	420	748	781	24	14.34	1.98	0.4	5.75	6.15	0.88	129.01	405.98	4.05	
16:58:03	1026.18	115	1948	420	748	781	24	14.35	1.98	0.44	5.74	6.18	0.96	141.87	406.22	4.05	
16:58:11	1026.43	114	1940	413	748	765	28	14.34	1.95	0.38	5.75	6.13	0.79	123.85	406.46	4.05	
16:58:17	1026.68	115	1921	417	748	781	24	14.29	1.94	0.34	5.81	6.15	0.84	133.11	406.72	4.05	
16:58:24	1026.93	115	1944	418	747	781	24	14.33	1.99	0.4	5.75	6.15	0.86	136.75	406.98	4.05	
16:58:31	1027.18	115	1939	416	747	781	24	14.33	1.95	0.35	5.76	6.2	0.83	129.60	407.23	4.06	
16:58:38	1027.43	115	1912	415	747	781	28	14.3	1.96	0.37	5.80	6.2	0.86	133.95	407.47	4.06	
16:58:45	1027.68	116	1912	419	747	781	28	14.31	1.97	0.39	5.79	6.18	0.81	126.36	407.74	4.06	
16:58:51	1027.93	115	1885	416	747	781	24	14.31	1.93	0.31	5.77	6.15	0.79	134.08	407.98	4.06	
16:58:58	1028.18	116	1905	422	747	781	24	14.32	1.97	0.34	5.77	6.15	0.81	137.15	408.22	4.06	
16:59:05	1028.43	115	1909	418	747	781	24	14.31	2.02	0.44	5.78	6.18	0.84	121.74	408.47	4.06	
16:59:12	1028.68	115	1907	417	747	781	24	14.33	1.98	0.32	5.76	6.13	0.86	141.96	408.73	4.07	
16:59:19	1028.93	116	1889	422	748	765	28	14.31	2.03	0.54	5.77	6.34	1.13	126.13	408.98	4.07	
16:59:26	1029.18	116	1928	428	747	781	28	14.31	1.99	0.3	5.78	6.25	0.93	132.70	409.23	4.07	
16:59:33	1029.43	117	1915	423	747	781	24	14.21	1.91	0.37	5.85	6.3	0.81	124.03	409.49	4.07	
16:59:41	1029.68	117	1880	423	748	781	28	14.2	1.92	0.36	5.85	6.27	0.86	112.38	409.72	4.07	
16:59:48	1029.93	117	1904	423	746	781	28	14.25	1.93	0.28	5.85	6.2	0.74	129.82	409.98	4.08	
16:59:56	1030.19	117	1881	424	745	781	28	14.24	1.95	0.32	5.83	6.22	0.83	118.78	410.23	4.08	
17:00:02	1030.44	117	1967	424	746	781	28	14.3	1.93	0.31	7.80	8.18	2.78	135.07	410.48	4.08	
17:00:08	1030.69	117	3024	423	747	781	24	12.23	1.95	0.38	7.87	8.26	0.81	153.49	410.73	4.08	
17:00:15	1030.94	117	3031	426	747	781	28	12.25	1.93	0.31	7.83	8.31	0.93	146.87	411.01	4.08	
17:00:21	1031.19	116	1967	421	746	781	24	12.17	1.84	0.34	7.92	8.33	0.88	148.41	411.24	4.09	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/28/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MF66H												
Ending Depth =	1982.14			Bit Size =	4.75												
Total Depth (Drilled) =	950.87			Bit Nozzles =		9, 9, 10, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	62.72			Mud Weight (lbs/gal)		8.33											
Drillstring (ft) =	1971.36			Pipe (ft) =	1882.66				Collar (ft)=	88.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	SPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
8:19:10	1031.27	108	971	394	-39	-39	26	19.66	1.81	0.22	-0.19	0.34	0.58	168.94	411.76	4.1034
8:19:14	1031.83	112	967	406	-40	-29	20	19.65	1.82	0.24	-0.12	0.36	1.05	209.43	411.76	4.1034
8:19:25	1031.78	108	1022	392	-37	-29	30	18.91	1.84	0.23	5.65	1.22	1.84	67.69	411.63	4.1062
8:19:53	1032.08	107	1169	359	-38	-25	31	16.55	1.81	0.26	3.02	5.65	3.64	61.44	413.06	4.1133
8:20:23	1032.18	107	1214	389	-38	-25	24	14.11	1.81	0.22	5.41	6.2	0.57	13.93	412.23	4.1215
8:20:39	1032.43	107	1397	386	-38	-29	29	12.47	1.87	0.34	7.13	8.86	4.01	61.31	412.47	4.1239
8:20:58	1032.66	107	1527	389	-41	-28	20	8.83	1.88	0.31	8.78	10.64	1.05	76.45	412.75	4.1268
8:20:59	1032.94	104	1775	376	-40	-29	34	10.67	2.02	0.64	8.84	9.34	1.03	109.14	412.88	4.1312
8:21:04	1033.15	105	1853	386	-39	-28	10	10.86	2	0.65	8.85	9.05	0.91	148.3	413.24	4.133
8:21:10	1033.44	106	1847	385	-39	-28	20	10.9	1.84	0.61	8.71	9.07	0.84	146.84	413.48	4.1354
8:21:17	1033.69	107	1835	386	-41	-28	33	10.98	2.03	0.6	8.75	9.28	0.84	130.64	413.71	4.1367
8:21:23	1033.94	103	1644	375	-39	-31	46	10.93	1.92	0.56	8.67	9.07	0.84	132.98	413.98	4.1381
8:21:31	1034.19	108	1629	385	-41	-28	53	10.74	1.98	0.46	8.87	9.33	0.91	116.4	414.23	4.1404
8:21:38	1034.44	105	1975	384	-40	-21	53	10.75	2	0.54	8.82	9.13	0.84	126.55	414.5	4.1424
8:21:45	1034.69	105	1952	382	-37	-25	46	10.78	1.96	0.47	8.85	9.19	0.74	127.61	414.76	4.1444
8:21:53	1034.94	104	1905	387	-37	-25	46	10.58	1.94	0.46	8.84	9.34	0.79	107.85	414.99	4.1467
8:22:04	1035.19	103	1874	375	-42	-25	49	10.46	1.93	0.46	9.16	9.5	0.74	88.28	415.25	4.1488
8:22:15	1035.45	102	2296	391	-151	-21	356	10.47	1.96	0.61	9.13	10.46	3.21	88.75	415.5	4.1504
8:22:45	1035.6	101	1459	368	-32	-29	69	18.97	2.19	1.36	0.1	5.62	15.63	18.53	415.65	4.155
8:22:54	1035.85	107	1761	369	-38	-25	24	16.26	1.85	0.31	3.32	4.4	2.06	85.19	415.9	4.1575
8:23:12	1036.1	106	1871	388	-39	-29	29	15.08	1.85	0.35	4.5	4.84	0.86	84.22	416.15	4.1597
8:23:38	1036.35	106	1874	385	-41	-29	24	14.67	1.87	0.33	4.91	4.96	0.91	37.6	416.36	4.1618
8:24:01	1036.6	107	1858	391	-40	-28	29	14.55	1.87	0.34	5.02	5.77	2.78	36.29	416.61	4.1792
8:24:11	1036.85	107	1781	369	-40	-29	20	12.67	1.86	0.62	6.72	7.86	0.84	Nil	416.8	4.1701
8:24:21	1037.1	107	1778	368	-39	-29	20	12.79	1.87	0.35	6.8	7.86	0.55	90.47	417.15	4.1815
8:24:32	1037.35	106	1801	359	-38	-31	15	12.8	1.87	0.33	6.76	7.98	0.67	80.22	417.41	4.1848
8:24:42	1037.6	106	1804	377	-39	-29	21	12.8	1.9	0.39	6.78	7.98	0.57	87.66	417.66	4.1877
8:24:53	1037.85	106	1788	381	-38	-29	20	12.77	1.92	0.46	6.83	7.98	0.53	84.79	417.9	4.1905
8:25:04	1038.1	106	1794	384	-39	-29	20	12.75	1.87	0.36	6.84	7.16	0.67	75.87	418.18	4.194
8:25:23	1038.35	107	1782	383	-38	-29	16	12.52	1.87	0.33	7.07	7.47	0.91	80.82	418.41	4.1969
8:25:34	1038.6	107	1796	368	-36	-33	16	12.75	1.88	0.38	6.89	7.36	0.89	76.26	418.66	4.202
8:25:41	1038.86	105	1838	362	-41	-33	16	12.42	1.88	0.37	7.17	7.66	1.58	119.17	418.91	4.2043
8:25:48	1039.1	104	1851	378	-38	-29	33	11.83	1.85	0.31	7.77	8.14	0.67	150.51	419.17	4.206
8:25:55	1039.35	105	1884	372	-37	-29	29	11.89	1.86	0.36	7.71	8.02	0.65	135.22	419.42	4.209
8:26:02	1039.6	105	1871	381	-39	-28	20	11.84	1.94	0.48	7.75	8.14	0.63	132.12	419.65	4.21
8:26:09	1039.86	106	1834	385	-39	-28	16	11.95	1.88	0.39	7.64	7.91	0.6	135.42	419.89	4.2117
8:26:16	1040.11	105	1834	383	-39	-28	16	11.88	1.87	0.35	7.71	8.07	0.67	132.68	420.15	4.2135

DOE high power mortor test Amaco Catoosa Test Site

Well No. 25	Date: 2/26/96						
Starting Depth =	1031.67		Bit Type =	Walker McDonald MP6SH			
Ending Depth =	1382.14		Bit Size =	4.75			
Total Depth Drilled =	350.57		Bit Nozzles =	9, 9, 12, 12			
Hours On Bit =	6.53		Mud Type =	Water Based			
Average ROP =	53.72		Mud Weight (lbs/gal)	9.00			
Drillstring (ft) =	1071.36		Pipe (ft) =	662.63	Collar (ft)=	408.69	

TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
8:26:23	1040.36	104	1818	379	-39	-29	30	11.72	1.82	0.34	7.87	8.14	0.53	115.03	430.4	4.210
8:26:33	1040.61	106	1875	384	-46	-28	28	11.62	1.81	0.41	7.97	8.33	0.76	94.83	429.67	4.2156
8:26:43	1040.86	106	1894	388	-46	-28	24	11.54	1.88	0.38	8.05	8.31	0.67	93.62	429.92	4.2212
8:26:54	1041.11	106	1899	390	-46	-28	28	11.46	1.86	0.84	8.13	8.45	0.57	76.75	421.16	4.22344
8:27:03	1041.36	107	1906	388	-46	-30	30	11.46	1.87	0.88	8.1	8.38	0.57	85.3	431.4	4.2317
8:27:14	1041.61	106	1885	384	-46	-29	30	11.56	1.87	0.31	8.01	8.26	0.6	67.77	421.68	4.2301
8:27:25	1041.86	106	1879	384	-38	-29	30	11.54	1.86	0.34	8.05	8.31	0.62	85.36	421.91	4.2302
8:27:34	1042.11	107	1902	391	-46	-29	29	11.58	1.85	0.33	8.02	8.35	0.65	100.84	422.16	4.2352
8:27:44	1042.36	107	1897	388	-46	-30	30	11.56	1.87	0.32	8.04	8.28	0.59	88.09	422.42	4.2361
8:27:53	1042.61	106	1902	387	-46	-29	29	11.56	1.88	0.36	8.02	8.31	0.6	84.83	422.68	4.2407
8:28:04	1042.86	106	1885	384	-45	-33	16	11.61	1.85	0.31	8.06	8.38	0.67	84.67	422.91	4.2436
8:28:17	1043.11	107	1842	365	-41	-29	24	11.41	1.84	0.32	8.16	8.46	0.67	69.26	423.16	4.2473
8:28:28	1043.36	107	1804	351	-40	-28	29	11.36	1.85	0.34	8.23	8.52	0.77	66.37	423.42	4.2513
8:28:38	1043.61	103	1946	374	-40	-33	16	11.67	1.89	0.39	7.92	8.19	0.55	107.54	423.68	4.2576
8:28:47	1043.86	105	1939	369	-40	-32	29	11.66	1.88	0.37	7.93	8.23	0.57	105.1	423.91	4.2599
8:28:58	1044.11	105	1912	361	-40	-33	16	11.66	1.91	0.43	7.93	8.23	0.57	108.19	424.16	4.2662
8:29:08	1044.36	105	1923	361	-40	-30	16	11.67	1.87	0.35	7.92	8.16	0.62	102.88	424.43	4.2697
8:29:14	1044.61	105	1874	354	-36	-28	16	11.54	1.84	0.31	8.05	8.4	0.75	84.3	424.66	4.2633
8:29:26	1044.87	107	1785	331	-40	-28	29	11.28	1.81	0.33	8.21	8.47	0.58	64.83	424.91	4.2673
8:29:47	1045.12	107	1760	326	-40	-33	16	11.24	1.85	0.27	8.34	8.64	0.72	47.68	425.16	4.2725
8:30:02	1045.37	107	1776	336	-40	-33	16	11.33	1.9	0.33	8.25	8.6	0.55	67.43	425.41	4.2765
8:30:19	1045.62	107	1771	330	-42	-33	29	11.3	1.88	0.31	8.28	8.55	0.6	52.38	425.65	4.2814
8:30:35	1045.87	107	1748	329	-41	-33	16	11.26	1.87	0.25	8.31	8.62	0.5	54.03	425.91	4.2855
8:30:53	1046.12	105	1732	322	-40	-33	16	11.27	1.81	0.24	8.31	8.62	0.53	50	426.16	4.2908
8:31:07	1046.37	107	1758	330	-40	-28	29	11.39	1.86	0.3	8.16	8.55	0.75	68.33	426.42	4.2946
8:31:23	1046.62	108	1786	352	-42	-28	29	11.49	1.84	0.28	8.3	8.52	0.53	55.65	426.66	4.2991
8:31:39	1046.87	106	1751	337	-41	-29	29	11.32	1.83	0.29	8.27	8.5	0.6	54.65	426.91	4.3037
8:31:54	1047.12	105	1750	334	-41	-33	16	11.31	1.82	0.29	8.27	8.57	0.57	60.98	427.17	4.3077
8:32:08	1047.37	107	1790	349	-42	-29	24	11.43	1.82	0.3	8.11	8.45	0.63	72.14	427.41	4.3113
8:32:23	1047.62	105	1747	339	-42	-33	29	11.24	1.81	0.23	8.34	8.52	0.55	47.44	427.66	4.3156
8:32:41	1047.87	107	1766	341	-41	-33	16	11.19	1.83	0.28	8.28	8.47	0.5	58.25	427.91	4.3206
8:33:01	1048.12	105	1754	334	-42	-33	32	11.34	1.82	0.29	8.35	8.65	0.43	43.77	428.17	4.3264
8:33:18	1048.37	105	1774	344	-42	-33	16	11.33	1.85	0.3	8.35	8.47	0.48	62.57	428.43	4.3304
8:33:35	1048.62	105	1763	337	-41	-33	16	11.36	1.85	0.32	8.32	8.45	0.53	63.86	428.68	4.3344
8:33:41	1048.87	107	1774	346	-42	-33	29	11.46	1.83	0.26	8.1	8.35	0.57	80.24	428.92	4.3373
8:34:02	1049.12	103	1745	336	-41	-33	16	11.19	1.81	0.24	8.36	8.57	0.61	42.99	429.17	4.3433
8:34:20	1049.37	107	1742	331	-42	-33	16	11.18	1.87	0.27	8.4	8.74	0.96	37.75	429.43	4.3496

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/26/09				
Starting Depth =	1031.27	Bit Type =	Walker McDonald MP65H		
Ending Depth =	1382.14	Bit Size =	4.75		
Total Depth Drilled =	350.87	Bit Nozzles =	9, 9, 12, 13		
Hours On Bit =	6.53	Mud Type =	Water Based		
Average ROP =	53.72	Mud Weight (lbs/gal)	8.60		
Drillstring (ft) =	1071.86	Pipe (ft) =	992.86	Collar (ft)=	40.8.68

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
8:34:26	1048.62	105	1872	383	-41	-33	16	11.84	2	0.58	5.04	5.43	1.06	88.47	428.68	4.8527
8:34:42	1049.67	106	1882	385	-41	-33	16	12.01	1.46	0.53	7.87	7.92	0.72	140.05	429.53	4.7844
8:34:51	1050.12	106	1877	386	-41	-33	16	11.72	1.85	0.29	7.66	8.21	0.59	108.67	430.2	4.7367
8:35:00	1050.57	106	1826	387	-41	-33	16	11.58	1.87	0.31	8	8.33	0.62	96.41	430.41	4.7293
8:35:11	1050.62	106	1823	390	-42	-33	25	11.59	1.84	0.31	8.06	8.35	0.65	80.27	430.67	4.7205
8:35:21	1050.87	106	1855	389	-42	-33	20	11.58	1.88	0.31	8.03	8.43	0.68	94.83	430.92	4.7205
8:35:29	1051.12	106	1900	386	-41	-33	16	11.72	1.87	0.35	7.85	8.29	0.79	114.96	431.18	4.7873
8:35:39	1051.37	107	1838	389	-41	-33	16	11.58	1.86	0.34	8.04	8.31	0.6	84.71	431.43	4.7702
8:35:49	1051.63	106	1815	385	-42	-33	16	11.51	1.84	0.31	8.06	8.35	0.65	91.03	431.69	4.7731
8:36:00	1051.88	105	1851	384	-41	-33	20	11.58	1.88	0.35	8.02	8.31	0.81	83.4	431.93	4.7702
8:36:07	1052.13	107	1862	389	-41	-33	16	11.76	1.85	0.31	7.81	8.19	0.64	121.74	432.17	4.7173
8:36:18	1052.38	106	1815	395	-41	-40	20	11.48	1.83	0.28	8.09	8.35	0.57	83.62	432.42	4.7611
8:36:28	1052.63	106	1858	394	-43	-37	16	11.57	1.85	0.28	8.01	8.33	0.67	86.58	432.67	4.7636
8:36:37	1052.88	105	1862	393	-41	-33	16	11.6	1.84	0.28	7.97	8.33	0.62	101.81	432.93	4.7636
8:36:48	1053.13	106	1892	382	-42	-33	16	11.66	1.84	0.28	7.91	8.21	0.65	99.48	433.17	4.7666
8:36:55	1053.38	106	1862	385	-42	-33	16	11.64	1.84	0.28	7.83	8.22	0.77	104.78	433.43	4.7814
8:37:04	1053.63	106	1858	384	-42	-40	16	11.61	1.84	0.28	7.86	8.22	0.65	96.75	433.67	4.7937
8:37:12	1053.88	105	1864	384	-42	-33	16	11.66	1.84	0.28	7.91	8.26	0.79	104.98	433.93	4.7966
8:37:21	1054.13	105	1877	382	-42	-33	16	11.63	1.85	0.25	7.94	8.28	0.8	106.09	434.18	4.7966
8:37:30	1054.38	105	1908	384	-42	-33	16	11.65	1.85	0.27	7.92	8.28	0.74	99.28	434.43	4.7937
8:37:39	1054.63	106	1877	387	-42	-33	16	11.63	1.81	0.28	7.85	8.26	0.77	104.81	434.67	4.7937
8:37:05	1054.88	109	1752	396	-42	-33	20	11.27	1.84	0.25	8.3	8.57	0.79	54.37	434.92	4.7966
8:36:58	1055.13	108	1785	395	-44	-33	20	11.4	1.81	0.29	8.17	8.4	0.68	66.12	435.2	4.7117
8:36:17	1055.38	104	1884	380	-43	-33	25	11.64	1.83	0.31	7.93	8.33	0.69	105.08	435.42	4.7414
8:36:29	1055.88	107	1818	391	-43	-33	25	11.48	1.85	0.3	8.1	8.43	0.74	78.59	435.68	4.7117
8:36:41	1056.88	109	1784	395	-42	-33	20	11.37	1.85	0.32	8.2	8.57	0.68	70.76	435.98	4.7206
8:36:54	1056.13	108	1792	392	-39	-29	20	11.42	1.86	0.31	8.15	8.43	0.68	70.86	436.18	4.7243
8:39:12	1056.38	107	1770	392	-42	-33	20	11.26	1.83	0.29	8.31	8.64	0.74	51.69	436.44	4.7292
8:39:19	1056.63	108	1872	394	-42	-29	20	11.7	1.83	0.27	7.87	8.19	0.62	118.67	436.68	4.7415
8:39:31	1056.88	105	1739	400	-42	-33	20	11.47	1.86	0.31	8.1	8.43	0.68	73.68	436.93	4.7341
8:39:43	1057.13	107	1785	389	-42	-33	20	11.41	1.83	0.24	8.15	8.56	1.01	75	437.18	4.7391
8:39:56	1057.38	107	1795	386	-42	-29	20	11.41	1.85	0.33	8.18	8.57	1.22	72.31	437.44	4.7415
8:40:07	1057.64	108	1811	383	-40	-29	20	11.46	1.85	0.35	8.08	8.38	0.81	78.82	437.7	4.7441
8:40:13	1057.89	108	1848	382	-42	-30	16	11.97	1.85	0.3	7.6	7.95	0.72	168.51	437.96	4.7464
8:40:20	1058.14	108	1822	387	-43	-33	20	11.85	1.85	0.32	7.69	7.96	0.79	133.31	438.18	4.7488
8:40:27	1058.39	107	1857	380	-44	-33	20	11.83	1.81	0.24	7.73	8.04	0.72	126.38	438.43	4.7464
8:40:35	1058.64	105	1837	381	-43	-33	16	11.77	1.81	0.21	7.79	8.14	0.65	101.64	438.68	4.7513

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/20/98				
Starting Depth =	1031.27	Bit Type =	Walker McDonald MP68H		
Ending Depth =	1382.14	Bit Size =	4.75		
Total Depth Drilled =	350.87	Bit Nozzles =	9, 8, 12, 12		
Hours On Bit =	6.53	Mud Type =	Water Based		
Average ROP =	53.72	Mud Weight (lbs/gal)	9.00		
Drillstring (ft) =	1071.36	Pipe (ft) =	662.68	Collar (ft) =	408.68

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
8:40:43	1058.89	107	1819	390	-41	-29	24	11.74	1.81	0.32	7.82	8.11	0.62	110.33	438.94	4.4547
8:40:50	1059.14	107	1818	391	-42	-33	16	11.72	1.82	0.26	7.85	8.14	0.65	136.53	439.19	4.4567
8:40:59	1059.39	107	1820	388	-42	-33	16	11.72	1.82	0.24	7.89	8.11	0.57	105.98	439.43	4.459
8:41:07	1059.64	108	1793	397	-42	-33	20	11.64	1.83	0.24	7.92	8.28	0.74	107.52	439.69	4.4613
8:41:19	1059.89	108	1787	398	-42	-33	20	11.42	1.83	0.25	8.15	8.5	0.77	74.82	439.94	4.4647
8:41:31	1060.14	108	1796	387	-42	-33	20	11.48	1.85	0.31	8.08	8.38	0.66	76.42	440.19	4.4682
8:41:42	1060.39	107	1764	390	-43	-33	20	11.38	1.87	0.31	8.09	8.39	0.5	69.5	440.43	4.4711
8:41:50	1060.64	108	1903	393	-42	-33	20	11.75	1.89	0.42	7.82	8.24	0.96	103.6	440.69	4.4733
8:41:56	1060.89	107	1931	389	-42	-33	16	12	1.86	0.34	7.56	7.9	0.67	152.58	440.95	4.4751
8:42:03	1061.14	105	1937	398	-42	-33	16	11.93	1.87	0.35	7.64	8.02	0.74	128.9	441.2	4.4768
8:42:10	1061.39	104	1983	390	-41	-33	16	11.84	1.89	0.42	7.73	8.18	0.86	117.42	441.45	4.4791
8:42:17	1061.64	105	1945	384	-41	-33	16	11.81	1.89	0.38	7.76	8.23	0.64	129.52	441.69	4.4811
8:42:26	1061.89	109	1853	397	-42	-33	20	11.76	1.85	0.28	7.81	8.11	0.72	110.69	441.94	4.4831
8:42:34	1062.14	108	1845	392	-43	-33	20	11.6	1.81	0.34	7.96	8.28	0.69	102.58	442.19	4.4857
8:42:46	1062.39	108	1810	392	-42	-33	16	11.44	1.82	0.29	8.13	8.36	0.53	80.22	442.43	4.4888
8:42:58	1062.64	108	1840	398	-41	-29	20	11.36	1.84	0.28	8.1	8.39	0.57	75.87	442.69	4.4923
8:43:09	1062.89	106	1838	387	-41	-33	20	11.49	1.83	0.27	8.07	8.31	0.53	86.83	442.94	4.4951
8:48:23	1063.21	108	1408	443	773	882	361	18.36	1.95	0.51	2.8	3.83	3.21	91.83	443.26	4.5034
8:48:32	1063.47	105	1860	438	986	1117	252	13.94	2.01	0.56	6.24	8.82	5.89	97.91	443.58	4.506
8:48:38	1063.72	106	1860	442	1064	1137	101	11.34	2	0.6	9.96	10.58	1.72	151.64	443.76	4.5074
8:48:44	1063.97	104	1895	434	1059	1173	203	11.07	1.92	0.53	10.12	10.56	1.05	155.23	444	4.5092
8:48:48	1064.22	107	1677	443	1019	1199	174	11.3	1.98	0.53	9.89	10.49	1.41	193.39	444.31	4.5108
8:48:52	1064.47	107	1808	443	1044	1183	166	11.06	1.98	0.51	9.53	10.01	1.1	217.34	444.52	4.5117
8:48:57	1064.72	107	1902	444	1081	1159	190	11.38	2.01	0.63	9.69	10.01	1.61	169.26	444.77	4.5129
8:49:02	1064.97	104	1923	426	1048	1170	255	11.16	2.06	0.62	10.33	10.35	1.13	172.93	445.01	4.5143
8:49:08	1065.22	108	1877	451	901	1158	247	11.25	1.98	0.54	9.94	10.39	0.93	175.49	445.28	4.5158
8:49:13	1065.47	106	1869	448	893	1158	247	11.24	2.04	0.8	9.95	10.44	0.98	187.83	445.53	4.5172
8:49:18	1065.72	107	1855	446	987	1257	595	11.14	2.05	0.8	10.05	10.51	0.96	180.23	445.79	4.5188
8:49:24	1065.97	106	1881	442	984	1181	250	11.12	1.89	0.59	10.07	10.83	1.05	158.17	446.03	4.5203
8:49:29	1066.22	103	1901	429	1026	1081	122	11.38	2.02	0.65	9.98	10.44	1.01	179.47	446.27	4.5218
8:49:35	1066.47	104	1932	435	1071	1174	174	11.18	2.02	0.64	10.01	10.53	1.1	155.68	446.52	4.5233
8:49:40	1066.72	104	2001	433	1121	1231	227	11.34	2.02	0.63	10.04	10.58	0.95	170.73	446.78	4.5246
8:49:46	1066.97	104	1986	435	1190	1194	186	11.13	2.14	0.86	10.06	10.61	0.98	150	447.04	4.5264
8:49:51	1067.23	104	1978	434	1102	1174	190	11.1	2.14	0.91	10.08	10.83	0.84	156.87	447.27	4.5281
8:49:57	1067.48	106	2000	446	1138	1257	219	11.08	2.08	0.89	10.1	10.56	0.98	157.75	447.52	4.5295
8:50:02	1067.73	103	2048	431	1176	1249	228	11.32	2.15	0.80	9.87	10.46	1.18	177.8	447.79	4.5309
8:50:07	1067.98	104	2097	434	1202	1279	186	11.28	2.87	3.2	9.96	10.53	1.30	192.62	448.02	4.5324

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/28/96						
Starting Depth =	10,11.27		Bit Type =	Walker McDonald MP6IH			
Ending Depth =	1382.14		Bit Size =	4.75			
Total Depth Drilled =	395.87		Bit Nozzles =	9, 8, 10, 12			
Hours On Bit =	6.53		Mud Type =	Water Based			
Average ROP =	60.72		Mud Weight (lbs/gal)	8.20			
Drillstring (ft) =	1071.35		Pipe (ft) =	662.69	Collar (ft)=	408.66	

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
8:50:12	1068.23	103	2118	432	1246	1384	340	11.29	2.31	1.03	9.85	10.53	1.22	187.4	446.27	4.5389
8:50:17	1068.48	105	2191	437	1223	1386	358	11.21	2.22	1.63	9.87	10.56	1.20	180.28	446.58	4.5362
8:50:23	1068.73	104	2148	434	1232	1405	344	11.16	2.2	0.95	10.04	10.83	1.03	171.47	446.82	4.5361
8:50:29	1068.98	104	2115	435	1193	1392	312	11.04	2.11	0.86	10.14	10.85	1.1	164.7	447.05	4.5384
8:50:35	1069.23	102	2156	429	1241	1777	798	11.1	2.23	1.08	10.09	10.92	1.58	169.12	447.27	4.5401
8:50:40	1069.48	103	2123	430	1181	1372	476	11.14	2.53	1.11	10.06	10.68	1.39	159.28	447.56	4.5419
8:50:47	1069.73	105	2050	436	1124	1318	369	10.67	2.29	1.07	10.32	10.64	1.1	130.04	447.78	4.5438
8:50:53	1069.98	105	2193	439	1168	2799	3131	10.84	2.51	0.97	10.84	11.9	2.81	120.75	448.05	4.5466
8:51:01	1070.24	104	2336	432	1498	2758	2901	12.07	2.85	1.14	8.8	11.87	5.62	141.6	448.28	4.5473
8:51:09	1070.49	108	1792	446	837	1267	902	16.1	2.25	1.01	5.06	6.58	3.47	117.22	448.51	4.5486
8:51:14	1070.74	105	1913	430	1029	1344	620	14.48	2.27	1.56	6.7	8.35	2.27	168.27	448.81	4.551
8:51:21	1070.99	105	1931	442	1045	1267	466	13.87	2.31	1.19	7.91	9.67	1.76	146.41	451.05	4.5627
8:51:25	1071.24	105	2012	437	1078	1306	514	13.76	2.36	1.2	7.4	9.23	2.06	229.68	451.3	4.5638
8:51:30	1071.49	105	2086	438	1162	2329	1645	13.76	2.4	1.45	7.42	9.66	3.06	173.1	451.58	4.5655
8:51:36	1071.75	109	2157	451	1298	2511	1856	13.48	2.36	1.19	7.72	9.62	3.66	183.52	451.83	4.5669
8:51:39	1072	105	1966	440	753	1320	776	17.46	2.11	0.76	3.69	7.47	3.27	215.42	452.04	4.5679
8:51:44	1072.25	108	1756	448	913	1291	667	15.27	2.29	1.03	5.9	7.83	4.28	86.96	452.3	4.5697
8:51:50	1072.5	107	1849	448	913	1166	391	13.73	2.13	0.89	7.45	8.16	1.24	170.08	452.56	4.5712
8:52:02	1072.76	106	1814	442	826	1062	359	13.3	2.07	0.78	7.96	8.43	1.03	121.47	452.81	4.5729
8:52:09	1073	108	1810	448	915	1348	338	13.06	2.34	0.97	8.12	8.86	1.27	123.69	453.04	4.5745
8:52:32	1073.25	107	1838	445	851	2191	1858	12.79	2.29	1.01	8.42	9.62	3.28	71.86	453.3	4.5802
8:52:29	1073.5	106	1830	442	1004	1336	555	13.17	2.54	1.48	8.01	8.74	1.48	139.82	453.53	4.5718
8:52:34	1073.75	109	1809	452	964	1044	168	13.41	2.58	0.73	7.76	8.25	0.68	167.93	453.81	4.5738
8:52:41	1074	109	1788	452	826	945	190	13.28	2.56	0.62	7.84	8.25	0.68	146.34	454.05	4.5751
8:52:47	1074.25	108	1748	441	833	923	164	13.16	2.61	0.61	8.01	8.45	0.86	134.54	454.31	4.5766
8:52:54	1074.5	108	1778	446	860	958	286	13.21	2.62	0.66	7.98	8.43	0.96	109.22	454.58	4.5784
8:53:01	1074.75	107	1797	447	904	993	192	13.26	2.59	0.53	7.9	8.8	0.93	137.73	454.81	4.5805
8:53:07	1075	108	1851	448	984	1044	150	13.33	2.61	0.6	7.88	8.38	1.01	147.97	455.04	4.5822
8:53:13	1075.25	108	1853	442	970	1046	168	13.25	2.19	0.84	7.61	8.05	0.83	136.64	455.31	4.5843
8:53:19	1075.51	108	1838	439	897	971	166	13.25	1.68	0.61	7.9	8.4	0.98	156.04	455.56	4.5857
8:53:25	1075.76	111	1774	460	884	1077	344	13.03	2.08	0.73	8.18	8.62	1.23	101.92	455.8	4.5882
8:53:34	1076.01	108	1886	437	820	1036	211	13.36	2.46	0.69	7.81	8.28	1.03	169.26	456.03	4.5897
8:53:42	1076.26	107	1808	445	865	1016	255	12.96	2.08	0.74	8.21	8.64	0.95	167.53	456.3	4.5923
8:53:59	1076.51	108	1798	443	855	1035	450	12.61	2.05	0.71	8.55	9	1.08	83.78	456.56	4.5938
8:54:21	1076.76	108	1705	448	748	1010	446	12.49	2.08	0.69	8.67	9.05	0.93	40.84	456.6	4.5942
8:54:31	1076.96	105	1643	448	658	943	428	13.41	2.05	0.68	8.76	9.1	0.82	59.82	457	4.5972
8:55:13	1077.21	105	1853	448	787	971	448	12.52	2.08	0.73	8.65	9.12	0.84	37.66	457.26	4.6177

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1081.27			Bit Type =	Walker McDonnald MF564												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	300.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.83			Mud Type =		Water Based											
Average ROP =	59.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.66			Collar (ft)=	408.68								

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK GS	DELTA GS	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet DrBit	Hours DrBit
8:55:26	1077.46	106	1755	443	828	1279	733	12.24	2.28	1.31	6.93	10.29	2.24	81.05	457.61	4.522
8:55:48	1077.71	106	1764	450	832	1085	488	10.6	2.08	0.69	10.53	11.56	2.13	54.86	457.73	4.52286
8:55:54	1077.96	105	1875	429	821	1060	361	10.29	2.08	0.71	10.65	11.32	0.54	116.67	458	4.52286
8:56:04	1078.21	106	1834	440	860	1032	236	10.31	2.1	0.74	10.97	11.65	0.68	81.41	458.27	4.52315
8:56:13	1078.46	105	1824	437	870	987	276	10.26	2.08	0.77	10.92	11.67	1.01	97.16	458.51	4.52343
8:56:22	1078.71	106	1801	436	841	1101	402	10.2	2.11	0.73	10.96	11.47	1.05	98.44	458.75	4.52372
8:56:34	1078.96	107	1760	444	838	1036	340	10.14	2.11	0.78	11.05	11.49	0.83	78.23	459.06	4.52408
8:56:42	1079.22	105	1864	451	846	1121	365	10.31	2.08	0.76	10.87	11.3	1.03	105.33	459.26	4.52431
8:56:48	1079.47	104	2101	438	1183	1315	348	10.64	2.86	1.85	10.54	13.15	1.36	123.33	459.51	4.52461
8:56:55	1079.72	108	2116	442	1014	1312	572	12.57	3.28	3.05	8.28	12.05	7.76	159.25	459.75	4.52490
8:57:06	1079.97	108	1760	448	775	874	236	15.67	2.24	0.93	5.13	5.87	1.13	81.9	460.02	4.52467
8:57:14	1080.22	105	1723	449	761	962	250	16.05	2.11	0.72	5.1	5.63	1.03	101.15	460.26	4.551
8:57:30	1080.47	110	1678	436	714	838	236	15.76	2.11	0.73	5.28	5.77	0.98	58.17	460.51	4.55353
8:57:43	1080.72	111	1633	456	645	825	284	15.78	2.03	0.6	5.38	5.79	1.03	89.77	460.77	4.559
8:57:59	1080.97	111	1668	455	621	778	284	15.74	1.96	0.55	5.42	5.91	1.27	97.11	461.01	4.56613
8:58:18	1081.22	110	1562	458	611	777	282	15.66	2.01	0.64	5.46	5.84	1.08	45.37	461.26	4.56897
8:58:31	1081.47	108	1579	440	626	740	198	15.83	2.01	0.55	5.52	5.63	0.68	73.28	461.5	4.57174
8:58:51	1081.72	106	1575	453	616	745	243	15.65	2.06	0.67	5.46	5.84	0.95	44.67	461.77	4.5771
8:59:07	1081.97	106	1563	452	636	764	219	15.7	2.08	0.71	5.44	5.84	0.91	84.56	461.99	4.58025
8:59:37	1082.16	108	1512	452	659	748	340	15.28	2.08	0.64	5.81	6.04	2.98	38.12	462.34	4.58368
9:00:03	1082.41	108	1804	449	646	781	237	11.53	1.93	0.62	9.64	10.41	2.56	35.76	462.46	4.58512
9:00:22	1082.66	107	1838	445	676	777	238	11.51	2.03	0.63	9.86	10.53	0.96	46.56	462.71	4.58811
9:00:40	1082.91	107	1865	445	731	971	454	11.53	2.08	0.72	9.93	10.58	0.93	48.41	462.95	4.59083
9:00:53	1083.16	107	1764	445	821	1089	540	11.46	2.02	0.69	9.75	10.32	1.46	69.7	463.22	4.712
9:01:09	1083.41	102	1901	429	869	1048	323	12.02	2.08	0.71	9.15	9.69	1.22	130.36	463.49	4.71457
9:01:26	1083.67	100	1874	441	670	1030	243	11.98	2	0.59	9.29	9.68	1.43	145.07	463.73	4.71728
9:01:37	1083.82	107	1832	444	886	979	271	11.51	2.08	0.73	9.88	10.15	1.1	86.01	463.98	4.7203
9:01:54	1084.17	106	1816	442	893	951	357	11.7	2.04	0.64	9.48	9.91	1.1	117.48	464.31	4.72406
9:01:39	1084.42	106	1796	441	742	967	466	11.9	2.08	0.7	9.86	10.36	1.15	62.51	464.46	4.72556
9:01:49	1084.67	106	1781	442	619	838	259	11.81	2.08	0.77	9.88	9.88	0.85	58.18	464.72	4.72773
9:01:55	1084.92	105	1837	439	638	875	243	11.72	2.1	0.7	9.94	9.88	0.85	104.98	464.97	4.72993
9:02:12	1085.17	106	1787	443	708	843	336	11.29	2.05	0.72	9.94	10.32	0.68	53.12	465.21	4.73196
9:02:30	1085.42	105	1778	438	789	1020	388	11.3	2.16	0.66	9.96	10.34	1.06	70.3	465.47	4.73389
9:02:52	1085.67	107	1877	446	687	778	134	11.13	2.07	0.78	10.03	10.39	0.77	41.64	465.72	4.73602
9:03:06	1085.92	106	1771	442	838	1218	563	11.41	2.06	0.7	9.74	10.34	1.04	62.5	465.98	4.73811
9:03:12	1086.17	106	2061	441	1083	1097	196	12.01	2.12	0.88	9.16	9.85	3.22	181.64	466.22	4.73994
9:03:16	1086.42	105	1975	438	975	1083	169	11.91	2.09	0.73	9.17	9.62	0.35	148.95	466.46	4.74211

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/28/98																
Starting Depth =	1081.27			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	300.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		8.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	982.68				Collar (ft)=	488.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
9:03:26	1086.67	104	1976	435	688	1238	550	11.73	2.07	0.71	9.44	10.15	1.43	110.35	386.74	3.7544
9:03:33	1086.93	106	1962	443	945	1182	361	11.68	2.08	0.75	9.5	9.91	1.01	126.91	466.97	3.7964
9:03:41	1087.18	106	1918	443	913	1020	430	11.76	2.08	0.7	9.36	9.81	1.01	115.07	497.25	4.7567
9:03:47	1087.43	104	2013	435	1049	1117	297	11.85	2.17	0.69	9.18	9.67	1.08	147.85	557.47	4.7601
9:03:54	1087.65	107	2019	443	1021	1137	393	11.8	2.45	0.81	9.28	9.98	1.27	139.69	487.75	4.7621
9:04:01	1087.93	106	1983	440	965	1077	388	11.68	2.11	0.66	9.5	10.2	1.2	123.85	487.97	4.7641
9:04:09	1088.18	106	1980	441	979	1101	280	11.73	2.08	0.65	9.43	9.98	0.86	125.82	485.22	4.7661
9:04:19	1088.42	107	1917	447	892	1222	596	11.45	2.04	0.64	9.71	10.17	1.34	83.36	466.47	4.7683
9:04:40	1089.69	107	1858	446	863	1164	668	11.16	2.19	0.85	10	10.44	1.03	44.23	468.74	4.7747
9:04:50	1089.93	107	1864	441	936	1302	519	11.46	2.06	0.66	9.71	10.1	0.86	85.04	466.07	4.7778
9:05:00	1090.18	106	1869	433	854	1015	306	11.48	2.08	0.73	9.67	10.08	0.75	81.07	469.23	4.7806
9:05:10	1090.43	106	1800	443	862	982	170	11.47	2.08	0.72	9.66	10.1	0.86	80.03	469.48	4.7833
9:05:27	1090.66	106	1825	442	836	1271	636	11.28	2.05	0.69	9.88	10.41	1.15	65.43	468.73	4.7879
9:05:37	1090.93	106	1881	443	879	1205	551	11.41	2.06	0.69	9.75	10.2	0.96	87.03	468.96	4.7908
9:05:48	1091.18	105	1869	442	798	979	289	11.37	2.06	0.69	9.79	10.25	0.89	73.58	470.23	4.7942
9:05:59	1091.43	103	1785	430	778	935	243	11.46	2.05	0.63	9.68	10.01	0.79	68.79	470.5	4.7976
9:06:09	1091.68	108	1772	449	769	856	194	11.53	2.04	0.64	9.61	9.98	0.81	97.99	476.76	4.7994
9:06:19	1091.93	108	1760	438	814	1048	332	11.63	2.17	0.98	9.68	10.06	1.17	93.21	471	4.8028
9:06:24	1092.18	106	1871	440	879	979	180	11.93	2.08	0.73	9.28	9.85	0.88	148.65	471.26	4.8058
9:06:30	1092.44	107	1903	448	911	979	146	12.03	2.04	0.66	9.12	9.55	0.81	156.46	471.48	4.8054
9:06:36	1092.69	104	1835	438	880	979	199	12.08	2	0.61	9.08	9.55	0.88	156.53	471.74	4.8077
9:06:41	1092.94	106	1857	441	844	933	134	12.07	2.11	0.75	9.05	9.43	1.03	167.45	472	4.8086
9:06:48	1093.19	106	1823	440	827	957	184	11.98	2.01	0.8	9.19	9.65	0.96	135.26	472.24	4.8105
9:06:55	1093.44	106	1810	441	800	896	65	11.95	2.06	0.64	9.3	9.72	0.86	134.66	472.51	4.8123
9:07:02	1093.69	108	1791	443	760	866	156	11.68	1.96	0.65	9.49	10.01	1.1	116.71	472.74	4.8148
9:07:12	1093.94	108	1785	450	762	864	156	11.58	2.03	0.69	9.59	9.98	0.84	93.81	472.96	4.8171
9:07:24	1094.19	106	1812	443	796	1008	425	11.38	2.02	0.6	9.77	10.22	1.03	78.61	473.23	4.8203
9:07:36	1094.44	106	1882	442	810	2086	1515	11.51	2.22	1.13	9.64	10.63	2.01	70.45	473.53	4.8237
9:07:48	1094.69	104	1960	435	944	1340	612	12.17	2	0.61	8.95	9.62	1.34	190.66	473.73	4.8255
9:07:49	1094.94	107	1764	445	707	947	356	12.11	1.92	0.4	9.04	9.58	1.15	185.45	473.99	4.8274
9:08:06	1095.19	107	1874	446	982	903	373	11.87	1.99	0.5	9.37	9.72	0.96	84.99	474.24	4.832
9:08:25	1095.44	105	1738	448	898	956	209	11.75	1.99	0.62	9.4	9.69	1.1	46.44	474.51	4.8378
9:13:21	1095.94	107	1548	443	781	927	571	14.09	1.95	0.81	6.7	10.06	9.63	102.86	474.89	4.8437
9:13:28	1096.19	108	1931	430	1031	1196	316	11.67	2.04	0.58	10.14	10.58	1.15	123.21	475.19	4.8457
9:13:34	1096.34	104	2076	431	1195	1214	283	11.71	1.89	0.58	10.01	10.31	1.1	158.9	475.39	4.8474
9:13:40	1096.6	102	2063	434	1046	1170	219	11.76	1.83	0.48	9.96	10.46	1.08	181.41	475.64	4.8495
9:13:46	1096.85	104	1918	432	879	1028	243	11.64	1.89	0.31	10.08	10.55	0.98	180.09	475.92	4.8519

DOE high power mortor test Amaco Catoosa Test Site

Test No. 23	Date: 2/26/98																
Starting Depth =	1091.27			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	270.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.58			Mud Type =		Water Based											
Average ROP =	58.72			Mud Weight (lbs/gal)		9.00											
Drilled (ft) =	1071.35			Flow (ft) =	902.68			Collar (ft)=	466.88								
TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
9:13:54	1086.1	108	1871	438	673	1016	280	11.41	1.92	0.37	10.31	10.75	0.99	110.35	476.13	4.85238
9:14:02	1086.85	104	1854	430	651	896	245	11.43	1.85	0.3	10.28	10.77	0.96	115.01	476.4	4.85515
9:14:08	1086.6	107	1824	442	628	874	89	11.34	1.49	0.35	10.17	10.56	0.77	137.47	476.66	4.85686
9:14:17	1086.85	108	1786	446	705	927	307	11.43	1.81	0.34	10.27	10.6	0.89	110.76	476.91	4.85932
9:14:23	1087.1	108	1806	446	788	879	139	11.45	1.86	0.28	10.29	10.63	0.86	131.38	477.17	4.86132
9:14:31	1087.35	108	1763	445	785	946	117	11.42	1.87	0.31	10.29	10.7	0.89	113.5	477.39	4.86332
9:14:39	1087.6	107	1798	443	795	956	150	11.45	1.87	0.33	10.29	10.68	0.89	114.79	477.65	4.86553
9:14:48	1087.85	110	1745	454	786	976	190	11.28	1.96	0.28	10.45	10.8	0.69	97.05	477.92	4.86781
9:15:02	1088.1	107	1762	443	761	859	255	11.07	1.92	0.33	10.64	11.04	0.93	85.06	478.14	4.87178
9:15:16	1088.35	108	1726	448	730	830	330	10.92	1.89	0.28	10.79	11.01	0.93	56.27	478.39	4.87401
9:15:34	1088.6	107	1711	442	728	815	310	10.86	1.84	0.28	10.77	11.09	0.73	83.36	478.65	4.87607
9:15:53	1088.85	106	1688	439	715	862	300	10.9	1.83	0.28	10.81	11.13	0.69	46.39	478.9	4.87838
9:16:07	1089.1	106	1667	437	681	801	247	10.66	1.84	0.25	10.74	11.11	0.74	62.53	479.15	4.88038
9:16:20	1089.35	106	1655	436	665	757	166	11.1	1.86	0.3	10.81	10.82	0.65	75.88	479.4	4.88238
9:16:36	1089.6	106	1728	442	750	851	351	10.93	1.87	0.33	10.77	11.19	0.93	65.23	479.65	4.88476
9:17:01	1089.85	107	1694	442	729	851	366	10.84	1.86	0.32	10.86	11.2	0.77	36.81	479.91	4.88747
9:17:20	1090.1	106	1751	437	767	928	400	10.92	1.89	0.35	10.78	11.16	0.65	47.62	480.16	4.89162
9:17:29	1090.46	106	1696	437	668	1031	484	11.88	2.07	0.64	10.43	10.69	1.17	97.78	480.4	4.89128
9:17:36	1090.6	106	1676	438	668	1086	327	11.68	1.98	0.47	10.61	10.48	0.98	134.7	480.55	4.89145
9:17:42	1090.85	104	1643	433	639	1036	316	11.61	1.94	0.41	10.85	10.96	1.01	165.76	480.8	4.89182
9:17:58	1091.11	105	1764	446	757	916	352	11.63	1.89	0.34	10.85	11.11	1.08	83.85	481.17	4.89186
9:18:19	1091.36	106	1723	446	715	847	372	10.87	1.87	0.33	10.81	11.18	0.65	98.71	481.4	4.89385
9:18:40	1091.61	107	1704	444	703	876	364	10.86	1.86	0.34	10.84	11.18	0.67	42.58	481.65	4.89595
9:18:58	1091.86	107	1703	442	719	829	236	10.99	1.87	0.31	10.71	11.04	0.69	98.08	481.9	4.89808
9:19:09	1092.11	106	1691	438	712	821	183	11.04	1.88	0.27	10.67	10.92	0.63	71.68	482.16	4.90003
9:19:21	1092.36	105	1654	438	700	817	227	11.07	1.89	0.27	10.63	10.96	0.81	70.79	482.4	4.9041
9:19:34	1092.61	107	1730	441	747	870	238	11.11	1.88	0.31	10.55	10.82	0.87	73.84	482.65	4.90571
9:19:44	1092.86	107	1736	442	744	821	174	11.15	1.87	0.33	10.55	10.84	0.85	88.2	482.9	4.90
9:19:56	1093.11	107	1727	442	736	813	193	11.13	1.86	0.33	10.57	10.87	0.83	77.81	483.16	4.90834
9:20:07	1093.36	107	1705	444	714	825	236	11.11	1.87	0.28	10.59	10.84	0.85	76.22	483.41	4.90966
9:20:17	1093.61	107	1680	442	838	1131	446	11.07	2.08	0.56	10.34	10.87	1.13	88.34	483.66	4.9099
9:20:24	1093.86	105	1663	436	862	1164	365	11.06	1.95	0.46	10.15	10.72	1.1	124.08	483.64	4.9131
9:20:30	1094.11	105	1646	436	872	1077	393	11.51	1.88	0.34	10.19	10.65	0.92	104.85	484.16	4.91626
9:20:40	1094.36	105	1695	436	867	1044	305	11.28	1.88	0.51	10.43	10.83	1.01	80.64	484.41	4.91655
9:20:48	1094.61	107	1977	440	980	1145	326	11.64	2.03	0.61	10.19	10.77	1.27	134.7	484.66	4.91673
9:20:59	1094.86	104	1961	431	997	1105	253	11.63	2.03	2.6	10.07	10.51	1.03	135.85	484.91	4.91692
9:20:59	1095.11	104	2024	432	1054	1139	327	11.63	1.97	0.55	10.07	10.51	0.96	143	485.16	4.91769

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/25/06						
Starting Depth =	1031.37	Bit Type =	Walker McDonald MP66H				
Ending Depth =	1162.14	Bit Size =	4.75				
Total Depth Drilled =	350.87	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	6.33	Mud Type =	Water Based				
Average ROP =	55.72	Mud Weight (Range)	8.35				
Drillstring (ft) =	1071.56	Pipe (ft) =	662.68	Collar (ft)=	408.88		

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
9:21:05	1105.30	107	1966	444	944	1040	174	11.28	1.82	0.35	10.02	10.44	0.84	182.76	485.41	4.9736
9:21:12	1105.61	107	1946	441	928	1044	216	11.6	1.91	0.41	10.11	10.58	0.91	131.42	485.66	4.9746
9:21:16	1105.86	106	1940	439	898	1069	352	11.45	1.85	0.48	10.25	10.78	1.03	123.13	485.92	4.9756
9:21:26	1106.12	105	1995	436	874	1194	482	11.54	1.69	0.51	10.16	10.66	1.13	132.51	486.17	4.9764
9:21:30	1106.37	103	1972	428	863	1056	192	11.56	1.97	0.46	10.15	10.63	1.05	126.87	486.43	4.9804
9:21:35	1106.63	105	1914	434	900	1012	267	11.41	1.88	0.35	10.28	10.7	0.96	175.27	486.67	4.98224
9:21:49	1106.87	108	1924	439	922	1083	276	11.42	1.92	0.44	10.26	10.7	1.03	107.19	486.91	4.9847
9:21:58	1107.12	107	1905	441	868	1073	417	11.22	1.91	0.4	10.48	10.89	0.98	98.55	487.11	4.9872
9:22:11	1107.37	105	1975	435	874	1338	664	11.09	1.83	0.44	10.61	11.04	0.98	68.48	487.41	4.991
9:22:16	1107.62	108	2043	435	1147	1275	502	11.54	2.07	0.84	10.16	10.83	0.98	180.42	487.63	4.993
9:22:24	1107.87	103	2014	428	975	1154	304	11.67	1.84	0.45	10.02	10.45	1.1	182.86	487.92	4.99644
9:22:30	1108.12	108	1975	440	888	1052	176	11.56	1.92	0.45	10.12	10.58	0.86	130.31	488.19	4.9965
9:22:37	1108.37	106	1977	439	978	1191	235	11.55	1.83	0.43	10.14	10.63	0.98	103.29	488.43	4.9991
9:22:44	1108.62	105	1972	434	944	1088	293	11.5	1.83	0.48	10.2	10.7	1.03	125.53	488.67	5.0017
9:22:53	1108.87	106	1951	438	898	1219	417	11.36	1.84	0.44	10.32	10.72	0.98	100.36	488.92	5.0027
9:22:59	1109.13	106	1975	439	943	1083	292	11.56	1.81	0.42	10.14	10.58	0.89	147.3	489.17	5.0044
9:23:06	1109.38	105	1961	436	948	1091	256	11.54	1.94	0.45	10.16	10.63	0.86	127.05	489.42	5.0064
9:23:13	1109.63	105	1956	434	959	1195	332	11.48	1.82	0.47	10.21	10.7	1.05	127.12	489.67	5.0084
9:23:20	1109.88	107	1946	441	904	1060	228	11.52	1.88	0.43	10.17	10.6	0.98	103.46	489.93	5.0102
9:23:25	1110.13	105	1957	435	955	1086	259	11.44	1.91	0.44	10.25	10.7	0.91	114.28	490.18	5.0122
9:23:35	1110.38	103	1952	428	907	1193	290	11.51	1.85	0.48	10.19	10.69	1.01	136.89	490.43	5.0142
9:23:48	1110.63	106	1911	436	889	883	182	11.42	1.93	0.42	10.28	10.68	0.76	111.31	490.67	5.0165
9:23:56	1110.88	107	1914	441	882	883	207	11.40	1.92	0.41	10.27	10.65	0.89	127.96	490.93	5.0185
9:24:05	1111.13	106	1870	436	873	1052	395	11.36	1.88	0.37	10.3	10.72	0.91	107.75	491.18	5.0205
9:24:06	1111.38	107	1943	442	918	1138	300	11.46	2.04	0.64	10.24	10.63	0.56	120.67	491.44	5.0225
9:24:13	1111.63	105	1917	435	886	1038	251	11.37	1.9	0.38	10.33	10.77	0.89	118.15	491.67	5.0243
9:24:22	1111.88	106	1917	440	880	1036	287	11.34	1.92	0.36	10.36	10.77	0.79	103.22	491.92	5.0263
9:24:30	1112.13	106	1905	439	894	897	186	11.36	1.94	0.44	10.35	10.8	0.96	108.82	492.18	5.0283
9:24:40	1112.38	108	1883	446	846	1032	352	11.21	1.97	0.56	10.48	10.96	1.13	83.67	492.44	5.0303
9:24:46	1112.63	107	1895	441	875	1052	228	11.35	1.89	0.4	10.34	10.75	0.82	105.86	492.7	5.0146
9:24:56	1112.88	106	1906	440	876	950	199	11.35	1.85	0.4	10.3	10.66	0.91	130.79	492.93	5.0165
9:25:04	1113.13	106	1857	437	895	931	182	11.41	1.88	0.37	10.28	10.6	0.81	112.86	493.18	5.0185
9:25:12	1113.38	105	1881	434	850	982	219	11.38	1.87	0.36	10.31	10.75	0.89	114.27	493.43	5.0511
9:25:21	1113.63	107	1844	442	799	919	385	11.21	1.8	0.4	10.48	11.04	1.27	96.28	493.68	5.0437
9:25:31	1113.88	107	1861	444	780	936	324	11.36	1.9	0.39	10.33	10.99	1.69	85.77	493.93	5.0457
9:25:35	1114.14	106	1897	439	878	843	165	12.04	1.84	0.42	9.66	10.2	1.18	187.77	494.32	5.0477
9:25:40	1114.39	105	1903	436	878	983	168	12.04	1.92	0.44	9.68	10.27	1.39	183.89	494.45	5.0491

DOE high power mortor test Amaco Catoosa Test Site

Well No. 22	Date: 2/26/98															
Starting Depth =	1081.27			Bit Type =	Weber McDonald MP58H											
Ending Depth =	1082.14			Bit Size =	4.75											
Total Depth Drilled =	350.87			Bit Nozzles =		8, 9, 12, 12										
Hours On Bit =	8.58			Mud Type =		Water Based										
Average ROP =	52.72			Mud Weight (lbs/gal)		9.00										
Drilstring (ft) =	1071.36			Pipe (ft) =	662.68			Collar (ft)=	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
9:25:46	1114.64	108	2037	435	1041	1231	334	11.84	2.11	0.67	10.65	10.63	1.15	141.69	484.65	5.0538
9:25:53	1114.65	104	2030	432	1021	1121	164	11.68	1.87	0.48	10.63	10.44	1.03	141.18	484.36	5.0625
9:25:59	1115.14	105	2072	436	1034	1145	227	11.98	2.02	0.58	9.71	10.44	1.53	139.38	485.18	5.0564
9:26:04	1115.36	103	2053	427	1018	1117	166	12.12	1.98	0.45	9.57	9.84	1.1	136.28	485.43	5.0537
9:26:10	1115.64	105	2018	434	981	1062	186	12.28	1.84	0.44	9.4	9.63	1.05	146.83	485.69	5.0573
9:26:15	1115.99	104	1980	432	956	1060	105	12.19	1.81	0.38	9.51	10.01	0.68	146.84	485.96	5.0551
9:26:22	1116.14	107	1982	442	946	1029	149	12.28	1.86	0.35	9.43	9.86	0.83	139.57	486.18	5.0636
9:26:28	1116.36	106	1992	439	952	1040	169	12.16	1.93	0.36	9.43	9.96	0.86	142.7	486.47	5.0623
9:26:34	1116.64	107	1982	444	938	1044	218	12.24	1.9	0.35	9.45	9.89	0.86	150.69	486.72	5.064
9:26:40	1116.98	108	1985	446	929	1058	211	12.29	1.87	0.34	9.42	9.85	0.81	148.84	486.98	5.0657
9:26:46	1117.14	105	1980	436	959	1049	178	12.28	1.94	0.42	9.43	9.89	0.91	156.46	487.18	5.0673
9:26:51	1117.36	105	1984	434	965	1020	138	12.3	1.95	0.37	9.5	9.84	0.91	157.68	487.44	5.0693
9:26:57	1117.64	104	1986	433	948	1035	155	12.3	1.86	0.35	9.39	9.81	1.01	152.96	487.7	5.0702
9:27:03	1117.9	103	1987	427	936	1016	146	12.31	1.94	0.4	9.36	9.79	0.96	169.51	487.96	5.071
9:27:09	1118.15	105	1956	434	912	986	176	12.31	1.92	0.38	9.36	9.79	0.93	152.85	488.2	5.0736
9:27:14	1118.4	106	1933	446	889	971	182	12.31	1.88	0.36	9.36	9.84	0.96	163.85	488.44	5.0752
9:27:20	1118.65	105	1929	437	903	1040	211	12.26	1.9	0.39	9.43	9.86	0.98	153.19	488.72	5.0768
9:27:27	1118.9	107	1957	442	946	1016	170	12.22	1.86	0.39	9.47	9.89	1.01	136.05	488.94	5.0786
9:27:32	1119.15	104	1977	432	945	1064	249	12.24	1.84	0.42	9.49	9.83	0.93	161.75	489.2	5.0801
9:27:38	1119.4	106	1943	436	917	983	134	12.19	1.88	0.37	9.53	9.83	0.86	135.48	489.44	5.0821
9:27:44	1119.65	104	1957	431	927	1016	190	12.17	1.93	0.4	9.52	9.91	0.86	153.11	489.69	5.0836
9:27:51	1119.9	105	1960	429	885	1031	238	12.16	1.87	0.33	9.53	10.17	1.05	143.29	489.94	5.0855
9:27:58	1120.15	105	1950	437	904	1034	162	12.16	1.87	0.36	9.55	9.96	0.91	135.61	490.21	5.0873
9:28:03	1120.4	107	1956	441	917	983	122	12.15	1.89	0.33	9.54	9.93	0.91	149.68	490.45	5.0889
9:28:11	1120.15	106	1941	440	894	1020	207	12.11	1.89	0.37	9.58	9.98	0.89	131.92	490.7	5.09
9:28:17	1120.9	107	1940	441	904	1032	207	12.13	1.9	0.36	9.55	9.96	0.91	136.14	490.97	5.0917
9:28:24	1121.15	105	2033	426	1012	1117	227	12.21	1.92	0.42	9.48	10.01	1.05	140.74	491.2	5.0944
9:28:30	1121.41	104	2059	431	1035	1101	146	12.19	1.94	0.43	9.53	9.93	0.93	135.18	491.46	5.0963
9:28:36	1121.66	104	2070	432	1044	1101	110	12.16	1.91	0.37	9.53	10.03	1.05	151.71	491.7	5.0981
9:28:43	1121.91	106	2075	435	1044	1115	146	12.14	1.88	0.41	9.54	9.91	0.88	133.63	491.95	5.0998
9:28:50	1122.16	104	2073	431	1048	1121	182	12.12	1.82	0.44	9.57	10.08	0.98	137.67	492.2	5.1015
9:28:56	1122.41	104	2061	431	1035	1104	186	12.13	1.84	0.43	9.58	10.03	1.05	143.64	492.45	5.1033
9:29:03	1122.66	104	2052	431	1032	1101	146	12.13	1.9	0.36	9.54	10.03	0.98	133.1	492.7	5.1052
9:29:09	1122.91	103	2023	427	995	1061	203	12.12	1.91	0.37	9.56	9.98	0.91	128.68	492.95	5.107
9:29:16	1123.16	105	2019	436	988	1082	162	12.16	1.89	0.35	9.53	9.91	0.91	134.03	493.21	5.109
9:29:22	1123.41	104	2060	430	1020	1093	170	12.1	1.83	0.42	9.58	10.03	0.98	136.56	493.47	5.1109
9:29:29	1123.66	105	2045	435	1023	1141	223	12.14	1.89	0.37	9.55	9.96	0.89	157.94	493.73	5.1127

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96				
Starting Depth =	1091.67	Bit Type =	Walker McDonald MP6SH		
Ending Depth =	1382.14	Bit Size =	8.75		
Total Depth Drilled =	356.87	Bit Nozzles =	9, 9, 12, 12		
Hours On Bit =	6.29	Mud Type =	Water Based		
Average ROP =	53.72	Mud Weight (Ibs/gal)	9.00		
Drillstring (ft) =	1071.30	Pipe (ft) =	962.65	Collar (ft)=	468.60

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
9:29:09	1130.91	106	2028	440	953	1085	186	12.17	1.85	0.48	9.51	10.05	1.08	137.62	503.96	5.1134
9:29:42	1124.16	106	1994	439	963	1086	231	12.14	1.87	0.31	9.54	9.91	0.84	143.5	504.33	5.1161
9:29:45	1124.01	106	1991	438	962	1073	263	12.11	1.85	0.32	9.57	9.98	0.89	139.89	504.47	5.1162
9:29:50	1124.56	105	1982	437	952	1056	211	12.14	1.85	0.34	9.54	9.91	0.84	142.76	504.7	5.1169
9:30:01	1124.51	106	1971	436	938	956	138	12.16	1.8	0.31	9.51	9.63	0.68	147.08	504.85	5.1218
9:30:07	1125.16	107	1986	443	949	1058	134	12.2	1.87	0.17	9.48	9.91	0.83	137.27	505.2	5.1235
9:30:13	1125.41	106	1988	446	957	1036	219	12.18	1.87	0.31	9.5	9.86	0.86	150.12	505.47	5.1245
9:30:20	1126.66	107	1977	443	963	958	134	12.17	1.86	0.3	9.51	9.91	0.86	142.75	505.72	5.1267
9:30:28	1126.92	105	1997	436	961	1129	336	12.18	1.86	0.35	9.5	9.96	0.91	136.14	505.98	5.1283
9:30:33	1128.17	106	2022	438	965	1141	275	12.37	1.85	0.31	9.31	9.96	2.21	140.69	506.21	5.1302
9:35:46	1126.84	106	1565	430	744	1085	745	17.01	1.84	0.26	5.19	5.84	0.22	102.62	506.5	5.132
9:35:53	1126.79	105	1897	432	968	1063	162	12.27	1.87	0.31	8.66	9.07	0.25	145.95	506.85	5.1337
9:35:58	1127.05	105	2001	435	948	1068	247	12.26	1.84	0.29	8.66	9	0.84	170.5	507.1	5.1353
9:36:03	1127.3	106	1915	437	870	971	188	12.82	1.86	0.35	8.4	8.86	0.61	167.65	507.36	5.1368
9:36:14	1127.56	107	1926	441	773	863	340	11.64	1.87	0.32	9.29	9.84	1.32	85.83	507.8	5.1395
9:36:22	1127.8	106	1811	438	818	1016	361	11.86	1.88	0.33	9.33	9.72	0.72	76.32	507.93	5.1403
9:36:37	1128.05	105	1804	436	856	1095	812	11.77	1.93	0.43	9.46	9.79	0.79	90.61	508.09	5.146
9:36:48	1128.3	107	1881	440	826	1008	335	11.86	1.86	0.39	9.37	9.79	0.83	110.48	508.35	5.1483
9:37:09	1128.55	105	1756	434	718	850	227	11.89	1.86	0.32	9.54	9.88	0.86	80.65	508.59	5.1523
9:37:19	1128.8	107	1795	442	792	971	312	11.77	1.87	0.31	9.46	9.86	0.91	86.67	508.84	5.1539
9:37:28	1129.05	106	1842	438	825	966	251	11.87	1.88	0.5	9.36	9.74	0.74	96.08	509.11	5.1576
9:37:36	1129.3	106	1833	439	799	955	259	11.85	1.85	0.33	9.35	9.69	0.74	102.93	509.34	5.1604
9:37:57	1129.55	105	1841	436	846	988	264	11.91	1.87	0.34	9.32	9.69	0.88	102.93	509.59	5.1627
9:37:48	1129.8	105	1805	434	861	1020	248	12.04	1.87	0.33	9.13	9.62	0.88	117.8	509.86	5.1648
9:37:55	1130.05	107	1845	440	815	997	262	11.73	1.88	0.31	9.5	9.86	1.2	87.05	510.09	5.1675
9:38:11	1130.3	106	1844	439	826	1032	482	11.56	1.88	0.42	9.64	10.13	0.93	87.61	510.35	5.1721
9:38:30	1130.55	107	1845	441	819	1085	490	11.5	1.91	0.52	9.73	10.13	0.93	87.92	510.59	5.1773
9:38:41	1130.8	105	1815	436	880	1141	462	11.72	1.92	0.48	9.51	10.01	1.17	76.82	510.85	5.1804
9:38:50	1131.05	106	1835	438	890	1082	324	11.93	1.91	0.41	9.29	9.79	1.17	107.46	511.09	5.183
9:38:57	1131.3	105	1855	439	870	1102	401	12.04	1.84	0.44	9.18	9.75	1.46	121.08	511.35	5.185
9:39:03	1131.55	105	2025	427	982	1073	186	12.36	1.94	0.43	8.89	9.41	1.03	169.36	511.61	5.1864
9:39:10	1131.8	106	1971	437	946	1086	235	13.07	1.88	0.36	9.15	9.62	0.89	129.69	511.85	5.1887
9:39:17	1132.05	104	1979	432	927	1081	276	12.66	1.87	0.33	9.15	9.58	0.89	150.91	512.12	5.1904
9:39:25	1132.3	105	1838	434	983	1077	203	12.15	1.87	0.46	9.08	9.55	1.15	121.35	512.35	5.1923
9:39:32	1132.55	106	1957	436	944	1073	255	12.04	1.89	0.35	9.15	9.6	1.08	126.95	512.61	5.1945
9:39:41	1132.8	106	1981	438	956	1044	255	11.91	1.88	0.35	9.32	9.77	1.05	101.86	512.86	5.197
9:39:52	1133.05	107	1915	442	940	1020	247	11.72	1.88	0.38	9.51	9.63	0.98	79.53	513.11	5.2002

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/28/96																
Starting Depth =	1031.87			Bit Type =	Walker McDonald MP68H												
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	330.27			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.52			Mud Type =		Water Based											
Average ROP =	51.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.86			Pipe (ft) =	662.06				Collar (ft)=	409.80							
TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet DrBit	Hours DrBit
9:40:05	1133.81	107	1867	441	823	1028	377	11.81	1.89	0.34	9.61	9.95	0.81	71.64	513.35	5.2538
9:40:19	1133.56	107	1859	441	828	1220	392	11.81	1.85	0.55	9.61	10.05	0.96	68.21	513.61	5.2676
9:40:29	1133.81	107	1881	442	816	978	312	11.75	1.89	0.32	9.47	9.81	0.81	91.23	513.86	5.2102
9:40:37	1134.06	105	1834	432	765	918	243	11.9	1.84	0.29	9.62	9.76	0.68	107.67	514.11	5.2128
9:40:46	1134.31	107	1915	440	809	894	170	11.9	1.86	0.26	9.53	9.99	0.81	102.49	514.37	5.2151
9:40:54	1134.56	106	1911	438	780	894	239	11.87	1.86	0.5	9.35	9.74	0.81	107.62	514.62	5.2173
9:41:08	1134.81	106	1852	436	803	978	156	11.9	1.83	0.3	9.62	9.73	0.79	109.29	514.86	5.2196
9:41:11	1135.06	107	1900	443	821	940	199	11.81	1.83	0.27	9.31	9.67	0.79	114.91	515.1	5.2217
9:41:19	1135.31	105	1833	435	769	856	174	11.93	1.87	0.28	9.29	9.68	0.89	107.46	515.35	5.2240
9:41:26	1135.56	107	1913	441	785	870	156	11.87	1.82	0.24	9.38	9.67	0.74	103.44	515.62	5.2265
9:41:37	1135.81	107	1832	442	781	875	179	11.86	1.86	0.27	9.36	9.74	0.81	100	515.86	5.2287
9:41:48	1136.06	107	1891	440	764	884	227	11.86	1.87	0.31	9.36	9.74	0.79	95.52	516.11	5.232
9:41:56	1136.31	105	1804	436	763	863	160	11.92	1.85	0.28	9.4	9.74	0.81	105.27	516.36	5.2343
9:42:04	1136.56	107	1890	441	779	862	221	11.86	1.84	0.28	9.37	9.62	0.66	97.72	516.61	5.2366
9:42:13	1136.81	106	1809	438	764	860	247	11.83	1.86	0.3	9.36	9.74	0.79	93.86	516.85	5.2384
9:42:23	1137.06	105	1794	445	745	829	168	11.79	1.86	0.33	9.42	9.78	0.74	98.79	517.11	5.2407
9:42:32	1137.31	107	1866	443	758	870	258	11.83	1.85	0.32	9.36	9.72	0.74	93.69	517.36	5.2446
9:42:41	1137.56	106	1897	439	770	806	259	11.85	1.85	0.28	9.36	9.69	0.74	105.64	517.6	5.2472
9:42:48	1137.81	106	1851	439	790	890	134	11.91	1.85	0.28	9.3	9.67	0.81	103.79	517.85	5.2495
9:42:55	1138.06	106	1847	435	804	978	275	11.94	1.86	0.28	9.36	9.66	0.96	111.35	518.11	5.2517
9:43:06	1138.31	107	1823	441	775	880	130	11.86	1.83	0.27	9.35	9.69	0.85	111.91	518.37	5.254
9:43:16	1138.56	106	1828	437	776	862	166	11.9	1.86	0.28	9.33	9.67	0.77	100.2	518.6	5.2563
9:43:28	1138.81	107	1825	443	776	842	170	11.84	1.83	0.27	9.38	9.68	0.93	107.73	518.86	5.2589
9:43:34	1139.07	107	1782	441	718	862	266	11.69	1.84	0.27	9.53	9.91	0.89	91.79	519.13	5.2618
9:43:47	1139.32	108	1772	443	716	813	223	11.68	1.84	0.31	9.58	9.68	0.64	78.56	519.36	5.2655
9:44:01	1139.57	105	1816	446	762	1196	586	11.61	1.9	0.76	9.6	10.03	1.09	64.63	519.51	5.2692
9:44:07	1139.82	104	2087	430	1016	1192	295	12.21	1.94	0.81	9.01	9.53	1.06	196.48	519.87	5.2709
9:44:13	1140.07	104	2034	430	1046	1185	243	12.19	1.93	0.81	9.04	9.6	1.01	142.83	520.14	5.2726
9:44:20	1140.32	104	2132	429	1077	1162	174	12.19	1.94	0.87	9.03	9.55	1.05	105.03	520.39	5.2747
9:44:27	1140.57	101	2146	419	1086	1190	211	12.2	2.03	0.84	9.05	9.72	1.25	140.58	520.63	5.2764
9:44:32	1140.82	105	2116	439	1037	1174	260	12.21	2.05	0.84	9	9.69	1.25	152.9	520.89	5.2781
9:44:39	1141.07	103	2049	436	987	1084	184	12.21	1.92	0.44	9	9.53	1.1	139.53	521.11	5.2798
9:44:44	1141.32	102	2002	437	935	1044	267	12.19	1.9	0.4	8.83	9.28	0.93	178.45	521.36	5.2815
9:44:51	1141.57	103	2110	428	1084	1206	267	12.18	1.96	0.46	9.03	9.6	1.1	138.26	521.61	5.2832
9:44:57	1141.82	103	2143	427	1086	1235	284	12.17	1.98	0.54	9.04	9.6	1.13	140.66	521.88	5.2849
9:45:03	1142.07	101	2136	419	1075	1178	231	12.21	2.02	0.59	8.96	9.46	1.05	156.11	522.12	5.2866
9:45:19	1142.32	102	2131	424	1086	1218	259	12.18	1.98	0.64	9.03	9.6	1.2	128.5	522.4	5.2882

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/5/98																
Starting Depth =	1031.29			Bit Type =	Walker MacDonald MP63H												
Ending Depth =	1852.14			Bit Size =	6.75												
Total Depth Drilled =	820.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.82			Mud Type =		Water Based											
Average ROP =	83.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1671.36			Pipe (ft) =	862.68				Collar (ft) =	408.68							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
9:45:16	1142.67	103	2130	428	1006	1249	226	12.32	2.1	0.76	8.69	9.57	1.17	160.61	522.6	5.2901
9:45:23	1142.83	105	2114	431	1038	1170	223	12.18	2.08	0.81	9.04	9.83	1.24	131.63	522.59	5.2923
9:45:29	1143.07	105	2122	429	1060	1302	271	12.28	2.08	0.83	8.97	9.53	1.22	169.57	523.12	5.2956
9:45:34	1143.32	103	2117	428	1068	1184	248	12.37	2.13	0.7	8.85	9.5	1.56	156.06	523.38	5.2983
9:45:40	1143.57	105	2080	428	1013	1109	211	12.19	1.95	0.56	8.69	9.55	1.29	150.59	523.62	5.297
9:45:46	1143.83	104	2063	432	1002	1141	243	12.33	2.05	0.59	8.89	9.48	1.15	166.16	523.9	5.2994
9:45:51	1144.08	103	2073	439	1020	1118	176	12.35	1.96	0.5	8.87	9.31	1.05	156	524.13	5.2969
9:45:57	1144.33	106	2117	436	1075	1299	327	12.28	2.62	0.69	8.84	9.5	1.24	147.01	524.38	5.3016
9:46:03	1144.56	104	2105	431	1119	1226	227	12.2	2.22	0.64	8.62	9.5	1.15	150.37	524.63	5.3033
9:46:09	1144.83	105	2070	433	969	1083	243	12.47	2.1	0.79	8.74	9.43	1.36	174.72	524.87	5.3047
9:46:15	1145.08	105	1975	433	894	973	186	12.54	1.95	0.44	8.87	9.31	1.22	186	525.13	5.3062
9:46:19	1145.33	105	1946	434	884	967	176	12.24	1.82	0.49	8.87	9.69	1.65	146.77	525.37	5.3079
9:46:30	1145.69	108	1947	444	862	1024	300	11.76	2.64	0.57	8.45	9.98	1.16	87.83	525.63	5.3108
9:46:41	1146.83	107	1948	443	866	1036	336	11.64	3	0.8	8.37	(0.08)	0.08	78.8	525.68	5.3139
9:46:48	1146.08	108	2074	433	1024	1268	397	12.06	3.07	0.59	9.19	9.87	1.1	115.88	525.14	5.3158
9:46:56	1146.33	104	2043	432	973	1098	225	11.87	1.94	0.45	9.24	9.72	1.01	122.61	525.37	5.3182
9:47:05	1146.58	108	2031	436	953	1128	275	11.9	2.64	0.84	9.31	9.77	1.05	109.07	525.62	5.3205
9:47:14	1146.83	105	2003	434	956	1210	306	11.86	2.6	0.7	9.35	9.81	1.2	97.91	525.88	5.3231
9:47:20	1147.08	102	2134	425	1073	1196	286	12.21	2.11	0.81	9	9.55	1.15	148.97	527.12	5.3249
9:47:27	1147.33	104	2146	432	1070	1178	216	12.13	2.08	0.79	9.08	9.62	1.15	134.2	527.4	5.3269
9:47:34	1147.58	103	2176	437	1051	1251	316	12.05	2.28	1.07	9.18	9.72	1.17	130.34	527.63	5.3285
9:47:41	1147.84	103	2164	439	1067	1166	227	12.19	2.34	0.93	9.02	9.61	1.22	143.06	527.89	5.3302
9:47:48	1148.09	104	2152	432	1053	1216	260	12.1	2.22	1.08	9.11	9.62	1.06	134.15	528.14	5.3322
9:47:54	1148.34	104	2162	431	1053	1176	175	12.15	2.15	0.9	9.02	9.6	1.15	147.23	528.38	5.334
9:48:01	1148.59	104	2153	430	1052	1156	207	12.13	2.23	1.35	9.08	9.63	1.17	131.85	528.64	5.336
9:48:07	1148.84	104	2171	431	1056	1231	275	12.19	2.32	0.9	9.05	9.63	1.06	136.53	528.89	5.3377
9:48:14	1149.09	103	2235	428	1135	1308	373	12.07	2.29	1.18	9.14	9.72	1.24	107.13	529.14	5.3397
9:48:21	1149.34	102	2235	425	1115	1293	275	12.17	2.31	1.18	9.04	9.6	1.24	183.89	529.39	5.3417
9:48:27	1149.59	103	2236	428	1128	1281	259	12.13	2.34	1.18	9.02	9.65	1.29	152.61	529.64	5.3434
9:48:34	1149.84	103	2149	427	1054	1186	325	12.16	2.36	1.15	9.05	9.61	1.22	127.01	529.88	5.3451
9:48:40	1150.09	103	2149	434	1072	1231	305	12.28	2.55	0.89	8.99	9.43	1.09	162.06	530.17	5.3466
9:48:47	1150.34	104	2114	431	1031	1162	325	12.09	2.09	0.81	9.12	9.69	1.17	128.72	530.4	5.3486
9:48:53	1150.59	103	1940	446	882	1000	275	11.87	1.88	0.58	9.34	9.53	1.1	150.65	530.64	5.3511
9:49:01	1150.84	100	1864	435	824	967	328	11.8	1.83	0.43	9.41	9.51	1.01	86.67	530.9	5.3527
9:49:16	1151.09	107	1844	441	776	973	397	11.86	1.82	0.34	9.52	9.59	1.01	77.86	531.14	5.3552
9:49:28	1151.34	107	1795	441	737	887	438	11.56	1.88	0.28	9.63	10.01	0.79	75.11	531.4	5.36
9:49:43	1151.6	107	1782	440	710	886	417	11.55	1.85	0.28	9.68	10.13	0.91	58.21	531.66	5.3643

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/29/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP68H												
Ending Depth =	1382.34			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.83			Mud Type =		Water Based											
Average ROP =	51.72			Mud Weight (lb/gal)		9.00											
Collaring (ft) =	1071.96			Pipe (ft) =	893.68			Collar (ft)=	488.68								

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
9:50:08	1151.85	109	1743	447	684	898	413	11.44	1.68	0.39	9.76	10.2	0.89	45.36	831.86	5.3761
9:50:23	1152.1	108	1722	447	680	878	408	11.41	1.65	0.28	9.79	10.44	1.2	45.62	832.16	5.3765
9:50:45	1152.35	108	1716	446	666	910	393	11.44	1.68	0.31	9.76	10.08	0.72	40.69	832.56	5.38015
9:51:03	1152.6	109	1714	446	646	853	308	11.41	1.64	0.28	9.79	10.25	0.86	44.67	832.96	5.3827
9:51:23	1152.85	108	1717	447	663	947	478	11.4	1.66	0.01	9.8	10.15	0.68	38.51	833.89	5.38153
9:51:54	1153.1	108	1711	446	665	878	386	11.39	1.67	0.33	9.82	10.25	0.54	25.68	837.14	5.40067
9:52:13	1153.35	107	1725	441	674	866	401	11.44	1.7	0.33	9.78	10.25	1.03	46.01	838.35	5.40861
9:52:28	1153.6	108	1747	444	687	919	377	11.59	1.86	0.31	9.61	10.03	0.81	60.68	839.87	5.41052
9:52:52	1153.85	108	1684	448	620	829	385	11.36	1.67	0.3	9.84	10.22	1.05	37.87	839.89	5.41187
9:53:15	1154.1	109	1697	448	639	856	417	11.39	1.81	0.25	9.81	10.1	0.72	88.11	934.14	5.42393
9:53:34	1154.35	111	1749	457	678	906	369	11.46	1.84	0.25	9.72	10.2	0.91	47.2	834.4	5.42585
9:54:00	1154.6	108	1670	460	611	795	377	11.35	1.81	0.22	9.87	10.2	0.77	32.62	834.65	5.43033
9:54:21	1154.85	107	1737	442	719	1141	680	11.51	1.58	0.48	9.68	10.15	1.34	46.96	834.9	5.44173
9:54:29	1155.1	108	3071	435	913	1681	951	12	2.1	0.77	9.19	9.74	1.22	129.23	835.15	5.44487
9:54:49	1155.35	108	1728	444	651	987	651	11.4	1.81	0.6	9.79	10.28	1.08	44.1	835.41	5.44684
9:55:19	1155.58	107	1685	443	623	825	351	11.28	1.87	0.3	9.81	10.25	0.72	34.81	835.6	5.4577
9:55:42	1155.81	108	1646	444	623	831	361	11.16	1.91	0.34	9.81	10.22	1.17	39.85	835.83	5.46
9:55:56	1156.06	107	1677	441	651	905	398	11.6	1.66	0.28	9.88	9.96	0.89	58.07	836.11	5.46172
9:56:09	1156.31	107	1731	442	636	880	395	11.61	1.91	0.59	9.56	9.68	0.81	66.86	836.36	5.4715
9:56:27	1156.56	107	1716	442	676	882	364	11.46	1.92	0.47	9.74	10.15	1.05	80.17	836.61	5.47763
9:56:44	1156.81	106	1705	444	662	905	298	11.48	1.84	0.36	9.73	10.08	0.83	51.64	836.86	5.48128
9:56:57	1157.06	107	1687	443	656	808	384	11.56	1.83	0.26	9.61	10.01	0.91	68.75	837.11	5.4849
9:57:06	1157.31	107	1748	443	715	842	327	11.64	1.85	0.3	9.56	9.66	0.98	108.44	837.37	5.4872
9:57:14	1157.56	106	1709	438	716	860	284	11.6	1.85	0.3	9.6	9.72	0.93	107.81	837.61	5.48965
9:57:25	1157.81	105	1970	405	843	1129	302	11.75	2.43	1.3	9.41	10.08	1.69	58.06	837.86	5.49027
9:57:30	1158.06	106	2000	401	868	1129	1142	12.03	2.81	1.26	9.16	9.72	1.3	169.43	838.13	5.49041
10:02:31	1158.27	105	1858	445	820	1159	815	13.28	1.96	0.54	8.75	14	13.84	102.61	838.32	5.495
10:02:51	1158.52	107	1703	443	668	787	535	11.7	1.96	0.48	10.45	12.04	3.23	45.12	838.57	5.4974
10:03:06	1158.77	108	1722	441	740	1059	465	11.62	1.93	0.48	10.51	10.84	0.79	51.5	838.84	5.50058
10:03:28	1159.02	107	1781	443	767	947	362	11.71	1.95	0.48	10.41	10.75	0.79	63.08	839.08	5.50303
10:03:38	1159.27	105	1790	438	796	1080	421	11.75	1.88	0.56	10.38	10.7	0.85	72.35	839.32	5.50518
10:03:45	1159.52	104	2093	418	1002	1240	458	12	2.13	2.76	10.12	11.15	1.86	84.78	839.56	5.51123
10:03:52	1159.77	105	2053	438	950	1222	438	12.12	2.28	2.64	10	11.37	2.32	128.19	839.82	5.5143
10:04:03	1160.02	108	1801	441	897	1029	853	11.78	2.05	0.75	10.36	10.64	1.03	76.8	840.07	5.5175
10:04:21	1160.27	107	1787	444	743	992	454	11.6	2.16	0.84	10.53	11.08	1.19	80.27	840.34	5.5224
10:04:37	1160.52	106	1781	440	782	1080	470	11.86	2.07	1.11	10.46	11.04	1.19	84.14	840.57	5.527
10:04:48	1160.78	104	1860	436	845	1210	470	11.87	2.18	0.88	10.26	10.8	1.08	60.5	840.84	5.52601

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/28/96			Bit Type =	Walker McDonough MP66H												
Starting Depth =	1051.27			Bit Size =	4.75												
Ending Depth =	1362.14			Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled =	310.87			Mud Type =		Water Based											
Hours On Bit =	6.53			Mud Weight (lbs/gal)		8.65											
Average ROP =	53.72			Pipe (ft) =	962.68			Collar (ft)=	468.66								
Drillstring (ft) =	1071.35																
TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK Δx	DELTA Δx	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
10:04:56	1161.03	104	2120	432	1100	1281	271	12.24	2.14	0.76	9.85	10.44	1.96	123.73	541.67	5.5821
10:05:10	1161.39	103	2056	417	952	1332	640	14.19	3.94	4.72	7.95	8.79	8.76	64.96	541.33	5.5838
10:05:22	1161.69	106	1975	441	891	1068	306	16.05	2.72	2.3	7.06	8.51	2.15	74.41	541.67	5.5393
10:05:34	1161.78	108	1926	447	838	1029	312	14.85	2.55	1.91	7.25	8.04	1.8	73.92	541.82	5.54127
10:05:48	1162.03	105	1940	437	846	1086	405	14.84	2.81	2.81	7.27	7.92	1.41	76.28	542.08	5.5461
10:06:57	1162.28	105	1854	441	804	910	251	14.83	2.26	1.19	7.28	7.73	0.95	79.21	542.33	5.5423
10:06:09	1162.53	103	1846	460	813	919	180	14.83	2.18	1.12	7.25	7.8	1.03	76.41	542.58	5.5524
10:06:20	1162.78	105	1845	442	831	987	247	14.85	2.13	1	7.26	7.85	1.15	66.83	542.83	5.5863
10:06:30	1163.03	105	1828	441	834	947	243	14.87	2.26	1.35	7.23	7.71	1.08	67.13	543.08	5.5686
10:06:39	1163.28	103	1801	442	819	1004	315	15.03	2.16	1.67	7.09	7.66	1.05	67.36	543.33	5.5961
10:06:47	1163.53	105	1892	436	867	987	165	15.58	2	0.6	7.85	7.82	0.86	117.05	543.61	5.583
10:06:54	1163.78	104	1886	435	852	957	168	15.13	1.98	0.47	6.88	7.47	0.93	124.28	543.53	5.5851
10:07:02	1164.03	107	1853	443	879	947	102	15.17	1.93	0.4	6.93	7.35	0.89	131.18	544.08	5.5675
10:07:09	1164.28	105	1832	442	846	936	154	15.19	1.89	0.41	6.91	7.28	0.86	136.87	544.34	5.5891
10:07:16	1164.53	107	1807	444	812	902	178	15.2	1.93	0.5	6.9	7.87	0.91	122.46	544.82	5.5711
10:07:23	1164.72	105	1800	446	853	888	170	15.25	1.89	0.41	6.89	7.32	0.89	153.31	544.85	5.5728
10:07:29	1165.04	108	1795	436	791	856	203	15.27	1.89	0.38	6.91	7.28	0.84	163.49	545.11	5.5746
10:07:35	1165.29	105	1800	440	819	916	186	15.3	1.88	0.41	6.81	7.18	0.88	152.44	545.36	5.5765
10:07:42	1165.54	108	1800	440	819	882	156	15.27	1.86	0.43	6.83	7.22	0.91	145	545.61	5.5782
10:07:48	1165.78	103	1812	438	828	915	178	15.27	1.85	0.4	6.83	7.25	0.89	129.01	545.83	5.5802
10:07:55	1166.04	105	1812	436	819	902	169	16.04	1.9	0.4	6.76	7.21	0.88	151.71	546.09	5.583
10:08:01	1166.29	107	1795	440	792	880	174	15.27	1.9	0.37	6.88	7.23	0.89	145.82	546.33	5.5847
10:08:09	1166.54	107	1795	446	809	891	207	15.21	1.93	0.44	6.86	7.37	0.88	118.07	546.58	5.5857
10:08:15	1166.79	105	1820	441	818	853	162	15.27	1.96	0.4	6.84	7.32	1.01	148.8	546.85	5.5874
10:08:22	1167.04	107	1818	443	818	882	139	15.26	1.92	0.46	6.8	7.21	0.81	134.23	547.08	5.5894
10:08:28	1167.29	107	1811	445	785	894	182	15.52	1.84	0.44	6.85	7.44	1.05	130.75	547.34	5.5911
10:08:36	1167.54	107	1775	445	760	615	284	14.97	1.86	0.46	7.14	7.82	0.81	98.76	547.59	5.5927
10:08:46	1167.79	108	1817	446	787	963	194	15.08	1.93	0.43	7.02	7.4	0.84	108.72	547.84	5.596
10:08:53	1168.04	108	1810	448	793	890	182	15.11	1.9	0.38	6.99	7.42	0.89	128.93	548.1	5.5978
10:09:00	1168.29	105	1836	442	830	965	166	15.18	1.98	0.5	6.98	7.5	0.84	121.56	548.35	5.6
10:09:06	1168.54	107	1760	445	777	963	271	15.1	1.97	0.35	7	7.37	0.91	114.9	548.59	5.60123
10:09:14	1168.8	107	1813	445	778	902	253	15.34	1.89	0.51	6.77	7.28	0.96	157.86	548.84	5.6037
10:09:23	1169.05	110	1742	456	688	870	280	15.05	2.61	0.86	7.05	7.43	0.86	103.53	549.12	5.6061
10:09:34	1169.3	110	1686	453	644	850	286	14.77	1.94	0.46	7.03	7.73	1.06	76.84	549.34	5.60985
10:10:04	1169.49	111	1675	457	535	765	371	14.48	1.97	0.45	7.67	8.04	0.81	23.07	549.53	5.6115
10:10:34	1169.63	107	1520	443	531	652	383	14.36	1.94	0.48	7.71	8.07	0.85	17.01	549.68	5.6261
10:11:04	1169.87	107	1548	446	549	671	275	14.47	1.82	0.41	7.63	7.97	0.79	47.8	549.91	5.6347

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MR58H												
Ending Depth =	1382.14			Bit Size =	6.75												
Total Depth Drilled =	350.87			Bit Nozzles =		8, 8, 12, 12											
Hours On Bit =	6.83			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.86				Collar (ft)=	405.50							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
10:11:04	1170.05	107	1571	445	569	740	300	13.53	1.06	0.44	8.67	10.08	2.7	22.15	550.1	5.643
10:11:55	1170.3	107	1638	444	852	950	351	12.43	1.96	0.83	8.68	10.1	1.08	43.64	550.35	5.6417
10:12:05	1170.55	106	1687	439	873	797	284	12.58	1.97	0.47	8.55	9.89	0.79	70.79	550.61	5.6327
10:12:24	1170.8	105	1773	436	772	1044	527	12.98	2.01	0.65	8.98	10.03	1.03	87.54	550.86	5.6264
10:12:40	1171.05	106	1758	442	841	979	538	12.46	2.03	0.63	8.85	10.1	1.22	54.97	551.1	5.961
10:13:10	1171.29	106	1665	447	807	788	350	12.5	1.97	0.54	8.81	10.2	0.81	29.87	551.35	5.6603
10:13:33	1171.54	106	1788	446	736	1071	510	12.41	2.19	0.68	8.69	10.22	1.1	39.6	551.59	5.6756
10:13:50	1171.79	107	1788	442	748	905	263	12.48	2.6	1.73	8.64	10.39	1.44	29.02	551.84	5.6808
10:14:03	1172.05	106	1863	439	916	1403	756	12.75	2.54	1.73	8.35	10.96	2.02	72.02	552.1	5.6839
10:14:10	1172.3	106	2083	436	1091	1258	352	13.81	2.15	0.84	8.6	9.28	1.06	117.73	552.34	5.6869
10:14:15	1172.56	104	2150	432	1046	1182	288	13.4	2.09	0.81	8.7	9.24	1.22	119.67	552.6	5.6892
10:14:26	1172.8	106	2091	441	1005	1166	308	13.44	2.07	0.69	8.65	9.14	0.96	109.82	552.84	5.6909
10:14:33	1173.05	107	1972	444	873	975	318	13.63	1.93	0.44	8.47	8.88	0.96	150.75	553.09	5.6932
10:14:42	1173.3	107	1813	444	749	878	285	13.3	1.81	0.36	8.5	8.78	0.96	92.83	553.35	5.6948
10:14:52	1173.55	107	1767	445	746	821	203	13.28	1.84	0.49	8.54	9.31	1.01	57.85	553.6	5.6977
10:15:02	1173.8	107	1758	444	738	850	227	13.29	1.92	0.4	8.61	9.19	0.86	91.47	553.84	5.7005
10:15:12	1174.05	107	1770	445	795	821	105	13.29	1.93	0.41	8.61	9.24	0.91	89.38	554.11	5.7034
10:15:21	1174.3	106	1782	440	761	852	255	13.35	1.94	0.44	8.78	9.22	0.86	96.41	554.36	5.706
10:15:31	1174.55	107	1805	443	786	846	156	13.23	1.96	0.46	8.71	9.19	0.86	89.28	554.6	5.7086
10:15:39	1174.8	107	1815	445	756	892	211	13.4	1.9	0.42	8.7	9.14	1.01	104.7	554.84	5.7109
10:15:46	1175.05	107	1838	444	764	850	113	13.32	1.91	0.44	8.68	8.97	0.91	127.96	555.09	5.7135
10:15:54	1175.3	106	1841	440	826	918	166	13.35	1.88	0.52	8.56	9	0.96	116.81	555.35	5.716
10:16:01	1175.55	106	1846	439	817	866	174	13.64	1.83	0.38	8.57	8.82	0.91	132.46	555.59	5.7183
10:16:11	1175.8	107	1814	445	766	834	158	13.82	1.87	0.46	8.76	9.17	0.86	93.08	555.85	5.7198
10:16:22	1176.05	107	1782	446	763	887	258	13.18	1.94	0.44	8.61	9.41	1.32	76.74	556.09	5.7225
10:16:39	1176.3	107	1797	444	862	886	86	13	1.95	0.45	8.63	9.6	1.27	87.4	556.34	5.7272
10:17:06	1176.55	108	1859	447	821	842	369	12.87	1.94	0.44	8.23	9.57	0.74	31.89	556.6	5.7349
10:17:30	1176.8	107	1843	445	821	842	346	12.84	1.94	0.41	8.28	9.62	0.84	31.84	556.85	5.7429
10:18:06	1177.05	108	1818	448	802	769	316	12.81	1.94	0.5	8.89	9.82	0.69	22.19	557.09	5.7513
10:18:35	1177.19	107	1810	443	853	790	223	13.51	1.96	0.46	8.26	9.67	0.74	24.49	557.25	5.7566
10:18:54	1177.44	107	1715	446	720	1030	474	12.89	2.06	0.56	8.1	9.67	1.32	47.34	557.5	5.7647
10:19:13	1177.69	108	1698	446	841	868	480	12.84	1.94	0.42	9.16	9.6	1.13	46.75	557.74	5.7702
10:19:28	1177.94	105	1779	451	862	1060	521	13.14	1.88	0.44	8.85	8.55	1.38	61.43	558.01	5.7742
10:19:34	1178.2	104	1962	451	923	1216	166	13.64	1.93	0.43	8.48	8.93	0.96	131.96	558.27	5.7762
10:19:40	1178.45	106	1864	450	918	1282	315	13.8	1.91	0.39	8.29	8.79	1.01	104.81	558.51	5.7778
10:19:46	1178.7	106	1841	450	913	1026	243	13.77	1.86	0.49	8.35	8.74	0.91	166.79	558.75	5.7793
10:19:53	1178.95	106	1904	449	874	968	192	13.97	1.91	0.39	8.43	8.88	1.01	138.73	559	5.7813

DOE high power mortar test Amaco Catoosa Test Site

Well No. 28	Date: 2/20/90		
Starting Depth =	1081.27	Bit Type =	Walker McDonald MP28H
Ending Depth =	1382.14	Bit Size =	4.75
Total Depth Drilled =	300.87	Bit Nozzles =	9, 9, 12, 12
Hours On Bit =	6.03	Mud Type =	Water Based
Average ROP =	49.79	Mud Weight (lbs/gal)	9.00
Drillstring (ft) =	1071.35	Pipe (ft) =	982.66
		Collar (ft)=	426.69

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
10:20:10	1179.2	107	1809	443	856	1004	280	13.61	1.91	0.39	8.49	8.88	0.86	137.29	559.24	5.7533
10:20:07	1179.46	107	1861	446	826	947	251	13.5	1.92	0.41	8.59	9.02	0.93	122.79	559.5	5.7559
10:20:17	1179.7	107	1838	445	816	931	247	13.38	1.91	0.43	8.75	9.17	0.91	90.85	559.74	5.7578
10:20:26	1179.95	107	1856	444	813	979	282	13.32	1.93	0.56	8.77	9.17	0.79	103.41	560.03	5.7606
10:20:35	1180.2	106	1858	442	832	947	215	13.33	2.05	0.58	8.78	9.14	0.81	64.71	560.25	5.7631
10:20:43	1180.46	106	1877	441	838	971	190	13.42	1.85	0.57	8.68	9.07	0.78	116.84	560.51	5.7657
10:20:53	1180.7	105	1852	442	821	885	146	13.39	1.93	0.41	8.6	9.14	0.74	80.65	560.74	5.7679
10:21:03	1180.95	107	1855	443	864	1028	296	13.34	1.94	0.44	8.75	9.1	0.85	93.14	561.01	5.7706
10:21:08	1181.2	105	1896	435	936	1018	186	13.85	2.02	0.64	8.48	8.86	0.85	144.02	561.26	5.7731
10:21:16	1181.46	106	1814	440	881	978	159	13.64	1.84	0.49	8.46	8.86	0.84	125.52	561.52	5.7757
10:21:22	1181.71	106	1906	439	865	983	170	13.65	1.95	0.41	8.46	8.83	0.84	140.5	561.78	5.7783
10:21:29	1181.96	107	1903	444	886	1004	211	13.85	1.88	0.33	8.44	8.9	0.86	141.21	562	5.7808
10:21:36	1182.21	107	1865	445	827	883	208	13.49	1.9	0.31	8.61	8.85	0.81	130.18	562.25	5.81
10:21:43	1182.46	106	1818	440	823	919	182	13.85	1.87	0.35	8.58	8.9	0.81	130.91	562.51	5.813
10:21:50	1182.71	107	1839	443	815	902	176	13.68	1.91	0.32	8.52	8.93	0.84	121.08	562.76	5.8156
10:21:57	1182.96	107	1861	444	858	935	186	13.62	1.9	0.32	8.47	8.93	0.83	143.05	563.01	5.8182
10:22:03	1183.21	107	1884	445	880	983	182	13.62	1.85	0.31	8.46	8.86	0.81	135.86	563.26	5.8174
10:22:10	1183.46	106	1873	439	867	1058	250	13.66	1.89	0.33	8.51	8.86	0.81	127.2	563.5	5.8134
10:22:17	1183.71	106	1907	442	902	1024	253	13.67	1.98	0.38	8.59	8.9	0.79	128.5	563.79	5.8214
10:22:24	1183.96	106	1946	438	924	1046	211	13.62	1.86	0.41	8.47	8.86	0.86	126.99	564	5.8239
10:22:30	1184.21	104	1832	435	819	1083	266	13.7	1.85	0.29	8.36	8.81	0.83	152.61	564.25	5.8265
10:22:36	1184.46	106	1892	440	874	1024	271	13.63	1.9	0.4	8.46	8.83	0.81	138.05	564.5	5.8288
10:22:43	1184.71	104	1905	439	867	963	148	13.66	1.9	0.29	8.43	8.9	0.86	138.63	564.75	5.8314
10:22:49	1184.96	107	1917	442	869	967	188	13.7	1.93	0.4	8.36	8.71	0.87	154.11	565.01	5.8341
10:22:56	1185.21	106	1823	441	903	959	113	13.71	1.84	0.45	8.36	8.76	0.84	141.45	565.26	5.837
10:23:02	1185.46	105	1914	437	908	986	174	13.72	1.9	0.37	8.57	8.74	0.78	146.58	565.53	5.8398
10:23:08	1185.71	106	1937	439	926	1024	194	13.66	1.9	0.34	8.42	8.86	0.84	136.33	565.78	5.8424
10:23:15	1185.96	106	1914	441	885	1044	275	13.67	1.89	0.36	8.42	8.68	0.88	138.16	566.01	5.8448
10:23:21	1186.22	108	1888	446	855	979	163	13.71	1.9	0.4	8.37	8.79	0.84	160.93	566.27	5.8475
10:23:28	1186.47	106	1884	440	881	943	170	13.62	1.88	0.37	8.47	8.83	0.77	124.15	566.54	5.8503
10:23:34	1186.72	105	1859	429	867	1089	340	13.7	1.81	0.39	8.39	9	1.15	148.19	566.77	5.8526
10:23:40	1186.97	105	1857	439	841	881	154	13.68	1.88	0.34	8.4	8.78	0.75	142.7	567.01	5.8552
10:23:47	1187.22	107	1871	444	847	926	203	13.79	1.98	0.43	8.35	8.74	0.83	145.75	567.27	5.8579
10:23:52	1187.47	106	1863	439	845	883	139	13.8	1.86	0.34	8.29	8.61	0.93	155.85	567.51	5.8605
10:24:00	1187.72	106	1862	441	853	1186	881	13.29	1.93	0.5	8.83	9.31	1.22	85.29	567.76	5.8631
10:24:10	1187.97	105	1911	438	865	976	231	13.45	1.95	0.42	8.64	9.14	0.98	119.84	568.01	5.8658
10:24:24	1188.22	106	1853	441	831	1052	428	13.11	1.94	0.44	8.87	9.43	0.98	68.84	568.26	5.8684

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/25/96																	
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP65H													
Ending Depth =	1382.14			Bit Size =	4.75													
Total Depth Drilled =	350.87			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	6.53			Mud Type =		Water Based												
Average ROP =	53.72			Mud Weight (lbs/gal)		8.01												
Drilling (ft) =	1021.66			Pipe (ft) =	662.68				Collar (ft)=	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
10:24:52	1185.47	105	1960	438	950	1135	352	13.49	2.02	0.56	8.89	9.66	1.68	107.62	560.52	5.859
10:24:58	1185.72	106	1944	442	913	1032	343	13.48	1.91	0.41	8.88	9.1	1.17	127.74	565.77	5.86077
10:25:52	1188.67	108	1585	482	851	1040	454	13.1	1.91	0.41	8.88	9.35	0.84	97.51	580.05	5.96644
10:25:22	1189.16	110	1695	454	826	947	494	12.76	1.85	0.46	8.38	8.72	0.79	21.07	589.2	5.97277
10:25:52	1189.41	107	1727	446	713	963	470	12.83	1.97	0.46	8.25	8.57	0.65	30.85	589.46	5.981
10:31:00	1189.81	106	1644	439	687	915	454	13.09	1.96	0.46	8.57	10.17	8.38	38.05	589.86	5.98777
10:31:20	1190	106	1661	439	689	1024	591	11.81	1.95	0.46	8.85	10.15	0.65	28.48	590.05	5.99055
10:31:48	1190.28	106	1615	484	847	1180	636	10.63	1.99	0.54	10.74	11.68	2.13	61.36	590.31	5.99163
10:31:57	1190.5	103	2130	427	1107	1235	433	10.7	2.5	1.49	10.97	11.97	2.25	85.7	590.56	5.99429
10:32:05	1190.75	104	2140	429	1034	1281	636	10.79	3.03	2.94	10.97	12.69	4.02	120.28	590.8	5.99145
10:32:18	1191.01	104	2035	430	1036	1233	397	12.8	3.36	3.34	9.88	12.54	8.64	93.66	591.06	5.9917
10:32:28	1191.26	106	1921	437	881	1024	373	14.19	3.67	3.93	7.47	10.15	6.37	74.67	591.3	5.99212
10:32:37	1191.51	106	1948	437	904	1083	498	14.52	3.17	3.27	7.37	9.38	4.21	88.33	591.61	5.99298
10:32:45	1191.76	105	1973	438	980	1117	340	14.47	2.74	2.39	7.18	8.52	2.56	103.59	591.8	5.99264
10:32:51	1192.01	104	1962	439	930	1105	313	14.66	2.08	0.85	6.98	7.66	1.24	147.3	592.06	5.9931
10:32:57	1192.26	102	1934	435	956	967	178	14.83	2.01	0.64	6.85	7.37	1.01	163.41	592.31	5.99298
10:33:02	1192.51	102	1998	437	888	1008	235	14.94	1.93	0.43	6.62	7.35	1.06	184.91	592.57	5.99313
10:33:10	1192.76	105	1870	439	847	982	318	14.46	1.96	0.61	7.13	7.6	1.6	118.7	592.81	5.9933
10:33:37	1193.01	106	1859	445	838	982	430	13.92	1.95	0.61	7.73	8.04	0.65	30.43	593.06	5.9407
10:33:58	1193.26	107	1871	442	872	987	335	13.57	1.98	0.61	7.66	8.11	0.61	45.89	593.3	5.9467
10:34:14	1193.51	108	1704	444	711	971	490	14.05	1.93	0.67	7.53	8	0.79	54.67	593.55	5.951
10:34:34	1193.76	107	1672	440	688	898	462	13.29	1.99	0.59	7.66	8	0.77	44.98	593.8	5.9565
10:35:51	1194.01	107	1678	441	677	931	462	13.66	1.94	0.45	7.66	7.87	0.67	53.07	594.06	5.9613
10:35:15	1194.26	106	1644	443	636	886	421	13.9	1.94	0.51	7.75	8.04	0.5	30.04	594.3	5.9686
10:35:44	1194.51	108	1654	443	648	921	368	13.74	1.93	0.48	7.61	8.78	2.39	35.44	594.56	5.9759
10:36:01	1194.76	108	1761	439	782	999	373	12.01	2	0.86	9.61	10.01	0.83	87.61	594.81	5.9787
10:36:15	1195.02	107	1726	440	781	919	393	11.61	1.94	0.55	9.75	10.1	0.79	50.87	595.07	5.9845
10:36:32	1195.27	107	1737	442	710	858	312	11.85	1.97	0.5	9.77	10.1	0.74	52.61	595.32	5.9883
10:36:47	1195.52	107	1751	441	748	870	267	12.03	3.39	0.51	9.85	9.95	0.77	61.67	595.57	5.9934
10:37:04	1195.77	107	1738	440	750	963	519	11.9	1.98	0.51	9.76	10.23	1.01	50.37	595.81	5.9983
10:37:13	1196.02	105	1678	436	1011	1198	377	12.38	2.13	0.75	9.28	9.98	1.39	109.92	596.06	6.00208
10:37:20	1196.27	106	1948	436	873	1056	389	12.46	1.97	0.52	9.2	9.93	1.41	125.77	596.31	6.00264
10:37:34	1196.52	108	1782	444	759	923	316	11.96	2.12	0.88	9.69	10.38	1.1	64.57	596.56	6.00566
10:37:46	1196.77	106	1865	438	929	1180	604	12.19	1.96	0.56	9.47	9.93	1.22	76.54	596.82	6.00767
10:37:53	1197.02	106	1887	437	1063	1170	207	12.41	3.47	0.79	9.35	9.77	0.98	126.33	597.07	6.0113
10:38:03	1197.27	106	1956	436	909	1060	251	12.13	3.35	2.98	9.51	11.39	3.54	86.21	597.32	6.01186
10:38:17	1197.52	106	1926	438	831	975	373	12.27	3.66	4.03	9.36	12.8	8.87	61.3	597.61	6.01521

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP6IH												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.58			Mud Type =		Water Based											
Average ROP =	53.32			Mud Weight (lbs/gal)		8.00											
Drillstring (ft) =	1071.58			Pipe (ft) =	662.66				Collar (ft)=	408.66							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	On Bit	
10:38:47	1197.93	108	1523	440	480	882	382	17.8	4.54	4.82	16.46	9.52	13.34	577.85	9.1039		
10:39:15	1197.58	108	1503	438	476	863	381	14.85	2.15	3.04	7.29	5.13	3.97	33.2	577.85	9.10344	
10:39:41	1198.11	108	1660	444	526	834	446	15.84	3.83	4.2	8	10.72	8.8	33.96	578.18	9.04418	
10:40:11	1198.32	108	1561	447	556	695	150	18.66	2.61	3.74	4.67	5.55	1.39	22.71	578.37	9.0601	
10:40:41	1198.54	108	1576	448	565	663	188	18.45	1.59	0.66	5.18	5.85	0.81	26.34	578.59	9.0558	
10:41:11	1198.78	108	1585	446	580	639	122	18.46	2.1	0.76	5.17	5.48	0.62	24.87	578.78	9.0567	
10:41:41	1199.06	108	1588	445	585	671	108	18.46	2.12	0.77	5.16	5.58	0.74	28.37	579	9.0751	
10:42:11	1199.18	108	1567	447	587	682	203	18.46	2.07	0.8	5.16	5.65	0.81	27.96	579.24	9.0636	
10:42:39	1199.43	108	1629	447	612	744	194	18.55	2.08	0.83	5.08	5.48	0.62	32.83	579.48	9.0911	
10:43:24	1199.88	107	1705	443	735	967	362	18.42	2.03	0.69	5.2	5.67	2.39	58.68	579.73	9.0954	
10:43:53	1199.94	104	1999	430	1046	1256	344	13.6	2.07	0.71	8.05	9.5	2.67	104.3	580.03	9.039	
10:43:57	1200.19	104	2150	429	1140	1251	251	11.78	1.95	0.88	9.61	10.68	1.7	153.88	580.23	9.0894	
10:44:14	1200.44	104	2106	429	1073	1202	281	11.42	1.88	0.56	10.23	10.75	1.09	456.82	580.5	9.1011	
10:44:29	1200.69	105	2019	436	968	1081	183	11.54	2.03	0.66	10.11	10.6	1.03	185.74	580.73	9.1026	
10:44:45	1200.94	107	2018	440	1017	1067	182	11.55	2.03	0.55	10.1	10.56	0.96	178.78	580.99	9.104	
10:45:02	1201.18	104	2116	429	1136	1360	389	11.32	2.44	1.28	10.33	10.82	1.33	124.14	581.23	9.1108	
10:45:36	1201.44	103	2104	435	1108	1136	373	11.62	2.05	0.8	10.04	10.65	1.2	216.21	581.5	9.1071	
10:45:46	1201.69	103	2116	439	1138	2203	1471	11.92	3.14	1.63	10.13	11.65	2.03	93.18	581.74	9.1067	
10:45:54	1201.94	103	2237	427	1153	2582	2013	13.74	3.48	1.13	7.91	11.25	5.76	114.4	581.99	9.112	
10:46:06	1202.19	103	1816	445	804	931	425	15.46	2.16	0.76	5.17	7.96	4.74	61.9	582.24	9.1167	
10:46:14	1202.44	103	1873	437	846	976	338	12.83	2.17	0.8	9.02	10.34	3.11	94.97	582.49	9.1177	
10:46:37	1202.69	103	1746	445	713	867	468	10.96	2.04	0.68	10.57	11.06	1.13	38.75	582.74	9.124	
10:46:56	1202.94	103	1693	444	672	905	486	10.91	2.08	0.77	10.74	11.06	0.81	31.2	582.98	9.1321	
10:47:36	1203.14	103	1674	445	657	866	389	10.96	2.08	0.69	10.76	11.08	0.72	23.78	583.19	9.1404	
10:48:56	1203.39	102	1714	441	721	1063	393	10.99	2.04	0.68	10.6	11.06	1.23	36.23	583.43	9.1497	
10:48:07	1203.64	102	1696	439	695	1056	312	11.42	2	0.68	10.15	10.63	0.89	105.03	583.68	9.1592	
10:48:14	1203.89	101	1858	439	873	971	227	11.84	2.1	0.69	10.01	10.44	0.83	127.61	583.94	9.151	
10:48:22	1204.14	101	1850	439	862	1279	518	11.57	2.1	0.9	10.08	10.56	1.34	116.01	584.18	9.1553	
10:48:30	1204.39	104	2083	429	1065	1285	340	11.64	2.26	0.98	10	10.63	1.32	121.3	584.44	9.1653	
10:48:39	1204.69	104	2217	431	1184	2521	1656	11.36	2.37	1.24	10.3	11.63	2.1	92.13	584.69	9.1581	
10:48:58	1204.91	103	1806	447	735	974	494	13.5	4.74	8.4	8.13	11.16	6.98	50.15	584.89	9.169	
10:47:28	1205.08	101	1802	396	265	2460	2544	14.66	3.01	2.47	6.93	9.88	7.92	21.86	585.14	9.1713	
10:47:43	1205.33	101	1806	411	500	1964	782	13.4	2.07	0.68	8.23	9.76	1.2	56.96	585.39	9.1756	
10:47:50	1205.58	101	1836	429	753	947	312	13.79	1.85	0.8	7.9	9.43	1.13	119.74	585.63	9.1778	
10:48:02	1205.83	101	1802	415	768	976	370	12.29	1.89	0.8	9.25	9.84	1.69	34.96	585.87	9.1781	
10:48:11	1206.08	105	1971	464	985	1218	514	12.51	2.08	0.63	9.19	9.8	0.85	103.28	586.17	9.1836	
10:48:18	1206.33	105	1974	396	807	1077	335	13.78	1.92	0.4	8.58	9.36	0.81	120.29	586.38	9.1853	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP66H												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		6, 9, 12, 12											
Hours On Bit =	6.83			Mud Type =		Water Based											
Average ROP =	51.72			Mud Weight (lbs/gal)		9.0+											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.68			Collar (ft)=	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
10:48:26	1206.58	108	1971	410	944	1058	304	12.55	1.91	0.38	8.06	8.41	0.74	116.36	566.58	6.1876
10:48:31	1206.83	108	1985	403	842	1048	285	12.53	1.99	0.03	8.11	8.46	0.64	110.06	566.9	6.1886
10:48:41	1207.09	108	2011	406	973	1056	178	12.64	1.84	0.41	8.1	8.43	0.72	110.36	567.15	6.1919
10:48:46	1207.34	105	2033	404	1526	1186	357	12.56	1.97	0.55	8.08	8.48	0.81	112.72	567.39	6.1942
10:48:57	1207.69	104	2088	399	1075	1278	324	12.59	2.02	0.62	8.11	8.43	0.74	111.19	567.69	6.1965
10:49:08	1207.94	107	2016	410	956	1308	494	12.21	2.38	1.14	8.22	9.86	1.18	77.45	567.89	6.1967
10:49:28	1208.09	106	2131	409	1178	3648	3111	12.15	2.49	1.75	8.49	10.84	2.75	47.85	568.15	6.2046
10:49:33	1208.34	105	2093	444	1526	1814	1090	13.63	2.13	0.58	7.7	8.41	3.9	183.45	568.36	6.2063
10:49:52	1208.59	107	1763	315	716	921	377	15.47	2.21	1.16	6.15	7.11	1.84	48.4	568.65	6.2114
10:50:05	1208.84	105	1846	415	859	1903	586	15.48	2.08	0.76	6.14	6.68	1.2	65.62	568.9	6.2103
10:50:15	1209.09	107	1677	424	630	898	405	15.85	1.93	0.43	6.26	6.56	1.01	70.28	569.15	6.2136
10:50:35	1209.34	108	1706	428	731	854	336	15.83	2.19	0.67	6.29	6.65	0.79	50.62	569.36	6.2212
10:50:51	1209.59	107	1720	424	708	827	184	15.93	2.17	0.63	6.28	6.73	0.91	55.85	569.61	6.2277
10:51:21	1209.73	109	1843	416	328	983	1017	15.75	3.93	4.72	6.67	8.29	7.36	18.54	569.81	6.2263
10:51:51	1209.84	109	1625	353	686	1024	429	16.03	1.84	0.35	6.28	6.58	1.19	25.09	569.96	6.2146
10:52:02	1210.19	107	1757	385	809	866	170	15.71	2.01	0.55	5.81	6.32	0.74	63.55	570.28	6.2475
10:52:12	1210.44	107	1758	382	812	906	208	15.71	2.09	0.64	5.81	6.27	0.74	62.8	570.46	6.2567
10:52:32	1210.69	107	1710	381	757	858	152	15.48	1.98	0.49	6.14	6.49	0.75	45.89	570.74	6.2561
10:53:02	1210.89	108	1936	394	864	1050	186	15.26	1.95	0.48	6.34	6.56	0.62	39.72	570.94	6.2644
10:53:30	1211.14	108	1864	394	767	993	365	15.33	2.11	0.71	6.28	6.91	0.86	31.76	571.2	6.2731
10:54:05	1211.31	109	1622	396	669	720	91	15.27	1.91	0.41	6.34	6.81	0.59	29.83	571.36	6.2804
10:54:30	1211.56	108	1664	393	703	1061	466	15.32	3.04	0.88	6.08	6.56	0.93	35.08	571.62	6.2868
10:55:00	1211.76	110	1858	400	880	940	108	15.28	1.97	0.55	6.63	6.68	0.46	24.1	571.82	6.2971
10:55:30	1211.94	108	1837	392	880	926	81	15.37	2.04	0.61	6.36	6.68	0.48	20.48	571.96	6.3057
10:55:53	1212.19	108	1734	385	779	1286	580	14.77	2.94	2.58	8.32	10.72	6.44	40.58	572.24	6.3117
10:56:04	1212.44	106	2024	383	1079	1179	316	11.58	1.98	0.61	9.78	10.13	0.91	64.8	572.49	6.3142
10:56:10	1212.69	104	2086	378	1146	1256	287	12.03	1.92	0.58	9.6	9.96	0.77	118.26	572.74	6.3165
10:56:17	1212.94	104	2119	376	1158	1296	235	12.01	1.94	0.4	9.61	10.01	0.81	121.58	573	6.3185
10:56:26	1213.19	104	2156	379	1167	1268	188	11.9	2.07	0.64	9.73	10.15	0.91	101.66	573.24	6.3211
10:56:33	1213.44	105	2153	375	1174	1267	192	11.93	1.94	0.46	9.63	9.96	0.82	129.4	573.5	6.3228
10:56:43	1213.69	102	2158	374	1196	1356	328	11.64	2.26	0.82	9.78	10.36	1.01	90.58	573.74	6.3257
10:56:50	1213.94	104	2141	378	1115	1372	436	11.88	2.03	0.77	9.77	10.25	0.86	118.52	573.99	6.3277
10:57:02	1214.19	105	2046	383	1078	1367	527	11.8	2.46	1.35	9.83	11.3	4.38	75.16	574.24	6.3311
10:57:38	1214.44	103	1842	396	891	1040	403	15.79	1.85	0.28	5.81	5.97	0.77	44.1	574.48	6.3382
10:57:48	1214.69	103	1846	397	735	1034	373	15.84	1.89	0.45	5.76	6.13	1.01	35.05	574.76	6.3405
10:57:58	1214.94	108	1784	386	886	947	117	16.13	1.85	0.31	5.41	5.67	0.36	83.72	574.96	6.3409
10:58:11	1215.19	108	1787	387	853	896	207	16.16	1.87	0.3	5.44	5.7	0.36	77.26	575.23	6.3561

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/28/90																
Starting Depth =	1361.27			Bit Type =	Walker McDonald MP53H												
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	359.87			Bit Nozzles =		9, 9, 10, 10											
Hours On Bit =	6.83			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		9.50											
Drillstring (ft) =	1371.36			Pipe (ft) =	962.68			Collar (ft)=	408.68								
TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours On Bit
10:56:21	1215.44	107	1791	362	878	967	146	16.17	1.63	0.33	5.43	5.87	0.57	87.4	595.63	6.8228
10:56:34	1215.89	107	1781	358	872	963	182	16.13	1.64	0.38	5.47	5.74	0.55	89.47	595.73	6.6566
10:56:46	1215.94	107	1792	361	868	958	146	16.14	1.62	0.35	5.46	5.73	0.57	78.91	596	6.8355
10:56:58	1216.19	107	1780	356	874	931	113	16.13	1.61	0.36	5.47	5.72	0.6	74.45	596.26	6.8622
10:59:10	1216.44	107	1791	358	879	918	101	16.14	1.6	0.36	5.46	5.72	0.53	71.83	596.49	6.8677
10:59:22	1216.69	107	1788	358	873	927	117	16.09	1.63	0.41	5.51	5.72	0.48	77.08	596.74	6.8734
10:59:35	1216.84	108	1786	357	885	987	164	16.12	3.04	0.6	5.46	5.72	0.55	71.95	597	6.8791
10:59:46	1217.19	107	1775	359	887	927	176	16.11	1.64	0.45	5.46	5.62	0.67	77.01	597.24	6.8787
10:59:59	1217.48	108	1797	362	852	930	93	16.11	1.62	0.37	5.49	5.74	0.55	71.74	597.49	6.8841
11:00:13	1217.7	107	1782	360	848	952	113	16.08	1.64	0.38	5.51	5.74	0.5	62.1	597.75	6.8841
11:00:25	1217.95	108	1787	357	853	962	101	16.11	1.65	0.38	5.49	5.77	0.5	75.77	597.99	6.8895
11:00:39	1218.2	107	1779	361	863	931	139	16.08	1.66	0.3	5.5	5.75	0.5	85.3	598.24	6.8949
11:00:51	1218.45	108	1783	355	857	928	126	16.08	1.63	0.26	5.51	5.64	0.53	97.3	598.49	6.895
11:01:04	1218.7	107	1813	360	883	956	150	16.17	1.56	0.28	5.42	5.67	0.48	76.89	598.75	6.9002
11:01:17	1218.95	108	1797	364	885	947	123	16.15	1.57	0.27	5.45	5.67	0.63	72.51	598.99	6.9056
11:01:28	1219.2	107	1796	359	876	975	166	16.13	1.57	0.31	5.48	5.72	0.57	78.38	599.24	6.9051
11:01:41	1219.45	107	1781	355	868	939	134	16.11	1.57	0.25	5.48	5.7	0.45	69.6	599.5	6.9165
11:01:53	1219.7	107	1782	362	879	951	136	16.16	1.6	0.26	5.43	5.67	0.45	79.84	599.74	6.9116
11:02:05	1219.95	107	1783	360	873	931	132	16.16	1.57	0.29	5.43	5.7	0.53	76.07	599.99	6.9161
11:02:18	1220.2	107	1783	359	864	910	109	16.19	1.61	0.33	5.41	5.72	0.53	72.88	600.24	6.9165
11:02:28	1220.45	108	1783	364	885	933	122	16.15	1.86	0.31	5.44	5.74	0.65	80.48	600.5	6.9217
11:02:41	1220.7	107	1776	360	887	915	109	16.18	1.87	0.29	5.43	5.7	0.5	75.18	600.75	6.9251
11:02:53	1220.95	108	1772	358	869	906	113	16.18	1.85	0.26	5.44	5.7	0.65	74.05	601.01	6.9285
11:03:04	1221.2	108	1766	363	880	919	124	16.19	1.89	0.3	5.44	5.7	0.48	79.19	601.26	6.9317
11:12:53	1221.63	106	1470	306	691	915	514	19.2	1.86	0.27	3.6	4.14	3.85	46.47	601.62	6.436
11:13:14	1221.83	106	1548	367	886	732	93	19.03	1.83	0.23	3.67	4.17	0.41	41.84	601.87	6.4393
11:13:26	1222.08	107	1548	360	879	728	126	19.01	1.81	0.27	3.68	4.19	0.41	41.68	602.13	6.4448
11:13:50	1222.33	106	1665	385	912	1226	296	17.32	1.83	0.44	5.68	9.98	5.08	44.26	602.37	6.4503
11:14:05	1222.58	106	2017	380	1115	1532	336	14.69	2.01	0.54	5.94	9.19	0.55	109.68	602.63	6.4561
11:14:12	1222.83	104	2028	440	1116	1351	352	14.18	1.96	0.5	5.86	8.24	0.77	123.25	602.87	6.4561
11:14:19	1223.08	104	2039	438	1106	1243	292	14.23	1.97	0.61	5.8	8.22	0.79	136.69	603.16	6.4598
11:14:26	1223.33	104	2066	439	1116	1243	278	14.21	2.06	0.73	5.82	8.1	0.82	130.56	603.38	6.4637
11:14:33	1223.58	105	2083	441	1125	1287	413	14.16	1.96	0.53	5.85	8.17	0.67	127.51	603.63	6.4696
11:14:41	1223.83	105	1996	432	1105	1213	288	14.15	2.16	0.73	5.88	8.04	0.61	116.87	603.85	6.4666
11:14:49	1224.08	104	2062	439	1113	1206	302	14.2	2.06	0.61	5.83	8.14	0.65	110.86	604.14	6.4804
11:14:56	1224.33	105	2084	441	1085	1214	297	14.22	1.97	0.6	5.81	8.17	0.74	131.5	604.38	6.4701
11:15:03	1224.58	105	2047	441	1081	1178	211	14.24	2.02	0.64	5.75	8.19	0.81	126.32	604.65	6.4731

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 9/26/96			Bit Type =	Walker McDonald MP66H												
Starting Depth =	1093.27			Bit Size =	4.75												
Ending Depth =	1662.14			Bit Nozzles =	9, 9, 10, 12												
Total Depth Drilled =	568.87			Mud Type =	Water Based												
Hours On Bit =	6.83			Mud Weight (lbs/gal)	9.00												
Average ROP =	83.72			Pipe (ft) =	662.68			Collar (ft)=	498.68								
Drilling (ft) =	1071.86																

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	Gs	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:15:10	1226.63	104	2844	437	1086	1174	160	14.25	3	0.48	8.79	9.17	0.69	135.33	604.86	6.4741
11:15:17	1226.68	107	2926	447	1064	1174	228	14.25	2.81	0.56	8.78	9.17	0.84	131.66	605.37	6.4763
11:15:25	1226.93	106	2931	444	1067	1174	260	14.33	1.86	0.56	8.78	9.18	0.81	119.47	606.4	6.4781
11:15:31	1225.65	104	2838	437	1066	1218	325	14.24	2.81	0.59	8.76	9.18	0.79	132.81	605.64	6.4560
11:15:39	1225.63	105	2824	442	1067	1154	235	14.27	2.81	0.58	8.76	9.17	0.81	127.12	605.88	6.4637
11:15:46	1226.08	105	2819	443	1042	1154	231	14.29	2.06	0.63	8.78	9.22	0.81	131.76	606.15	6.4658
11:15:52	1226.33	105	2805	442	1019	1109	179	14.36	2.05	0.55	8.78	9.18	0.84	136.68	606.37	6.4659
11:15:59	1226.65	106	2887	444	1024	1137	221	14.25	2.06	0.55	8.78	9.1	0.72	122.03	606.65	6.4670
11:16:06	1226.84	105	1883	444	1016	1129	207	14.23	1.86	0.44	8.79	9.11	0.72	185.23	606.89	6.4696
11:16:13	1227.08	105	1884	442	1019	1141	229	14.24	2.01	0.64	8.79	9.16	0.78	125.23	607.14	6.4716
11:16:20	1227.34	105	1883	442	1013	1119	190	14.33	2.03	0.59	8.78	9.19	0.77	126.95	607.41	6.4736
11:16:28	1227.56	106	1943	445	994	1078	216	14.16	1.87	0.55	8.86	9.19	0.69	124.44	607.63	6.4956
11:16:36	1227.84	106	1917	445	994	1161	351	14.16	2.03	0.58	8.87	9.31	0.81	110.77	607.89	6.4977
11:16:43	1228.08	106	1848	445	973	1060	174	14.17	2.07	0.59	8.85	9.24	0.77	129.14	608.14	6.4998
11:16:51	1228.34	107	1928	446	975	1052	180	14.15	2.02	0.58	8.86	9.24	0.81	118.88	608.39	6.5023
11:16:58	1228.58	105	1882	450	972	1080	170	14.14	2.06	0.57	8.88	9.24	0.74	118.36	608.63	6.5043
11:17:06	1228.84	106	1880	449	933	1000	174	14.08	1.98	0.59	8.90	9.29	0.69	117.87	608.89	6.5066
11:17:13	1229.08	107	1892	449	935	1032	211	14.04	2.16	0.61	8.88	9.29	0.67	94.97	609.13	6.5091
11:17:20	1229.34	105	1908	444	942	1054	271	14.08	2.04	0.68	8.95	9.36	0.74	111.96	609.41	6.5114
11:17:28	1229.59	106	1881	445	901	1016	231	14.04	2.03	0.63	8.98	9.29	0.68	107.28	609.64	6.5136
11:17:34	1229.84	108	1848	453	870	1060	352	13.88	2	0.58	9.15	9.62	0.91	76.63	609.89	6.5160
11:17:41	1230.08	107	1863	449	968	1183	470	13.78	3.14	0.74	8.37	10.01	1.29	84.37	610.13	6.5197
11:18:03	1230.36	106	2048	447	1102	1271	466	13.77	2.21	0.84	10.26	10.85	1.36	166.58	610.41	6.5223
11:18:18	1230.53	106	1832	436	756	1063	643	12.15	3.58	3.05	10.87	12.76	3.83	67.17	610.64	6.528
11:18:33	1230.71	106	1652	396	86	1174	1227	14.55	3.08	2.74	8.46	11.54	0.84	20.87	610.83	6.5243
11:19:11	1231.53	106	1749	356	1	651	705	13.83	2.79	2.28	8.91	10.19	1.04	36.82	611.07	6.5411
11:19:34	1231.77	106	1727	357	-42	-83	28	13.67	1.81	0.37	8.34	9.53	0.36	38.32	611.32	6.5434
11:19:43	1231.92	105	1697	353	-42	-83	28	14.02	2.05	0.58	8	9.36	0.6	67	611.56	6.5503
11:19:51	1231.77	105	1690	353	-43	-83	28	14.02	1.96	0.61	8.69	9.24	0.48	83.62	611.45	6.5535
11:20:14	1232.02	107	1761	360	-43	-83	28	13.75	1.84	0.42	9.27	9.53	0.62	48.13	612.07	6.5656
11:20:40	1232.27	107	1748	366	-42	-83	28	13.67	1.68	0.32	9.34	9.53	0.41	38.48	612.32	6.5688
11:20:58	1232.52	106	1803	365	-43	-83	28	13.75	1.96	0.61	9.28	9.53	0.57	48.45	612.56	6.5719
11:21:10	1232.77	105	1951	361	-42	-83	28	14.01	1.84	0.44	8	9.31	0.57	62.96	612.84	6.5741
11:21:21	1233.02	106	1996	365	-42	-83	28	14.04	1.97	0.48	8.88	9.29	0.85	61.07	613.07	6.577
11:21:41	1233.27	106	1853	361	268	1380	1431	13.64	2.76	2.14	9.16	10.29	2.01	44.48	613.33	6.5827
11:21:57	1233.52	105	1935	367	268	998	893	13.92	3.24	3.04	9.1	10.7	3.47	101.01	613.57	6.5883
11:21:58	1233.77	105	2016	361	-43	-83	28	14.11	1.82	0.37	8.91	9.12	0.48	109.44	613.84	6.5875

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 6/26/98																	
Starting Depth =	1031.27			Bit Type =	Walker McDonald MF88H													
Ending Depth =	1582.14			Bit Size =	4.75													
Total Depth Drilled =	550.87			Bit Nozzles =		6, 6, 12, 12												
Hours On Bit =	6.53			Mud Type =		Water Based												
Average ROP =	83.72			Mud Weight (lbs/gal)		9.00												
Drillstring (ft) =	1071.36			Pipe (ft) =	862.68				Collar (ft) =	208.68								

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:22:12	1234.62	108	1998	385	-42	-50	20	13.9	1.56	0.33	8.12	9.46	0.69	87.45	614.97	6.5913
11:22:36	1234.27	102	1882	372	-43	-30	20	13.91	1.91	0.38	9.11	9.38	0.55	85.65	614.31	6.59053
11:22:36	1234.52	102	1912	371	-44	-33	20	14.02	1.92	0.36	9	9.34	0.46	87.8	614.57	6.59082
11:22:48	1234.72	99	1891	361	-42	-25	25	14.01	1.9	0.35	8.81	9.24	0.5	77.27	614.83	6.59313
11:22:59	1235.02	88	1781	316	-42	-28	20	13.97	1.84	0.44	8.04	9.24	0.53	79.87	615.09	6.59496
11:23:11	1235.27	88	1780	316	-42	-33	20	13.97	1.86	0.36	8.04	9.34	0.53	75.24	615.32	6.59679
11:23:32	1235.62	104	1978	392	-43	-43	20	14.04	1.94	0.41	8.68	9.19	0.5	80.09	615.67	6.611
11:23:53	1235.77	105	1984	388	-43	-33	25	14.02	1.92	0.38	8.69	9.26	0.5	69.92	615.82	6.61136
11:23:43	1236.02	107	1980	389	-44	-28	24	14.05	1.97	0.46	8.56	9.24	0.57	52.5	616.08	6.61568
11:23:54	1236.28	107	1979	390	-44	-33	26	14	1.96	0.48	8.61	9.22	0.5	83.63	616.32	6.61956
11:24:04	1236.53	107	2008	390	-43	-28	20	14.04	1.91	0.41	8.66	9.24	0.57	87.44	616.57	6.62225
11:24:36	1236.78	107	1992	388	-43	-33	24	14.02	1.9	0.43	8.69	9.15	0.48	80.54	616.83	6.62657
11:24:24	1237.03	108	2013	386	-42	-33	25	14.14	1.91	0.42	8.67	9.13	0.62	104.76	617.07	6.62829
11:24:33	1237.28	107	1999	388	-43	-33	25	14.18	1.93	0.41	8.83	9.12	0.6	99.65	617.32	6.63005
11:24:46	1237.53	108	1793	386	-42	-33	26	13.93	1.84	0.36	8.03	9.34	0.57	78.34	617.57	6.63317
11:25:00	1237.78	108	1741	384	-43	-33	20	13.84	1.84	0.28	8.17	9.46	0.6	97.97	617.82	6.6359
11:25:13	1238.03	110	1708	386	-42	-43	26	13.95	1.85	0.24	8.06	9.36	0.65	88.77	618.08	6.64177
11:25:25	1238.38	104	1739	382	-43	-43	24	13.96	1.84	0.25	8.08	9.39	0.45	76.04	618.32	6.64451
11:25:41	1238.53	110	1707	386	-46	-65	24	13.83	1.81	0.22	8.16	9.46	0.61	69	618.57	6.64804
11:25:55	1238.78	108	1718	384	-46	-37	20	13.9	1.85	0.23	8.11	9.43	0.57	97.77	618.83	6.65133
11:26:10	1239.03	109	1716	387	-46	-35	20	13.92	1.84	0.28	8.18	9.46	0.55	97.17	619.08	6.65474
11:26:25	1239.28	109	1709	387	-46	-43	24	13.93	1.85	0.27	8.12	9.41	0.62	93.96	619.32	6.65815
11:26:34	1239.53	107	1741	389	-46	-63	24	14.06	1.87	0.33	8.56	9.17	0.51	94.12	619.58	6.6644
11:26:50	1239.78	107	1719	391	-45	-63	24	13.93	1.87	0.09	8.17	9.43	0.67	90.66	619.83	6.66788
11:27:05	1240.03	108	1723	393	-45	-63	20	13.86	1.87	0.08	8.14	9.36	0.62	92.1	620.1	6.67128
11:27:21	1240.28	109	1720	395	-46	-33	26	13.85	1.85	0.24	8.15	9.43	0.6	86.17	620.33	6.67408
11:27:34	1240.53	107	1732	396	-46	-30	20	13.95	1.85	0.24	8.05	9.34	0.6	86.34	620.57	6.67651
11:27:47	1240.78	108	1722	392	-45	-37	18	13.92	1.86	0.26	8.08	9.26	0.5	86.58	620.83	6.67944
11:28:00	1241.03	108	1719	392	-45	-63	24	13.92	1.85	0.22	8.08	9.31	0.48	86.08	621.08	6.68231
11:28:13	1241.28	108	1736	392	-44	-63	26	13.98	1.83	0.23	8.02	9.34	0.67	78.84	621.32	6.68513
11:28:25	1241.53	108	1736	388	-46	-67	18	13.93	1.86	0.27	8.07	9.31	0.48	70.16	621.58	6.7895
11:28:37	1241.78	107	1762	391	-44	-33	20	14.02	1.86	0.3	8.08	9.22	0.65	70.86	621.83	6.69581
11:28:47	1242.03	108	1758	391	-44	-37	18	14.02	1.82	0.24	8.09	9.24	0.5	88.36	622.1	6.701
11:29:03	1242.28	102	1750	413	815	1214	1258	13.97	1.9	0.36	8.03	9.41	0.77	58.52	622.32	6.70356
11:29:16	1242.53	103	1749	424	782	890	258	13.94	1.88	0.32	8.07	9.38	0.65	73.58	622.59	6.7068
11:29:30	1242.78	107	1725	428	765	886	264	13.88	1.91	0.4	8.12	9.41	0.69	62.6	622.83	6.713
11:29:41	1243.04	105	1739	424	758	870	223	14.01	1.95	0.44	8.09	9.24	0.53	80.04	623.05	6.7182

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/98																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP93R												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		8, 8, 12, 12											
Hours On Bit =	8.53			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.58				Collar (ft) =	408.68							
TIME	BIT DEPTH	FLOW	PRESS	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
11:29:53	1243.29	108	1731	425	744	879	182	13.96	1.97	0.38	9.31	9.29	0.6	82.83	823.13	8.713
11:30:05	1243.54	108	1717	425	739	850	275	13.97	1.98	0.38	9.04	9.32	0.75	71.74	823.8	8.7228
11:30:14	1243.79	108	1755	424	785	854	239	14.08	1.98	0.33	8.92	9.25	0.89	85.37	824.04	8.7253
11:30:28	1244.04	109	1763	426	716	845	255	13.85	1.91	0.4	9.16	9.48	0.79	89.74	824.1	8.7259
11:30:41	1244.29	108	1748	427	760	927	339	13.99	1.98	0.5	9.01	9.53	0.91	74.42	824.34	8.7328
11:30:51	1244.54	108	1764	424	770	848	168	14.01	1.94	0.28	8.96	9.24	0.62	89.94	824.6	8.7357
11:31:04	1244.79	108	1742	425	760	862	219	13.97	1.9	0.37	9.03	9.29	0.6	86.81	824.83	8.7381
11:31:13	1245.04	107	1758	422	775	878	178	14.04	1.89	0.36	8.95	9.24	0.67	91.11	825.09	8.742
11:31:25	1245.29	108	1744	426	756	842	207	14.04	1.83	0.35	8.96	9.24	0.6	82.6	825.33	8.7451
11:31:39	1245.54	108	1764	426	710	801	182	13.93	1.91	0.37	9.07	9.36	0.57	67.85	825.58	8.7483
11:31:50	1245.79	108	1735	426	738	868	219	13.96	1.89	0.35	9.02	9.34	0.74	78.46	825.84	8.752
11:32:03	1246.04	108	1717	425	722	834	227	13.96	1.84	0.41	9.04	9.31	0.65	70.41	826.09	8.7552
11:32:15	1246.29	107	1767	428	717	821	160	13.91	1.82	0.36	9.03	9.34	0.6	73.47	826.35	8.7586
11:32:27	1246.54	108	1722	424	736	868	271	13.96	1.86	0.37	9.06	9.38	0.72	72.55	826.58	8.7612
11:32:40	1246.79	107	1744	421	756	881	328	13.95	1.92	0.37	9.05	9.34	0.62	70.52	826.84	8.7647
11:32:52	1247.04	107	1746	422	768	901	304	13.94	1.91	0.35	9.05	9.29	0.55	70.59	827.08	8.7679
11:33:08	1247.29	108	1748	425	756	838	352	13.92	1.92	0.36	9.06	9.36	0.6	66.6	827.34	8.7714
11:33:19	1247.54	108	1728	426	736	918	348	13.97	2.1	0.56	9.13	9.46	0.69	69.7	827.59	8.7748
11:33:30	1247.79	108	1747	426	765	927	364	13.97	1.8	0.33	9.02	9.31	0.61	78.41	827.84	8.7781
11:33:40	1248.04	108	1722	427	724	874	284	13.97	1.85	0.32	9.12	9.36	0.57	58.42	828.09	8.7814
11:33:50	1248.29	108	1735	426	738	843	356	13.91	1.85	0.34	9.09	9.38	0.77	70.21	828.35	8.7848
11:34:11	1248.54	107	1742	425	754	894	280	14	1.87	0.31	9	9.36	0.67	73.92	828.59	8.7880
11:34:21	1248.8	108	1757	424	771	862	311	14.06	1.86	0.38	8.94	9.29	0.62	80.19	828.84	8.7913
11:34:31	1249.05	107	1761	422	771	870	254	14.06	1.86	0.31	8.94	9.31	0.61	86.69	829.12	8.7949
11:34:45	1249.3	109	1752	427	747	852	257	13.92	1.86	0.28	8.97	9.36	0.59	86.55	829.34	8.7978
11:34:55	1249.55	108	1737	426	750	856	219	14.02	1.86	0.31	8.97	9.36	0.57	87.53	829.6	8.8012
11:35:08	1249.8	108	1731	426	743	834	186	13.99	1.85	0.31	9.01	9.31	0.6	70.42	829.85	8.8045
11:35:19	1250.05	108	1742	426	755	870	261	14.01	1.8	0.33	8.97	9.26	0.57	81.4	830.1	8.8078
11:35:30	1250.3	107	1761	431	774	850	188	14.05	1.46	0.44	8.94	9.24	0.62	80.98	830.34	8.8109
11:35:41	1250.55	107	1758	431	768	845	284	14.02	1.49	0.32	8.96	9.24	0.62	81.82	830.6	8.8143
11:35:52	1250.8	109	1747	427	754	919	312	14	1.87	0.39	8.99	9.24	0.6	80.57	830.86	8.8176
11:36:03	1251.05	109	1750	428	732	886	288	13.94	1.86	0.29	9.06	9.36	0.62	67.1	831.09	8.8206
11:36:15	1251.3	108	1753	424	736	852	283	14.03	1.87	0.35	8.98	9.34	0.67	65.52	831.34	8.8239
11:36:27	1251.55	108	1750	425	758	846	186	14.08	1.86	0.31	8.91	9.22	0.6	67.83	831.61	8.8275
11:36:38	1251.8	109	1744	429	731	817	223	14.04	1.92	0.4	8.95	9.22	0.6	81.82	831.85	8.8318
11:36:49	1252.05	109	1724	429	703	797	193	13.96	1.95	0.43	9.03	9.36	0.67	78.71	832.1	8.8351
11:37:05	1252.3	109	1694	429	681	826	296	13.86	1.92	0.35	9.13	9.43	0.67	58.48	832.35	8.8383

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/29/96						
Starting Depth =	1031.27	Bit Type =	Walker McDonald MP64H				
Ending Depth =	1382.16	Bit Size =	4 7/8				
Total Depth Drilled =	350.67	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	8.83	Mud Type =	Water Based				
Average ROP =	53.72	Mud Weight (lbs/gal)	9.00				
Drillstring (ft) =	1071.36	Pipe (ft) =	982.68	Collar (ft)=	406.68		

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
11:37:17	1253.58	108	1738	426	723	852	284	13.98	1.87	0.31	9.05	9.36	0.86	71.18	833.6	8.84429
11:37:38	1252.8	106	1742	424	741	835	259	14.03	1.87	0.31	8.69	9.29	0.77	69.06	832.85	8.84557
11:42:50	1253.36	105	1662	418	969	886	723	16.64	1.96	0.43	7.43	10.46	3.96	52.75	828.4	8.85264
11:43:00	1253.61	106	1744	419	779	862	162	13	1.84	0.44	10.03	10.39	0.08	87.06	833.66	8.85363
11:43:13	1253.86	106	1737	422	737	860	227	12.96	1.91	0.39	10.12	10.44	0.67	70.78	831.91	8.85117
11:43:26	1254.11	107	1717	422	730	935	255	12.85	1.97	0.47	10.19	10.62	0.65	67.61	834.16	8.8556
11:43:40	1254.36	106	1723	421	746	878	238	12.99	1.84	0.38	10.15	10.41	0.55	68.41	834.41	8.85632
11:43:51	1254.61	108	1781	428	746	918	305	12.65	1.83	0.43	10.17	10.46	0.56	76.43	834.66	8.85725
11:44:03	1254.86	107	1738	423	756	870	264	13.07	1.89	0.39	10.12	10.44	0.72	76.84	834.91	8.85758
11:44:15	1255.11	107	1726	422	735	847	401	12.95	1.84	0.39	10.13	10.39	0.0	72.48	835.16	8.85792
11:44:26	1255.36	106	1734	421	746	870	276	12.99	1.88	0.38	10.09	10.41	0.62	67.71	835.41	8.85825
11:44:39	1255.61	107	1734	422	730	805	482	12.65	1.89	0.36	10.15	10.41	0.57	67.46	835.66	8.85858
11:44:53	1255.86	106	1745	416	762	874	308	13.03	1.82	0.38	10.16	10.56	0.65	64.86	835.9	8.85891
11:45:07	1256.11	106	1733	418	734	916	330	12.91	1.93	0.41	10.17	10.48	0.57	72.91	836.16	8.8593
11:45:19	1256.36	106	1733	422	728	880	332	12.91	1.94	0.39	10.17	10.44	0.63	83.83	836.41	8.8597
11:45:28	1256.61	105	1747	417	782	862	194	13.07	1.91	0.38	10	10.32	0.62	104.13	836.66	8.85963
11:45:38	1256.86	106	1759	421	780	882	287	13.1	1.84	0.43	9.98	10.25	0.65	86.79	836.91	8.85921
11:45:47	1257.11	105	1767	411	786	878	170	13.18	1.9	0.42	9.91	10.2	0.68	101.41	837.16	8.86047
11:45:57	1257.36	106	1757	420	740	825	307	13.07	1.9	0.38	10.01	10.27	0.6	80.07	837.41	8.86079
11:46:08	1257.61	106	1759	416	771	863	255	13.05	1.83	0.4	10.03	10.36	0.63	84.01	837.66	8.86104
11:46:20	1257.86	105	1748	417	743	862	320	12.85	1.88	0.4	10.16	10.44	0.6	76.96	837.91	8.86136
11:46:32	1258.11	105	1736	417	744	882	299	12.95	1.91	0.39	10.13	10.44	0.6	78.19	838.16	8.8617
11:46:44	1258.36	106	1747	421	747	874	267	12.94	1.91	0.39	10.13	10.39	0.62	77.53	838.41	8.86216
11:46:57	1258.61	106	1743	419	739	910	336	12.91	1.9	0.37	10.17	10.41	0.56	72.26	838.67	8.86259
11:47:11	1258.86	107	1732	425	719	819	403	12.8	1.89	0.36	10.15	10.48	0.67	64.25	838.91	8.86275
11:47:22	1259.12	107	1748	425	737	819	361	12.96	1.91	0.37	10.12	10.44	0.68	78.64	839.17	8.86311
11:47:34	1259.37	106	1751	421	734	866	328	12.96	1.91	0.38	10.11	10.44	0.72	76.38	839.41	8.86342
11:47:49	1259.62	107	1742	425	719	866	365	12.88	1.9	0.42	10.22	10.53	0.77	61.33	839.66	8.86387
11:47:58	1259.87	108	1737	422	747	919	328	12.95	1.91	0.35	10.12	10.44	0.8	83	839.92	8.86414
11:48:10	1260.12	108	1736	422	773	939	296	13.07	1.88	0.37	10	10.34	0.84	87.23	840.16	8.86442
11:48:18	1260.37	106	1838	417	819	918	199	13.17	1.9	0.41	9.9	10.2	0.65	112.65	840.41	8.8646
11:48:27	1260.62	105	1801	419	772	874	227	13.09	1.91	0.4	9.98	10.27	0.62	95.82	840.67	8.86491
11:48:37	1260.87	107	1803	423	777	886	199	13.08	1.88	0.34	9.98	10.23	0.6	81.23	840.94	8.86517
11:48:48	1261.12	105	1799	422	775	918	309	12.97	1.9	0.38	10.1	10.39	0.62	80.76	841.16	8.86545
11:49:00	1261.37	105	1789	418	778	927	316	13.03	1.86	0.44	10.05	10.48	0.75	76.75	841.41	8.8658
11:49:10	1261.62	105	1777	417	762	887	352	12.97	1.84	0.41	10.1	10.41	0.68	85.08	841.66	8.86609
11:49:21	1261.87	105	1782	418	773	838	271	13.05	1.87	0.38	10.02	10.29	0.62	86.56	841.92	8.866

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/28/96																
Starting Depth =	1051.27			Bit Type =	Reed-McDonald MP55H												
Ending Depth =	1382.14			Bit Size =	8.75												
Total Depth Drilled =	330.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	50.72			Mud Weight (lbs/gal)		9.00											
Collaring (ft) =	1071.36			Pipe (ft) =	682.65			Collar (ft)=	405.86								

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:49:32	1262.12	105	1786	419	760	961	301	12.84	1.96	0.48	10.18	10.58	0.57	74.76	642.16	8.5872
11:49:45	1262.37	105	1756	421	732	956	344	12.86	1.93	0.4	10.19	10.51	0.74	73.16	642.42	8.8706
11:49:58	1262.62	105	1774	419	754	979	233	13.06	1.95	0.48	10.61	10.39	0.72	87.58	642.66	8.8735
11:50:06	1262.87	106	1781	421	691	906	285	12.93	1.94	0.48	10.14	10.39	0.67	82.13	643.01	8.9768
11:50:20	1263.12	107	1718	423	668	864	312	12.85	1.88	0.4	10.18	10.53	0.77	65.24	643.17	8.98.0
11:50:31	1263.37	108	1748	421	713	813	247	13	1.91	0.43	10.02	10.35	0.67	81.83	643.41	8.9835
11:50:43	1263.62	108	1709	427	679	821	283	12.92	1.96	0.43	10.15	10.44	0.67	79.23	643.67	8.9866
11:50:57	1263.87	108	1734	422	696	910	351	12.68	1.91	0.44	10.19	10.48	0.65	62.31	643.91	8.9907
11:51:10	1264.12	107	1728	424	728	826	284	12.91	1.92	0.44	10.16	10.52	0.72	73.38	644.17	8.9941
11:51:22	1264.37	108	1701	421	734	947	328	12.84	1.86	0.37	10.13	10.44	0.67	71.04	644.43	8.9979
11:51:35	1264.62	107	1754	423	710	854	259	12.91	1.94	0.47	10.16	10.46	0.69	72.11	644.68	9.0013
11:51:48	1264.88	107	1723	425	696	909	267	12.87	1.94	0.46	10.2	10.48	0.67	69.78	644.93	9.005
11:52:01	1265.13	107	1727	420	694	905	285	12.83	1.97	0.47	10.15	10.51	0.77	69.13	645.17	9.0084
11:52:14	1265.38	107	1716	411	532	1622	1623	12.86	1.92	0.44	10.18	10.53	0.77	70.76	645.43	9.0121
11:52:29	1265.63	107	1716	425	681	829	328	12.84	1.95	0.56	10.22	10.51	0.65	83.74	645.67	9.0161
11:52:43	1265.88	107	1723	422	699	821	236	12.83	2.05	0.71	10.17	10.48	0.69	66.15	645.92	9.0202
11:52:56	1266.13	107	1716	423	676	781	231	12.96	1.94	0.4	10.21	10.53	0.77	67.62	646.18	9.0239
11:53:08	1266.38	108	1760	421	743	1068	393	12.97	1.99	0.51	10.09	10.46	0.82	74.03	646.44	9.027
11:53:19	1266.63	108	1762	420	737	821	180	13.02	1.93	0.48	10.04	10.41	0.81	87.86	646.67	9.0299
11:53:30	1266.88	108	1767	426	748	905	320	13.01	2.01	0.65	10.05	10.41	0.74	81.02	646.93	9.033
11:53:40	1267.13	108	1744	421	717	843	287	13.01	1.86	0.39	10.09	10.41	0.65	84.05	647.18	9.0362
11:53:52	1267.38	108	1745	421	728	906	335	12.98	1.97	0.53	10.11	10.44	0.72	78.13	647.43	9.0393
11:54:05	1267.63	107	1735	420	638	821	306	13.02	1.94	0.48	10.14	10.41	0.65	69.7	647.67	9.0428
11:54:16	1267.88	107	1728	421	711	870	312	12.97	1.92	0.46	10.09	10.41	0.79	83.97	647.94	9.0469
11:54:26	1268.13	107	1738	424	722	848	235	13.06	2.01	0.61	9.87	10.34	0.58	92.74	648.19	9.0495
11:54:37	1268.38	108	1742	421	682	817	365	12.94	1.95	0.5	10.12	10.46	0.69	76.22	648.43	9.053
11:54:51	1268.63	107	1680	424	667	793	227	12.97	1.91	0.37	10.19	10.51	0.69	58.64	648.69	9.0567
11:55:03	1268.88	108	1697	419	681	785	174	13.08	2.13	0.7	10.08	10.51	0.86	72.38	648.93	9.0601
11:55:13	1269.13	107	1689	423	640	785	223	13.01	1.98	0.5	10.06	10.23	0.72	99.26	649.18	9.0637
11:55:23	1269.38	107	1611	423	597	676	152	13.01	1.94	0.46	10.08	10.44	0.93	83.44	649.44	9.0676
11:55:33	1269.63	108	1655	426	624	720	160	13.14	1.9	0.4	9.82	10.41	0.86	96.02	649.69	9.0671
11:55:47	1269.88	107	1630	423	627	769	286	12.82	1.92	0.4	10.24	10.8	0.79	56.96	649.94	9.0713
11:55:58	1270.13	108	1685	419	679	777	207	13.02	1.85	0.4	10.04	10.48	0.86	83.53	650.18	9.0743
11:56:07	1270.39	107	1656	424	648	732	106	13.06	1.91	0.56	10	10.29	0.62	97.03	650.44	9.0769
11:56:18	1270.64	107	1693	424	628	798	182	13.06	1.91	0.41	10	10.34	0.69	98.16	650.69	9.0797
11:56:26	1270.89	107	1659	423	684	793	247	13.15	1.98	0.46	9.61	10.25	0.74	102.88	650.93	9.083
11:56:35	1271.14	106	1651	422	646	765	211	13.03	1.85	0.37	10.03	10.36	0.79	82.9	651.18	9.0864

DOE high power motor test Amaco Catoosa Test Site

Well No. 23	Date: 2/28/98						
Starting Depth =	1031.27	Bit Type =	Walker McDonald MP66H				
Ending Depth =	1362.14	Bit Size =	4.75				
Total Depth Drilled =	330.87	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	8.53	Mud Type =	Water Based				
Average ROP =	38.79	Mud Weight (lbs/gal)	8.90				
Drillstring (ft) =	1071.36	Pipe (ft) =	652.98	Collar (ft)=	418.38		

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	Q's	Q's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
11:50:46	1271.38	108	1675	421	675	757	182	13.1	1.89	0.48	9.96	10.34	0.84	99.72	651.44	7.0978
11:55:53	1271.64	107	1653	424	643	751	243	13.15	1.92	0.44	9.9	10.29	0.88	104.07	651.69	7.0307
11:57:04	1271.85	107	1727	432	749	893	403	13.15	1.99	0.61	9.91	10.44	1.08	95.14	651.90	7.0082
11:57:54	1272.08	106	1651	405	455	898	867	12.56	3	3.52	10.49	13.42	3.46	28.02	652.13	7.1003
11:58:04	1272.24	107	1809	380	792	2656	2771	15.4	2.81	2.46	8.63	11.75	3.1	18.29	652.29	7.1564
11:58:34	1272.52	107	1596	381	553	682	713	16.13	1.84	0.3	8.9	7.65	2.35	10.56	652.56	7.1176
11:58:04	1272.94	107	1564	386	540	676	174	14.13	1.84	0.3	8.91	10.53	2.73	14.4	652.89	7.1259
11:58:34	1273.63	106	1650	386	665	793	168	12.52	1.86	0.32	10.12	10.34	0.48	22.06	652.68	7.1343
12:00:01	1272.08	106	1706	387	724	909	184	12.88	1.85	0.36	10.06	10.25	0.43	33.06	652.81	7.1418
12:00:29	1278.13	106	1719	388	708	797	125	12.63	1.83	0.38	10.08	10.23	0.43	33.05	653.17	7.1488
12:00:59	1278.38	105	1726	382	752	824	142	13.01	1.81	0.35	10.04	10.37	0.45	30.29	653.43	7.1568
12:01:15	1271.63	106	1708	384	766	854	117	13.03	1.77	0.33	10.02	10.27	0.48	43.94	653.58	7.1627
12:01:41	1273.84	106	1730	386	767	862	170	13.01	1.72	0.69	10.04	10.23	0.5	34.42	653.94	7.1694
12:02:06	1274.13	105	1737	384	767	887	206	13	1.32	0.46	10.06	10.26	0.46	35.21	654.16	7.1756
12:02:36	1274.36	106	1723	387	576	961	1017	12.64	2.3	2.06	10.11	11.94	3.69	20.65	654.32	7.1845
12:03:06	1274.6	106	1716	388	676	748	138	12.64	2.16	2.03	10.11	12.02	3.87	28.78	654.58	7.1918
12:03:36	1274.84	107	1699	383	664	708	134	12.92	2.31	2.26	10.13	11.78	3.76	28.02	654.8	7.1979
12:04:06	1275.03	107	1698	380	656	734	117	12.6	2.62	2.59	10.18	11.59	3.85	32.01	655.04	7.2046
12:04:36	1275.24	107	1706	386	668	865	159	12.93	2.7	2.72	10.12	11.66	4	25.31	651.25	7.2181
12:05:06	1275.43	107	1697	390	613	2875	2875	17.61	2.5	2.56	8.4	11.75	11.39	28.42	655.46	7.2264
12:05:36	1276.8	108	1733	394	703	1194	614	16.56	1.96	0.61	8.63	7.68	10.58	656.04	7.2347	
12:06:06	1276.81	109	1772	397	718	1848	1653	15.04	1.87	0.84	7.89	8.79	5.04	24.08	655.85	7.242
12:06:30	1276.06	106	1447	392	734	676	216	13.14	1.74	0.61	9.69	10.44	2.42	37.15	656.11	7.2491
12:06:48	1276.31	107	1560	388	696	983	178	12.92	1.66	0.39	10.12	10.36	0.5	40.57	656.36	7.2558
12:07:03	1276.56	107	1635	388	678	1052	188	12.88	1.75	0.44	10.04	10.29	0.57	61.03	656.62	7.2559
12:07:16	1276.81	108	1684	390	1046	1087	162	13.04	1.77	0.44	9.66	10.26	0.58	59.07	656.86	7.2625
12:07:29	1277.06	107	1703	389	1021	1107	185	13.07	1.78	0.45	9.67	10.26	0.57	65.1	657.1	7.2683
12:07:40	1277.31	105	1748	384	1076	1222	306	13.13	1.67	0.38	9.81	10.25	0.66	60.67	657.37	7.2744
12:08:01	1277.56	106	1701	385	1076	1194	345	13.15	1.66	0.49	9.68	10.27	0.72	62.56	657.6	7.2807
12:08:01	1277.81	105	1808	383	1122	1267	348	13.17	1.66	0.49	9.67	10.17	0.67	66.2	657.88	7.2775
12:08:13	1278.06	106	1686	380	1174	2580	2185	13.07	1.75	0.71	9.46	11.75	3.01	73.77	658.13	7.2763
12:08:29	1278.31	108	1685	387	668	1080	215	14.67	1.69	0.43	8.05	8.66	0.67	58.92	658.37	7.2828
12:08:45	1278.56	107	1648	390	972	1109	233	14.67	1.73	0.46	8.36	8.65	0.5	67.75	658.61	7.2866
12:08:58	1278.81	108	1687	392	929	1108	186	14.6	1.73	0.42	8.43	8.64	0.46	58.08	658.85	7.2911
12:09:17	1279.06	108	1606	394	903	1016	211	14.67	1.69	0.4	8.46	8.67	0.53	48.72	659.11	7.296
12:09:33	1279.31	108	1578	394	916	1080	211	14.58	1.68	0.35	8.44	8.64	0.49	54.18	659.36	7.3008
12:09:50	1279.56	107	1617	393	983	1133	235	14.67	1.71	0.4	8.36	8.64	0.55	54.08	659.6	7.3052

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/20/08			Bit Type =	Walker McDonald MP08H												
Starting Depth =	1091.27			Bit Size =	8.75												
Ending Depth =	1582.19			Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled =	490.67			Mud Type =		Water Based											
Hours On Bit =	6.53			Mud Weight (lbs/gal)		9.00											
Average ROP =	53.72			Pipe (ft) =	902.03			Collar (ft) =	406.63								
Drillstring (ft) =	1971.36																
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:10:04	1276.81	107	1601	389	937	1064	228	14.62	1.72	0.42	8.41	8.97	0.56	61.06	556.66	7.3063
12:10:18	1286.06	107	1678	388	1032	1166	258	14.72	1.71	0.38	8.31	8.62	0.3	85.58	566.12	7.3132
12:10:31	1290.21	107	1671	388	1090	1193	349	14.71	1.66	0.41	8.31	8.69	0.66	72	570.25	7.3166
12:10:44	1290.56	106	1667	386	1017	1166	267	14.71	1.69	0.38	8.31	8.89	0.57	69.74	570.61	7.3204
12:10:58	1290.61	106	1788	384	1146	3523	2101	14.91	2.76	1.29	8.11	10.26	0.11	60.12	570.66	7.3044
12:11:12	1291.07	108	1613	384	993	1024	166	15.07	1.66	0.44	7.36	7.61	0.53	66.23	571.11	7.3251
12:11:29	1291.82	110	1563	401	898	987	166	15.59	1.66	0.43	7.43	7.68	0.53	54.05	571.86	7.3321
12:11:44	1291.57	108	1614	392	869	1093	251	15.69	1.7	0.46	7.33	7.61	0.57	60.25	571.62	7.327
12:11:58	1291.63	107	1584	396	932	1069	251	15.65	1.65	0.37	7.36	7.64	0.55	70.24	571.68	7.3404
12:12:14	1292.07	108	1561	394	913	1004	193	15.61	1.61	0.33	7.41	7.61	0.53	62.15	572.11	7.3453
12:12:30	1292.82	108	1641	392	897	1012	203	15.58	1.65	0.39	7.44	7.68	0.46	69.73	572.86	7.3508
12:12:49	1292.57	107	1631	391	899	987	168	15.57	1.63	0.46	7.45	7.68	0.5	49.72	572.61	7.355
12:13:05	1293.63	108	1564	391	917	1018	176	15.61	1.65	0.38	7.41	7.68	0.55	64.19	573.65	7.3596
12:13:22	1293.67	107	1582	388	952	1090	288	15.56	1.62	0.37	7.45	7.68	0.5	54.73	573.71	7.3642
12:13:43	1293.32	107	1603	390	872	947	180	15.53	1.64	0.37	7.43	7.73	0.55	42.06	573.36	7.3702
12:13:58	1293.51	106	1548	387	939	962	142	15.61	1.67	0.44	7.41	7.69	0.46	59.66	573.62	7.3749
12:14:15	1293.92	107	1621	390	877	979	180	15.58	1.72	0.46	7.45	7.61	0.41	52.73	573.96	7.3781
12:14:30	1294.07	107	1617	391	878	1026	231	15.64	1.69	0.36	7.47	7.58	0.58	44.46	574.11	7.3845
12:14:52	1294.33	108	1626	391	878	1040	276	15.66	1.7	0.44	7.46	7.68	0.58	50.63	574.36	7.3894
12:20:36	1294.71	106	1701	387	706	1113	708	15.16	1.96	0.48	4.62	9	6.5	26.05	574.76	7.4008
12:20:53	1294.96	106	1614	385	645	1163	528	14.9	1.6	0.45	5.8	8.12	0.66	61.05	575.02	7.4046
12:21:07	1295.21	106	1618	385	645	1128	275	14.9	1.66	0.36	5.79	9	0.53	53.08	575.26	7.4056
12:21:25	1295.46	107	1581	391	852	947	125	14.85	1.67	0.42	8.85	8.07	0.48	49.19	575.52	7.4136
12:21:35	1295.71	106	1554	392	858	1004	203	14.84	1.61	0.39	5.85	8.1	0.48	51.82	575.76	7.4186
12:22:04	1295.96	106	1468	393	895	852	122	14.76	1.61	0.38	5.91	8.1	0.38	43.24	576.01	7.4244
12:22:29	1296.21	105	1464	392	810	963	165	14.77	1.61	0.36	5.92	8.07	0.43	35.64	576.26	7.4313
12:22:54	1296.46	105	1418	392	761	853	176	14.74	1.28	0.42	8.83	9.19	0.46	38.92	576.51	7.4381
12:23:24	1296.69	105	1441	392	744	825	150	13.74	2.48	1.67	9.08	11.29	3.23	30	576.73	7.4464
12:23:54	1296.91	105	1429	393	720	765	117	13.59	2.38	1.63	10.11	10.93	1.77	22.48	576.95	7.456
12:24:24	1297.13	106	1564	392	694	744	97	13.66	2.29	1.41	10.14	10.96	1.69	26.64	577.17	7.4653
12:24:46	1297.33	107	1542	390	832	1848	1185	13.72	2.61	1.36	9.86	11.26	2.2	42.69	577.43	7.4691
12:25:06	1297.63	108	1480	392	751	852	860	13.63	2.55	1.68	10.07	10.64	1.75	42.23	577.67	7.4751
12:25:30	1297.82	108	1468	394	668	2097	2143	13.61	2.4	2.22	10.19	11.42	2.54	37	577.81	7.4804
12:25:46	1297.91	107	1727	396	923	2219	1868	13.61	2.4	1.82	9.88	11.78	3.13	64.8	577.94	7.488
12:26:15	1298.07	108	1313	393	678	839	271	13.76	2.65	3.21	7.92	11.11	4.82	20.3	578.1	7.4933
12:26:45	1298.2	108	1301	393	650	744	166	13.79	2.64	0.73	8.9	7.13	0.53	15.6	578.25	7.5008
12:27:16	1298.35	108	1290	392	586	761	352	13.81	2	0.83	6.86	7.16	0.57	29.09	578.4	7.5106

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/28/98																
Starting Depth =	1001.20			Bit Type =	Weiker McDonald M*984												
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	350.57			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (Range)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.68			Collar (ft) =	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
12:27:48	1288.65	107	1391	390	692	705	126	16.82	1.86	0.4	6.85	7.68	0.43	19.22	668.78	7.5195
12:28:18	1288.73	106	1357	387	745	842	203	16.21	1.87	0.35	7.44	8.38	1.7	22.88	668.78	7.5278
12:28:48	1288.98	106	1420	387	790	858	142	15.58	1.84	0.37	8.13	8.35	0.48	30.15	669.04	7.5361
12:29:18	1289.23	106	1344	388	813	883	146	15.58	1.85	0.47	8.09	8.26	0.39	32.48	669.29	7.5438
12:29:58	1289.48	105	1447	387	809	870	142	15.59	1.8	0.45	8.08	8.31	0.43	36.99	669.53	7.5504
12:29:57	1289.79	107	1437	389	697	825	796	15.84	2.42	1.53	8.13	8.68	1.39	47.61	669.78	7.5566
12:30:27	1289.97	107	1404	391	-37	27	73	16.8	1.81	0.28	8.18	8.31	0.34	28.58	670.03	7.5642
12:30:57	1290.19	106	1383	394	-37	-25	20	15.48	1.81	0.28	8.15	8.35	0.38	26.46	670.24	7.5726
12:31:27	1290.41	106	1378	392	-38	-25	24	15.47	1.86	0.4	8.16	8.35	0.41	35.34	670.42	7.5808
12:31:57	1290.63	107	1435	389	-36	-21	32	15.49	1.87	0.38	8.14	8.35	0.43	35.77	670.66	7.5891
12:32:27	1290.78	108	1351	392	-37	-25	24	15.49	1.81	0.28	8.19	8.38	0.45	19.1	670.83	7.5974
12:32:57	1291.01	106	1359	385	-38	-25	24	15.48	1.87	0.36	8.14	8.35	0.57	37.5	671.07	7.6057
12:33:19	1291.26	105	1487	382	-36	-20	24	15.5	1.81	0.35	8.03	8.28	0.59	46	671.3	7.612
12:33:49	1291.47	107	1392	389	-37	-25	24	15.48	1.81	0.27	8.15	8.33	0.38	28.07	671.52	7.6203
12:34:19	1291.63	107	1322	391	-39	-22	25	15.41	1.8	0.24	8.21	8.4	0.36	18.97	671.68	7.6268
12:34:49	1291.8	107	1348	389	-38	-17	41	15.44	1.88	0.31	8.19	8.43	0.5	20.65	671.86	7.6339
12:35:19	1291.99	107	1349	390	-38	-21	36	15.44	1.8	0.4	8.18	8.43	0.5	19.72	672.01	7.6412
12:35:49	1292.15	106	1345	387	-36	-17	41	15.48	1.89	0.37	8.18	8.43	0.46	21.6	672.19	7.6525
12:36:19	1292.3	107	1324	389	-36	-25	24	15.41	1.81	0.25	8.21	8.38	0.36	18.5	672.36	7.6618
12:36:49	1292.47	107	1353	388	-38	-28	20	15.44	1.8	0.25	8.18	8.4	0.38	20.17	672.53	7.6701
12:37:19	1292.62	107	1346	386	-41	-29	24	15.43	1.79	0.21	8.19	8.38	0.34	18.79	672.68	7.6783
12:37:49	1292.78	107	1336	389	-39	-28	20	15.41	1.78	0.24	8.21	8.38	0.34	18.49	672.83	7.6871
12:38:19	1292.96	107	1359	388	-39	-28	20	15.43	1.85	0.28	8.19	8.4	0.43	21.59	673.01	7.6956
12:38:49	1293.14	107	1378	388	-40	-29	20	15.44	1.88	0.31	8.17	8.5	0.53	21.8	673.19	7.7037
12:39:19	1293.31	107	1361	390	-42	-29	24	15.42	1.81	0.24	8.2	8.35	0.43	19.28	673.36	7.712
12:39:49	1293.47	107	1329	389	-41	-33	32	15.39	1.81	0.22	8.22	8.38	0.43	18.91	673.52	7.7203
12:40:19	1293.61	107	1329	391	-41	-29	20	15.39	1.79	0.19	8.22	8.38	0.34	17.48	673.67	7.7285
12:40:49	1293.75	107	1331	391	-40	-33	36	15.4	1.81	0.21	8.21	8.38	0.36	17.69	673.81	7.7368
12:41:19	1293.91	107	1332	390	-41	-29	24	15.4	1.81	0.2	8.21	8.38	0.38	18	673.98	7.7452
12:41:49	1294.11	107	1354	390	-40	-29	20	15.43	1.86	0.22	8.18	8.38	0.41	24.48	674.18	7.7535
12:42:19	1294.31	106	1356	388	-40	-20	24	15.44	1.81	0.31	8.17	8.35	0.38	22.88	674.38	7.7618
12:42:49	1294.48	107	1314	391	-41	-21	41	15.4	1.87	0.33	8.21	8.45	0.58	17.6	674.51	7.7704
12:43:19	1294.59	107	1295	393	-40	-25	28	15.38	1.84	0.3	8.23	8.4	0.48	36.48	674.66	7.7787
12:43:49	1294.7	107	1358	391	-17	465	536	15.33	1.95	0.64	8.28	8.53	2.13	12.6	674.78	7.787
12:44:19	1294.86	107	1462	390	66	813	871	15.44	2.12	0.64	8.19	8.17	0.41	38.74	674.93	7.7953
12:44:49	1295.05	106	1429	387	-2	663	721	14.93	2.01	0.51	8.08	10.32	1.77	16.51	675.06	7.8034
12:45:19	1295.21	107	1429	389	56	846	866	15.77	2.15	0.77	7.82	9.63	0.62	26.48	675.26	7.8117

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 9/28/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MF65H												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		9, 5, 13, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	692.68			Collar (ft)=	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled	
12:45:43	1285.28	197	1065	392	-41	-39	24	20.13	1.8	0.19	2.46	5.39	2.66	2.61	675.33	7.6523	
12:46:13	1285.31	197	1037	390	-41	-33	18	21.26	1.81	0.25	2.5	5.39	6.3	4.01	676.37	7.6528	
12:46:43	1285.41	197	1133	388	-41	-25	32	18.3	1.84	0.28	5.25	7.64	2.94	11.96	675.47	7.6343	
12:47:13	1285.63	197	1241	386	-42	-26	33	16.03	1.81	0.21	7.67	7.79	0.41	13.85	675.57	7.6421	
12:47:43	1285.82	197	1228	388	-42	-36	34	16.02	1.79	0.17	7.67	7.73	0.31	10.62	675.66	7.6529	
12:48:13	1285.73	197	1235	389	-42	-33	18	16.04	1.8	0.18	7.66	7.8	0.45	12.8	675.77	7.6526	
12:48:43	1285.49	197	1287	389	-42	-38	24	16.04	1.8	0.19	7.66	7.73	0.34	14.63	675.9	7.6578	
12:49:13	1285.38	196	1242	385	-41	-35	20	16.06	1.8	0.19	7.65	7.66	0.31	15.66	676.03	7.6761	
12:49:43	1285.11	196	1256	387	-41	-23	32	16.08	1.81	0.19	7.62	7.66	0.41	15.37	676.18	7.6844	
12:50:13	1284.24	197	1260	389	-42	-25	32	16.07	1.8	0.19	7.62	7.68	0.45	15.64	676.33	7.6927	
12:50:43	1284.37	196	1253	386	-41	-21	36	16.07	1.81	0.22	7.62	7.73	0.41	16.05	676.49	7.701	
12:51:13	1284.53	196	1267	384	-40	-39	20	16.07	1.81	0.19	7.61	7.66	0.34	16.84	676.66	7.7093	
12:51:43	1284.71	195	1256	382	-42	-33	16	16.09	1.8	0.19	7.5	7.71	0.36	21.67	676.88	7.7177	
12:52:13	1284.93	196	1317	382	-40	-23	29	16.15	1.83	0.26	7.48	7.61	0.34	25.63	677.07	7.726	
12:52:43	1285.11	196	1292	387	-40	-39	20	16.08	1.81	0.19	7.5	7.66	0.36	22.4	677.18	7.7343	
12:53:13	1285.31	196	1282	387	-40	-38	20	16.1	1.82	0.22	7.49	7.64	0.31	22.62	677.36	7.7426	
12:53:43	1285.48	197	1286	388	-39	-38	20	16.11	1.81	0.2	7.48	7.64	0.31	21.37	677.54	7.7512	
12:54:13	1285.67	196	1300	386	-39	-25	32	16.11	1.81	0.19	7.48	7.66	0.36	22.12	677.73	7.7595	
12:54:43	1285.85	196	1296	387	-39	-21	36	16.1	1.83	0.22	7.48	7.68	0.41	23.06	677.91	7.7679	
12:55:13	1286.05	196	1308	386	-38	-21	32	16.11	1.81	0.19	7.47	7.71	0.41	23.45	678.11	7.7761	
12:55:43	1286.25	197	1312	390	-40	-39	20	16.11	1.81	0.22	7.47	7.63	0.34	22.65	678.3	7.7844	
12:56:13	1286.45	196	1305	387	-39	-39	20	16.11	1.8	0.2	7.47	7.64	0.45	25.5	678.51	7.7927	
12:56:43	1286.64	196	1292	387	-40	-39	20	16.09	1.81	0.21	7.46	7.64	0.34	21.66	678.69	8.001	
12:57:13	1286.8	196	1279	387	-39	-21	32	16.07	1.81	0.2	7.5	7.66	0.34	18.17	678.85	8.0093	
12:57:43	1286.97	197	1264	389	-40	-21	28	16.05	1.81	0.19	7.53	7.68	0.31	19.42	679.01	8.0176	
12:58:13	1287.11	197	1253	390	-40	-23	24	16.04	1.81	0.2	7.55	7.8	0.53	17.92	679.16	8.0259	
12:58:43	1287.28	197	1260	389	-39	-26	28	16.03	1.83	0.24	7.55	7.76	0.39	17.31	679.31	8.0343	
12:59:13	1287.43	197	1307	390	18	748	816	17.71	2.17	0.81	5.83	8.59	8.62	19.17	679.47	8.0426	
12:59:43	1286.59	197	1345	388	-38	-21	32	16.84	1.82	0.23	7.71	7.9	0.36	17.17	679.61	8.0511	
13:00:13	1286.72	196	1271	387	-39	-26	24	15.85	1.82	0.2	7.72	7.85	0.31	16.13	679.76	8.0595	
13:00:43	1286.87	197	1265	389	-39	-39	24	15.85	1.81	0.2	7.72	7.85	0.34	17.86	679.92	8.0678	
13:01:13	1287	197	1261	389	-40	-39	24	15.85	1.79	0.18	7.72	7.85	0.2	16.13	680.08	8.0761	
13:01:43	1287.23	196	1256	385	-41	-23	24	15.84	1.83	0.27	7.69	7.83	0.41	27.2	680.29	8.0844	
13:02:13	1287.47	197	1248	391	-41	-26	28	15.85	1.83	0.27	7.69	7.83	0.43	28.68	680.53	8.0927	
13:02:43	1287.73	197	1279	389	-41	-43	20	15.88	1.87	0.36	7.66	7.78	0.41	30.46	680.78	8.101	
13:03:13	1288.07	196	1268	387	-42	-39	20	15.89	1.85	0.31	7.56	7.78	0.39	36.39	681.02	8.1093	
13:03:38	1288.22	196	1269	385	-41	-39	20	16	1.85	0.32	7.57	7.78	0.43	36.05	681.27	8.1145	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/26/96																
Starting Depth =	1031.27			BH Type =	Walker Mc Donald MP6RK												
Ending Depth =	1382.14			BH Size =	4.75												
Total Depth Cored =	350.87			BH Nozzles =		6, 6, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		8.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	882.65				Collar (ft)=	426.65							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Cored	
13:04:02	1031.47	105	1403	384	-40	-28	20	16.01	1.85	0.8	7.86	7.73	0.6	36.34	661.52	6.12213	
13:04:29	1031.72	107	1397	386	-42	-25	32	15.87	1.93	0.38	7.6	7.76	0.36	33.6	661.76	6.12458	
13:04:59	1031.81	106	1327	382	-42	-30	20	16.9	1.84	0.36	7.86	7.83	0.39	28.34	661.86	6.1271	
13:05:29	1032.08	105	1276	385	-41	-26	28	15.84	1.81	0.2	7.72	7.6	0.41	17.74	662.14	6.13454	
13:05:59	1032.21	106	1309	382	-41	-26	32	15.94	1.81	0.21	7.72	7.92	0.36	17.07	662.25	6.13637	
13:06:29	1032.57	106	1276	382	-40	-29	24	15.99	1.81	0.18	7.7	8	0.48	18.1	662.62	6.1402	
13:06:59	1032.65	107	1308	380	-42	-30	20	16.9	1.85	0.8	7.86	7.66	0.36	21.31	662.8	6.17053	
13:07:29	1032.71	107	1270	380	-42	-33	28	15.87	1.81	0.25	7.69	7.55	0.36	16.38	662.76	6.17286	
13:07:59	1032.85	106	1356	381	-42	-28	24	15.84	1.82	0.23	7.72	7.96	0.41	17.01	662.91	6.1872	
13:08:29	1033.01	107	1266	381	-42	-28	28	15.89	1.86	0.35	7.87	8.05	1.48	19.41	663.05	6.19558	
13:08:59	1030.28	105	1403	383	-39	-25	20	14.75	1.85	0.43	8.82	9.07	0.6	34.21	660.31	6.17027	
13:09:29	1030.51	106	1430	381	-39	-29	20	14.78	1.85	0.47	8.79	9	0.45	36.43	660.55	6.19296	
13:09:44	1030.79	107	1469	380	-39	-25	24	14.83	1.84	0.43	8.74	8.95	0.62	35.08	660.82	6.2161	
13:10:12	1031.01	107	1428	386	-39	-29	20	14.77	1.86	0.33	8.79	9.02	0.6	32.21	661.05	6.22139	
13:10:30	1031.26	106	1335	387	-38	-25	24	14.79	1.82	0.42	8.77	8.95	0.46	37.63	661.31	6.23305	
13:10:52	1031.51	106	1346	384	-37	-25	24	14.85	1.86	0.5	8.61	9	0.61	35.23	661.56	6.24561	
13:11:22	1031.7	106	1331	386	-37	-17	36	14.66	1.86	0.29	8.85	9.07	0.39	22.05	661.74	6.24434	
13:11:47	1031.85	107	1307	383	-37	-17	36	14.79	1.8	0.36	8.77	9.14	1.15	26.06	661.89	6.25052	
13:11:56	1032.2	107	1437	386	-37	-25	20	15.26	1.84	0.27	8.8	8.82	0.62	56.8	662.24	6.25126	
13:12:26	1032.45	107	1443	389	-37	-25	20	15.13	1.82	0.22	8.83	8.69	0.6	58.22	662.49	6.25587	
13:12:41	1032.7	106	1409	385	-37	-29	16	15.05	1.84	0.42	8.54	8.83	0.66	60.28	662.75	6.26	
13:12:51	1032.81	107	1348	381	-36	-25	24	14.71	1.86	0.29	8.86	9.05	0.41	61.75	662.86	6.26035	
13:13:21	1033.07	106	1357	383	-36	-25	20	14.65	1.81	0.23	8.9	9.05	0.29	19.81	663.13	6.27646	
13:13:51	1033.22	106	1339	383	-36	-25	20	14.65	1.84	0.23	8.91	9.07	0.34	17.02	663.27	6.28343	
13:14:21	1033.37	107	1326	381	-36	-25	28	14.68	1.82	0.21	8.69	9.12	0.41	18.35	663.42	6.29032	
13:14:48	1033.62	107	1321	380	-37	-25	24	14.76	1.99	0.63	8.8	9.02	0.62	33.92	663.67	6.30057	
13:15:18	1033.84	106	1358	383	-36	-29	20	14.7	1.85	0.3	8.85	9.05	0.41	26.24	663.89	6.30705	
13:15:38	1034.05	106	1343	381	-36	-29	30	14.7	1.84	0.28	8.85	9.14	0.46	24.81	664.09	6.31173	
13:16:18	1034.26	107	1357	380	-36	-25	20	14.72	1.83	0.23	8.83	8.98	0.36	20.45	664.3	6.32164	
13:16:48	1034.5	106	1448	387	16	776	776	16.08	2.22	0.45	8.88	9.77	7.76	28.13	664.54	6.33136	
13:17:18	1034.63	107	1166	381	-36	-17	36	17.92	1.86	0.81	5.62	5.69	5.46	15.86	664.67	6.34232	
13:17:48	1034.78	107	1357	382	-35	-21	28	15.43	1.87	0.32	8.11	8.33	0.5	25.05	664.81	6.35005	
13:18:18	1035.02	106	1277	382	-35	-25	28	15.35	1.82	0.26	8.2	8.35	0.41	39.23	665.07	6.35995	
13:18:48	1035.18	107	1308	380	-36	-25	20	15.35	1.86	0.25	8.17	8.35	0.34	38.62	665.23	6.36724	
13:19:18	1035.42	107	1360	380	-36	-25	20	15.44	1.87	0.33	8.1	8.23	0.62	28.75	665.46	6.37753	
13:19:35	1035.67	106	1458	386	-36	-25	20	15.6	1.84	0.44	7.94	8.16	0.59	54.11	665.71	6.38903	
13:19:51	1035.92	105	1471	385	-35	-29	16	15.66	1.83	0.43	7.89	8.14	0.62	54.38	665.97	6.39928	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/20/96						
Starting Depth =	1131.27	Bit Type =	Walker McDonough MP56H				
Ending Depth =	1782.14	Bit Size =	4.75				
Total Depth Drilled =	650.87	Bit Nozzles =	8, 8, 13, 13				
Hours On Bit =	8.53	Mud Type =	Water Based				
Average ROP =	55.72	Mud Weight (lbs/gal)	8.06				
Drillstring (ft) =	1071.38	Pipe (ft) =	642.68	Collar (ft) =	428.68		

TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet On Bit	Hours On Bit
13:20:02	1306.17	105	1429	367	-35	-25	25	15.78	1.9	0.33	7.76	8	0.53	81.75	656.22	8.368
13:20:18	1309.42	105	1325	362	-36	-26	18	15.69	1.81	0.2	7.85	8.08	0.5	64.03	659.48	8.3917
13:20:34	1309.67	103	1282	366	-35	-25	20	15.67	1.81	0.33	7.95	8.23	0.53	51.79	659.71	8.3966
13:20:52	1309.92	107	1337	369	-36	-26	20	15.85	1.85	0.25	7.95	8.33	0.6	48.16	659.97	8.4018
13:21:11	1310.17	107	1358	361	-36	-23	24	15.88	1.83	0.28	7.98	8.16	0.48	46.84	660.22	8.4068
13:21:34	1310.42	108	1301	368	-37	-25	25	15.49	1.81	0.28	8.06	8.38	0.6	39.29	660.48	8.4118
13:21:50	1310.67	106	1349	363	-36	-22	16	15.62	1.82	0.22	7.83	8.14	0.43	58.91	660.74	8.4170
13:22:03	1310.92	106	1474	366	-36	-22	24	15.74	1.86	0.3	7.81	8	0.41	70.42	660.97	8.4213
13:22:35	1311.17	106	1446	367	-40	-23	18	15.68	1.81	0.19	7.86	8.09	0.45	70.49	661.23	8.425
13:22:51	1311.42	107	1387	360	-38	-25	24	15.67	1.83	0.24	7.87	8.09	0.45	87.7	661.48	8.4299
13:22:42	1311.67	107	1377	368	-40	-23	18	15.75	1.8	0.16	7.78	8.07	0.55	79.16	661.73	8.4324
13:23:39	1311.92	106	1448	367	-36	-22	20	15.7	1.84	0.28	7.84	8.09	0.5	64.03	661.97	8.4361
13:23:07	1312.17	106	1501	365	-36	-26	20	15.8	1.85	0.25	7.75	7.95	0.38	80.34	662.21	8.4353
13:23:18	1312.42	105	1514	361	-36	-26	20	15.81	1.83	0.25	7.73	7.95	0.45	82.48	662.46	8.4402
13:23:29	1312.67	106	1524	364	-36	-25	18	15.82	1.82	0.23	7.71	8	0.5	77.78	662.72	8.4455
13:23:43	1312.92	107	1458	368	-35	-17	21	15.67	1.91	0.36	7.86	8.14	0.53	68.02	662.97	8.449
13:23:57	1313.17	106	1469	367	-36	-21	18	15.68	1.89	0.35	7.85	8.11	0.48	61.11	663.23	8.4539
13:24:13	1313.42	106	1462	367	-35	-29	22	15.69	1.85	0.29	7.85	8.04	0.41	63.13	663.47	8.4573
13:24:26	1313.67	107	1462	365	-36	-23	24	15.7	1.87	0.23	7.83	8.02	0.35	70.52	663.72	8.4609
13:24:39	1313.92	105	1468	367	-37	-22	20	15.71	1.87	0.33	7.83	8.14	0.53	64.71	664	8.4648
13:24:53	1314.18	107	1482	369	-36	-23	20	15.7	1.86	0.35	7.84	8.02	0.38	68.1	664.23	8.4682
13:25:05	1314.43	107	1467	369	-38	-19	20	15.69	1.87	0.38	7.85	8.04	0.48	69.04	664.47	8.472
13:25:19	1314.68	107	1481	368	-36	-20	20	15.69	1.83	0.25	7.84	8.07	0.41	68.58	664.72	8.476
13:25:36	1314.93	107	1442	369	-36	-21	18	15.68	1.84	0.23	7.86	8.16	0.5	60.03	664.96	8.4803
13:25:55	1315.18	108	1486	368	-40	-23	20	15.65	1.87	0.31	7.86	8.23	0.5	46.36	665.23	8.4857
13:26:22	1315.43	107	1399	360	-38	-19	20	15.43	1.69	0.32	8.09	8.31	0.6	83.05	665.49	8.4909
13:26:37	1315.68	106	1479	368	-38	-23	18	15.63	1.87	0.33	7.9	8.09	0.38	66.22	665.73	8.4957
13:26:55	1315.93	108	1451	365	-36	-20	22	15.6	1.86	0.27	7.84	8.28	0.6	51.38	665.98	8.5006
13:27:06	1316.18	105	1482	361	-36	-20	20	15.85	1.86	0.3	7.88	8.11	0.48	63.95	666.23	8.5054
13:03:37	1317.2	106	1282	365	7	913	569	18.43	1.88	0.24	3.77	4.6	4.74	49.53	667.24	8.5249
13:03:46	1317.45	107	1369	360	-23	-2	25	17.05	1.86	0.3	5.15	8.23	4.96	47.31	667.49	8.53
13:03:57	1317.7	105	1786	377	-34	35	29	13.57	1.98	0.42	9.66	9.84	1.34	53.12	667.74	8.5298
13:04:06	1317.95	108	1975	378	-33	-33	16	12.66	1.94	0.45	9.67	9.84	0.55	56.07	667.99	8.5298
13:04:16	1318.2	104	1910	381	-33	-30	20	12.57	1.94	0.42	9.68	9.88	0.6	91.42	668.23	8.5298
13:04:55	1318.41	106	1696	365	117	910	662	17.53	2.36	1.11	4.68	10.09	13.05	25.85	668.46	8.5346
13:05:01	1318.66	105	1447	373	-33	-21	20	17.08	1.83	0.22	5.11	6.37	1.66	57.34	668.71	8.5362
13:06:13	1318.91	104	1581	378	-33	-23	18	16.04	1.91	0.31	6.17	6.37	0.53	53.16	668.97	8.5421

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/28/99																
Starting Depth =	1081.27			Bit Type =	Walker McDonough MP68R												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	300.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	8.53			Mud Type =		Water Based											
Average ROP =	60.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.35			Pipe (ft) =	662.68			Collar (ft)=	408.67								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	Q's	Q's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
13:55:21	1319.17	103	1592	376	-32	-28	18	16.13	1.87	0.3	6.08	6.27	0.43	84.82	690.22	8.1451
13:55:33	1319.43	105	1575	382	-33	-28	15	16.13	1.85	0.28	6.08	6.3	0.45	86.89	699.46	8.0478
13:55:46	1319.87	106	1614	384	-35	-25	15	16	1.88	0.28	6.2	6.53	0.72	88.8	709.71	8.0515
13:56:00	1319.92	105	1597	385	-34	-28	15	16.01	1.9	0.33	6.19	6.56	0.67	87.46	709.97	8.0563
13:56:08	1320.17	105	1585	382	-33	-21	20	16.14	1.88	0.23	6.06	6.29	0.56	92.65	710.23	8.0278
13:56:21	1320.43	107	1578	388	-34	-28	20	16.13	1.87	0.27	6.07	6.32	0.48	76.42	710.49	8.561
13:56:33	1320.67	106	1597	388	-33	-25	15	16.04	1.93	0.36	6.17	6.07	0.41	74.36	710.71	8.5048
13:56:44	1320.92	105	1665	385	-34	-25	21	14.08	1.96	0.41	6.19	6.12	0.11	80.28	710.95	8.5676
13:56:58	1321.17	104	1786	378	-34	-28	15	13.71	1.89	0.32	6.61	6.79	0.98	66.23	711.22	8.5719
13:57:16	1321.42	104	1864	380	117	810	647	16.37	2.12	0.86	5.93	10.68	5.24	53.04	711.47	8.5765
13:57:28	1321.67	105	1528	383	-33	-25	16	16.54	1.83	0.21	5.68	5.86	0.45	75.43	711.72	8.5719
13:57:39	1321.92	105	1518	385	-34	-25	16	16.55	1.85	0.24	5.85	5.82	0.36	80.34	711.96	8.563
13:57:50	1322.17	105	1526	386	-33	-25	16	16.58	1.88	0.31	5.92	5.84	0.41	87.27	712.22	8.5509
13:58:01	1322.42	107	1515	390	-33	-25	16	16.6	1.83	0.21	5.8	5.79	0.28	81.83	712.47	8.5569
13:58:11	1322.67	107	1487	389	-33	-28	16	16.56	1.89	0.29	5.81	5.89	0.45	85.75	712.72	8.5916
13:58:24	1322.92	107	1425	391	-35	-25	16	16.5	1.94	0.3	5.7	5.86	0.45	69.83	712.98	8.5954
13:58:37	1323.17	106	1461	387	-33	-25	16	16.47	1.85	0.36	5.73	5.85	0.41	68.04	713.21	8.5931
13:58:51	1323.42	107	1493	388	-33	-25	16	16.45	1.91	0.32	5.74	5.84	0.33	68.89	713.46	8.5928
13:59:19	1323.67	107	1402	389	-34	-21	24	16.26	1.92	0.34	5.68	6.2	0.65	39.32	713.72	8.5097
13:59:46	1323.92	107	1387	391	-34	-28	16	16.13	1.83	0.22	5.96	6.8	0.45	21.66	713.9	8.518
14:00:16	1324.01	108	1348	393	-33	-28	16	16.13	1.93	0.33	6.06	6.32	0.48	19.04	714.08	8.5053
14:00:48	1324.18	108	1345	392	-33	-21	20	16.18	1.89	0.38	6.03	6.2	0.38	19.07	714.23	8.5349
14:01:08	1324.43	108	1446	389	-33	-21	24	16.29	1.85	0.32	6.0	6.13	0.61	38.85	714.47	8.5413
14:01:18	1324.68	108	1604	385	-34	-21	36	16.7	1.85	0.33	5.49	5.74	0.57	98.2	714.73	8.5439
14:01:29	1324.93	108	1583	385	-33	-18	36	16.64	1.92	0.33	5.28	5.62	0.55	83.76	714.97	8.5486
14:01:41	1325.18	107	1516	389	-33	-18	36	16.63	1.88	0.29	5.46	5.91	0.53	73.61	715.24	8.5501
14:01:56	1325.43	107	1502	388	-33	-21	20	16.48	1.91	0.35	5.72	5.94	0.45	60.78	715.47	8.5544
14:02:09	1325.85	108	1514	388	-34	-25	16	16.52	1.92	0.32	5.67	5.84	0.36	65.97	715.73	8.5678
14:02:28	1325.93	109	1513	388	-35	-25	16	16.5	1.9	0.32	5.69	5.85	0.34	68.9	715.98	8.5815
14:02:35	1326.18	108	1521	386	-33	-21	24	16.53	1.91	0.31	5.67	5.94	0.5	85.38	716.22	8.5853
14:02:48	1326.43	108	1478	382	-34	-21	20	16.47	1.91	0.31	5.72	5.89	0.38	55.61	716.47	8.5682
14:03:03	1326.68	107	1476	388	-33	-21	20	16.5	1.86	0.29	5.7	5.93	0.36	54.14	716.73	8.573
14:03:26	1326.93	107	1429	391	-32	-21	20	16.31	1.87	0.26	5.87	6.1	0.57	43.81	716.98	8.570
14:03:58	1327.19	108	1374	392	-32	-21	20	16.21	1.85	0.25	5.87	6.15	0.41	37.22	717.2	8.5873
14:04:26	1327.36	107	1409	390	-32	-21	36	16.19	1.82	0.22	7	7.49	1.8	24.14	717.41	8.5956
14:04:50	1327.61	105	1452	386	-33	-17	24	14.91	1.96	0.28	7.28	7.47	0.41	36.07	717.66	8.7025
14:05:17	1327.86	105	1454	388	-33	-21	20	14.91	1.87	0.27	7.28	7.44	0.38	34.04	717.9	8.7098

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/98																	
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP58N													
Ending Depth =	1053.14			Bit Size =	6.75													
Total Depth Drilled =	350.87			Bit Nozzles =		5, 8, 12, 12												
Hours On Bit =	6.83			Mud Type =		Water Based												
Average ROP =	56.72			Mud Weight (lbs/gal)		9.00												
Drillstring (ft) =	1071.36			Pipe (ft) =	642.68				Collar (ft) =	428.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
14:02:43	1035.11	107	1462	388	-30	-21	20	14.02	1.85	0.25	7.27	7.47	0.45	91.42	708.16	8.7171
14:03:11	1036.56	107	1465	390	-30	-21	16	14.85	1.87	0.27	7.3	7.47	0.36	51.54	708.41	8.7251
14:03:41	1038.09	107	1467	391	-30	-21	16	14.85	1.84	0.26	7.31	7.47	0.35	47.6	708.63	8.7334
14:04:09	1039.54	107	1467	388	-30	-21	20	14.89	1.87	0.3	7.36	7.47	0.38	51.04	708.89	8.7413
14:04:37	1040.98	107	1468	391	-31	-21	20	14.89	1.82	0.23	7.28	7.47	0.41	51.49	709.14	8.7492
14:05:02	1042.34	107	1468	388	-30	-20	20	14.84	1.92	0.34	7.25	7.47	0.45	56.44	709.4	8.7568
14:05:22	1043.63	106	1466	387	-31	-13	36	14.49	1.66	0.29	7.7	8.23	1.15	46.68	709.66	8.7648
14:05:36	1044.84	106	1500	385	-32	-13	41	14.17	1.59	0.31	8.02	8.23	0.55	28.8	709.89	8.7681
14:06:53	1046.03	104	1561	389	-31	-17	26	14.19	1.86	0.3	8	8.21	0.41	62.02	710.15	8.7701
14:09:18	1047.33	105	1559	382	728	1494	1552	14.19	1.91	0.37	8.04	8.26	0.53	38.94	710.39	8.777
14:09:36	1048.6	106	1537	385	845	1028	184	14.13	1.81	0.41	8.09	8.33	0.5	46.68	710.65	8.7821
14:09:55	1049.88	107	1508	385	903	978	135	14.09	1.87	0.51	8.14	8.43	0.62	45.33	710.88	8.7878
14:10:13	1051.1	106	1517	386	982	1038	207	14.07	2.85	1.51	8.16	9.14	1.77	32.85	711.15	8.7942
14:10:41	1051.35	107	1517	388	865	951	184	14.07	2.85	1.62	8.18	9.17	1.82	40.4	711.36	8.8006
14:11:02	1051.6	106	1539	388	612	1044	216	14.12	2.12	0.58	8.1	8.62	1.41	43.63	711.64	8.8085
14:11:19	1051.85	107	1556	388	834	1290	153	14.19	1.81	0.41	8.07	8.33	0.52	52.13	711.86	8.8159
14:11:35	1052.1	106	1572	384	941	1305	382	14.22	1.94	0.44	8.01	8.31	0.57	58.06	712.14	8.8151
14:11:51	1052.35	106	1571	384	990	1308	207	14.2	1.84	0.37	8.03	8.31	0.69	57.17	712.39	8.8184
14:12:08	1052.6	105	1824	384	986	1137	243	14.32	1.89	0.37	7.81	8.19	0.57	74.73	712.65	8.8228
14:12:14	1052.85	104	1888	380	1017	1285	126	14.4	1.82	0.4	7.83	8.11	0.56	76.26	712.9	8.828
14:12:25	1053.1	105	1672	383	1005	1073	134	14.35	1.92	0.39	7.85	8.11	0.57	86.14	713.16	8.8291
14:12:36	1053.35	106	1606	385	1036	1150	327	14.36	1.92	0.4	7.86	8.11	0.43	83.88	713.39	8.832
14:12:46	1053.6	104	1714	376	1067	1141	154	14.47	1.82	0.36	7.76	8.02	0.5	88.83	713.64	8.8344
14:12:56	1053.85	104	1658	378	1028	1133	153	14.41	1.9	0.41	7.81	8.09	0.72	88.38	713.9	8.8374
14:13:07	1054.1	105	1718	382	1066	1137	154	14.42	1.81	0.4	7.81	8.11	0.55	81.68	714.15	8.8406
14:13:17	1054.35	105	1742	379	1076	1176	219	14.4	1.86	0.44	7.82	8.13	0.57	88.22	714.4	8.8436
14:13:27	1054.6	104	1747	378	1083	1184	211	14.41	1.87	0.46	7.82	8.07	0.6	89.79	714.64	8.8465
14:13:38	1054.85	104	1769	376	1068	1178	182	14.44	1.85	0.5	7.76	8.02	0.52	87	714.91	8.8496
14:13:47	1055.1	104	1755	378	1083	1178	207	14.42	1.84	0.43	7.81	8.07	0.67	92.28	715.16	8.8527
14:13:58	1055.35	105	1758	381	1075	1174	189	14.45	1.84	0.4	7.79	8.07	0.52	86.14	715.39	8.8548
14:14:08	1055.6	105	1748	382	1042	1166	306	14.14	1.66	0.42	7.08	8	0.43	108.26	715.65	8.8573
14:14:18	1055.85	107	1564	391	917	978	138	13.4	1.62	0.36	6.82	6.98	0.55	87.36	715.9	8.8601
14:14:28	1056.1	107	1575	391	922	982	178	13.38	1.62	0.36	6.83	6.98	0.5	78.91	716.16	8.8632
14:14:51	1056.35	108	1359	382	764	827	259	13.08	1.51	0.37	6.18	6.42	0.69	38.15	716.33	8.8655
14:15:05	1056.6	105	1477	382	870	915	109	13.35	1.85	0.31	6.96	6.19	0.48	62.16	716.67	8.8713
14:15:24	1056.85	105	1475	384	853	923	130	13.28	1.84	0.38	5.98	6.55	0.66	66.18	716.92	8.8772
14:15:34	1057.1	105	1488	385	855	908	280	16.3	1.88	0.31	6.91	6.44	0.61	62.82	717.15	8.8815

DOE high power motor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1001.37			Bit Type =	Walker Ne	Dennalit MF68H											
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	360.77			Bit Nozzles =		9, 9, 13, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	55.22			Mud Weight (lbs/gal)		8.90											
Drillstring (ft) =	1971.36			Pipe (ft) =	662.66			Collar (ft)=	468.66								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	PIPE	FT/HR	OnBit	OnBit
14:18:04	1337.31	108	1356	392	732	846	219	15.89	2.17	0.75	6.32	6.76	0.93	24.2	717.36	5.5856
14:18:38	1337.56	107	1411	390	777	874	174	16.07	1.92	0.34	6.14	6.94	0.48	41.22	717.6	5.5859
14:19:55	1337.81	107	1384	391	751	821	129	16.03	1.85	0.3	6.18	6.36	0.45	31.09	717.86	5.5938
14:17:16	1336.56	106	1441	387	813	904	154	16.13	1.91	0.35	6.07	6.37	0.6	42.63	716.1	5.5796
14:17:31	1336.81	107	1472	388	838	894	134	16.19	1.85	0.33	6.02	6.27	0.53	57.17	716.36	5.5814
14:17:47	1336.56	107	1494	386	858	916	154	16.23	1.92	0.34	5.98	6.27	0.57	57.17	716.61	5.5795
14:18:00	1336.81	108	1505	387	870	956	142	16.26	1.94	0.4	5.94	6.18	0.53	68.03	716.85	5.5823
14:18:16	1339.56	108	1496	385	847	951	211	16.21	1.95	0.37	5.90	6.37	0.67	59.84	719.12	5.6035
14:18:46	1339.26	107	1390	391	738	842	190	15.99	2.28	1.02	6.32	6.75	0.96	27.33	718.96	5.6008
14:18:16	1336.45	108	1323	394	668	716	85	15.81	2.24	0.99	6.3	6.77	1.03	19.72	716.0	5.5931
14:18:46	1339.6	108	1327	395	676	716	85	15.84	2.28	0.94	6.27	6.77	1.05	48.13	716.65	5.5814
14:20:16	1339.77	108	1386	394	713	761	97	15.95	2.17	0.23	6.28	6.62	1.13	14.53	716.81	5.5837
14:20:46	1340.61	108	1392	393	730	886	156	16.02	2	0.52	6.18	6.61	0.74	29.06	720.06	5.605
14:21:04	1340.26	107	1490	390	827	951	211	16.14	1.85	0.33	6.06	6.3	0.57	46.23	720.3	5.6732
14:21:22	1340.51	108	1466	389	841	927	185	16.2	1.91	0.41	6	6.23	0.65	51.36	720.56	5.6761
14:21:39	1340.76	108	1480	389	857	927	170	16.26	1.92	0.4	5.94	6.2	0.57	65.57	720.8	5.6818
14:21:51	1341.01	105	1463	394	833	910	170	16.31	1.93	0.38	5.89	6.27	0.57	57.57	721.05	5.6661
14:22:09	1341.26	107	1441	398	813	906	174	16.13	1.82	0.35	6.07	6.37	0.62	49.38	721.32	5.6911
14:22:25	1341.49	108	1329	394	693	588	219	15.85	1.92	0.35	6.25	6.49	0.57	28.68	721.54	5.6795
14:23:09	1341.61	108	1279	396	651	892	85	15.89	1.88	0.3	6.3	6.7	0.67	16.37	721.67	5.6875
14:23:39	1341.75	108	1277	397	651	883	81	15.9	1.87	0.3	6.29	6.51	0.62	35.72	721.8	5.6902
14:24:09	1341.89	108	1276	395	650	704	108	15.9	1.89	0.3	6.29	6.49	0.58	37.58	721.95	5.6934
14:24:39	1342.03	108	1264	396	647	709	105	15.9	1.89	0.31	6.29	6.51	0.62	38.58	722.07	5.6929
14:25:09	1342.36	107	1361	398	751	856	283	16.05	2.3	0.99	6.17	6.82	1.36	28.01	722.31	5.6911
14:25:29	1342.51	108	1407	398	792	892	154	16.1	1.91	0.31	6.09	6.33	0.48	44.55	722.57	5.6886
14:25:49	1342.76	107	1429	399	812	931	190	16.12	1.92	0.36	6.08	6.32	0.53	45.57	722.8	5.6874
14:26:07	1342.91	108	1463	396	851	919	130	16.16	1.89	0.31	6.01	6.36	0.46	49.7	723.06	5.6874
14:26:21	1343.26	108	1487	398	874	931	101	16.22	1.9	0.31	5.97	6.32	0.57	52.1	723.31	5.6814
14:26:36	1343.61	108	1499	399	880	947	148	16.24	1.89	0.29	5.95	6.11	0.51	63.38	723.56	5.6854
14:26:50	1343.76	108	1499	399	879	975	227	16.24	1.89	0.34	5.95	6.25	0.62	63.81	723.8	5.6902
14:27:14	1344.01	107	1372	399	758	858	163	16.02	1.91	0.31	6.16	6.39	0.5	36.96	724.07	5.6974
14:27:39	1344.27	107	1426	395	813	871	271	15.1	1.89	0.35	7.09	8.16	2.47	36.36	724.32	9.6029
14:27:59	1344.52	108	1498	396	885	971	186	14.48	1.88	0.34	7.71	8	0.5	54.14	724.57	9.6073
14:28:13	1344.77	108	1505	397	914	983	146	14.54	1.88	0.36	7.66	7.85	0.46	56.11	724.82	9.6021
14:28:27	1345.02	108	1572	395	941	1032	178	14.55	1.91	0.32	7.64	7.85	0.43	61.21	725.19	9.6021
14:28:39	1345.27	104	1620	378	968	1080	142	14.67	1.92	0.34	7.53	7.8	0.52	72.21	725.31	9.0196
14:28:53	1345.52	105	1576	383	904	1145	490	14.55	1.85	0.35	7.6	8.04	0.89	72.98	725.56	9.103

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/96																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP08R												
Ending Depth =	1362.14			Bit Size =	6.75												
Total Depth Drilled =	330.87			Bit Nozzles =		8, 8, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	50.72			Mud Weight (lbs/gal)		8.90											
Drillstring (ft) =	1071.38			Pipe (ft) =	662.66			Collar (ft) =	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	Gs	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
14:29:22	1345.76	107	1408	391	748	821	103	14.26	2.21	0.89	7.9	8.76	1.08	28.93	725.61	0.1113
14:29:52	1345.97	106	1399	395	757	797	117	14.23	2.34	1.18	7.9	8.63	1.87	25.08	726.04	0.1158
14:30:22	1346.17	107	1369	391	783	777	55	14.28	2.23	0.74	7.81	8.76	1.75	23.33	726.21	0.1282
14:30:52	1346.41	107	1396	407	764	1085	449	14.31	2.28	1.16	7.88	8.76	1.7	28.8	726.46	0.1365
14:31:22	1346.67	105	1386	416	680	797	286	14.28	2.01	1.07	7.83	8.79	1.86	26.13	726.62	0.1448
14:31:52	1346.74	106	1382	408	703	813	195	14.26	2.4	1.4	7.83	8.83	1.86	26.05	726.78	0.1501
14:32:22	1346.91	106	1356	407	703	817	192	14.24	2.5	1.43	7.85	8.83	1.8	26.23	726.95	0.1616
14:32:52	1347.08	105	1348	408	697	801	190	14.26	2.59	1.58	7.93	8.76	1.68	20.62	727.12	0.1697
14:33:22	1347.24	105	1344	406	693	815	223	14.26	2.36	1.25	7.93	8.87	2.03	19.1	727.31	0.179
14:33:52	1347.4	107	1363	405	709	828	215	14.28	2.06	1.7	7.81	8.79	1.8	19.66	727.45	0.1866
14:34:22	1347.58	106	1362	407	716	813	194	14.28	2.53	1.41	7.81	8.96	1.75	23.63	727.63	0.1948
14:40:05	1347.82	106	959	392	-24	-13	20	20.4	1.87	0.3	2.99	10.53	9.69	84.16	727.87	0.2146
14:40:35	1348	106	1204	390	-27	-13	28	14.42	2.2	1.65	6.68	11.13	5.36	21.64	728.06	0.2226
14:41:05	1348.2	106	1336	397	-28	-9	36	14.24	1.85	0.27	8.17	9.36	0.43	24.27	728.26	0.2313
14:41:35	1348.43	106	1451	389	717	1247	1295	14.34	2.34	1.21	8.11	10.17	1.84	27.7	728.49	0.2396
14:41:55	1348.68	106	1511	385	686	1094	307	14.4	2.16	0.96	9.05	9.84	1.36	46.2	728.74	0.245
14:42:16	1349.03	106	1459	387	823	936	223	14.37	2.09	0.69	9.04	9.57	0.83	41.56	729.09	0.251
14:42:34	1349.19	105	1511	383	984	960	180	14.43	1.91	0.38	9.03	9.35	0.5	52.31	729.23	0.2552
14:42:53	1349.44	105	1520	386	980	1256	271	14.43	1.91	0.36	9.03	9.31	0.83	46.78	729.48	0.2613
14:43:10	1349.93	105	1527	384	880	975	175	14.44	1.96	0.4	9.01	9.28	0.65	53.35	729.71	0.2659
14:43:28	1349.94	106	1515	387	870	975	227	14.43	1.96	0.48	9.02	9.21	0.56	46.11	729.98	0.271
14:43:51	1350.19	107	1491	388	812	910	170	14.37	2.47	1.23	9.03	10.15	1.91	56.58	730.23	0.2773
14:44:13	1350.44	108	1501	390	862	971	239	14.37	2.29	1.13	9.06	10.25	2.06	40.1	730.48	0.2826
14:44:42	1350.69	106	1471	396	804	983	267	14.35	2.31	1.21	9.11	10.34	2.29	31.25	730.73	0.2917
14:44:58	1350.84	105	1552	394	892	1526	281	14.46	2.06	0.85	8.93	9.77	1.91	55.15	730.88	0.2965
14:45:16	1351.19	106	1640	385	899	1016	283	14.45	2.25	1.01	9	10.13	1.84	83.07	731.24	0.3061
14:45:34	1351.44	108	1658	387	911	1020	199	14.46	1.97	0.55	8.99	9.24	0.45	80.37	731.49	0.358
14:45:48	1351.69	108	1669	384	962	1077	198	14.52	1.99	0.32	8.93	9.19	0.48	80.75	731.74	0.3101
14:46:05	1351.94	104	1652	391	1008	1128	231	14.33	1.94	0.39	9.12	9.66	0.86	62.67	731.99	0.3214
14:46:14	1352.19	103	1753	378	1090	1335	313	14.09	1.86	0.31	8.36	9.65	0.57	86.18	732.25	0.3172
14:46:24	1352.44	104	1802	376	1137	1343	335	14.13	1.84	0.34	8.32	9.56	0.59	87.06	732.49	0.32
14:46:34	1352.69	104	1828	376	1139	1359	332	14.16	1.86	0.41	8.28	9.53	0.57	84.66	732.74	0.3256
14:46:42	1352.94	104	1784	380	1095	1305	404	14.12	2.01	0.48	8.33	9.67	0.62	107.04	733	0.3245
14:47:06	1353.19	108	1524	392	831	923	192	13.77	2.68	1.63	9.69	11.15	2.7	36.99	733.25	0.3518
14:47:36	1353.43	108	1467	398	775	829	118	13.66	2.67	1.87	9.76	11.18	2.61	28.84	733.49	0.3601
14:48:06	1353.66	107	1450	391	771	829	109	13.68	2.76	1.88	9.77	11.08	2.42	27.77	733.71	0.3684
14:48:36	1353.9	107	1483	398	818	1036	304	13.72	2.77	1.96	9.73	11.13	2.54	28.82	733.95	0.3767

DOE high power mortor test Amaco Catoosa Test Site

Well No. 22	Date: 2/28/96																
Starting Depth =	1031.37			Bit Type =	Walker McDonald MP88H												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	350.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	8.53			Mud Type =		Water Based											
Average ROP =	39.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.68			Collar (ft)=	408.68								

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	MOTOR LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
14:48:52	1354.15	105	1558	384	905	983	138	13.85	2.27	1.68	9.6	10.58	1.39	36.69	734.2	9.361
14:49:07	1354.9	105	1665	383	1008	1170	316	13.97	1.59	0.91	9.47	9.98	0.91	60.47	734.35	9.3655
14:49:17	1354.85	105	1769	381	1097	1210	166	14.1	2.04	0.56	9.35	9.88	1.01	66.82	734.73	9.3662
14:49:27	1354.9	104	1816	380	1131	1351	231	14.14	1.97	0.48	9.3	9.74	0.84	93.13	734.85	9.3767
14:49:37	1355.15	104	1810	385	1111	1273	275	14.15	2.64	0.68	9.3	9.98	1.32	86.6	735.02	9.3736
14:49:48	1355.4	103	1802	377	1105	1156	211	14.18	1.97	0.53	9.29	9.65	0.67	103.91	735.45	9.3762
14:49:57	1355.65	105	1782	386	1092	1210	307	14.13	1.92	0.43	9.34	9.67	0.69	83.65	735.7	9.376
14:50:07	1355.9	105	1774	384	1081	1186	166	14.09	1.84	0.44	9.28	9.72	0.67	85.5	735.95	9.3618
14:50:28	1356.16	105	1801	384	968	1126	204	13.95	1.94	0.44	9.42	9.74	0.57	63.13	736.2	9.3656
14:50:34	1356.41	107	1662	382	1003	1149	324	13.95	1.91	0.44	9.47	10.1	0.93	63.75	736.45	9.3589
14:50:48	1356.66	105	1650	383	971	1093	218	13.98	1.91	0.4	9.46	9.72	0.57	60.53	736.7	9.3825
14:50:58	1356.91	105	1689	382	1025	1193	229	14.04	1.95	0.45	9.41	9.72	0.57	72.75	736.97	9.3659
14:51:08	1357.16	103	1755	377	1090	1231	312	14.09	1.83	0.56	9.35	9.67	0.62	83.95	737.21	9.3591
14:51:18	1357.41	104	1815	378	1128	1256	280	14.17	1.9	0.34	9.27	9.79	0.77	96.66	737.46	9.4012
14:51:28	1357.66	105	1765	383	1075	1192	312	14.05	1.91	0.38	9.35	9.65	0.69	85.68	737.72	9.4036
14:51:48	1357.91	107	1678	380	976	1084	252	13.83	2.42	0.48	9.61	10.6	2.11	94.67	737.95	9.4021
14:52:10	1358.16	105	1516	382	820	921	162	13.75	2.42	1.3	9.7	10.7	1.81	35.96	738.2	9.416
14:52:35	1358.41	105	1523	385	830	992	162	13.74	2.47	1.36	9.7	10.75	2.05	30.6	738.46	9.4228
14:52:59	1358.66	105	1518	383	828	980	169	13.74	2.4	1.25	9.7	10.69	2.01	36.84	738.7	9.4291
14:53:21	1358.91	107	1576	381	896	1186	465	13.82	2.8	1.22	9.62	10.87	2.13	40.19	738.95	9.4358
14:53:31	1359.16	104	1743	375	1086	1186	353	14.11	1.94	0.48	9.39	9.84	0.67	92.1	739.2	9.4386
14:53:41	1359.41	105	1798	382	1113	1265	268	14.16	1.91	0.41	9.27	9.67	0.65	88.09	739.45	9.4411
14:53:50	1359.66	105	1820	384	1116	1223	223	14.2	1.83	0.47	9.24	9.6	0.72	105.2	739.72	9.4436
14:53:59	1359.91	104	1840	378	1144	1215	170	14.24	1.95	0.42	9.2	9.48	0.67	105.64	739.95	9.4404
14:54:09	1360.16	105	1758	383	1108	1184	162	14.16	1.94	0.53	9.35	9.88	0.77	90.37	740.21	9.4423
14:54:17	1360.42	103	1830	377	1150	1298	178	14.24	1.95	0.48	9.2	9.62	0.72	112.65	740.47	9.4513
14:54:28	1360.67	104	1801	378	1111	1262	223	14.18	1.86	0.5	9.26	9.65	0.69	89.75	740.74	9.4536
14:54:37	1360.92	105	1685	381	1018	1236	285	14.08	1.93	0.52	9.4	9.77	0.81	80.06	740.96	9.457
14:54:50	1361.17	106	1662	385	990	1214	459	13.99	1.96	0.5	9.44	9.81	0.79	69.61	741.21	9.4604
14:55:01	1361.42	105	1753	383	1046	1139	162	14.11	1.95	0.43	9.34	9.62	0.65	79.24	741.46	9.4625
14:55:17	1361.67	106	1820	383	1041	1012	293	13.8	1.97	0.42	9.64	9.81	0.69	35.76	741.71	9.4661
14:55:46	1361.92	108	1482	394	796	858	161	13.69	2.64	1.56	9.74	10.5	1.58	21.82	741.95	9.4764
14:56:14	1362.17	108	1483	393	801	868	113	13.69	2.66	1.71	9.74	10.7	1.8	21.68	742.23	9.4835
14:56:37	1362.42	107	1521	391	847	943	176	13.76	2.65	1.59	9.67	10.58	1.77	29.61	742.48	9.4903
14:56:57	1362.67	107	1558	391	891	991	117	13.83	2.5	1.45	9.6	10.36	1.86	36.39	742.71	9.4959
14:57:12	1362.92	107	1579	389	913	1012	166	13.89	1.94	0.44	9.54	9.64	0.53	59.31	742.97	9.4996
14:57:31	1363.17	108	1538	391	896	1000	186	13.84	1.87	0.33	9.56	9.61	0.45	46.65	743.22	9.5001

DOE high power mortor test Amaco Catoosa Test Site

Well No. 25	Date: 3/28/98																
Starting Depth =	1031.27			Bit Type =	Walker McDonald MP65H												
Ending Depth =	1902.14			Bit Size =	4.75												
Total Depth Drilled =	870.87			Bit Nozzles =		9, 9, 13, 13											
Hours On Bit =	9.83			Mud Type =		Water Based											
Average ROP =	53.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	662.68			Collar (ft)=	408.68								
TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK Gs	DELTA Gs	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
14:57:52	1383.42	109	1503	398	834	1200	343	18.78	2.8	2.02	9.65	10.36	1.72	42.86	748.47	9.5111
14:58:20	1383.67	108	1477	396	797	854	117	18.35	2.96	2.5	10.16	11.3	2.3	51.34	749.72	9.5168
14:58:50	1383.89	109	1470	396	797	850	105	13.08	3.11	2.6	10.35	11.42	1.99	26.34	750.04	9.5271
14:59:17	1384.14	110	1461	395	804	854	98	13.08	3.2	2.63	10.36	11.56	2.99	58.79	744.19	9.5346
14:59:47	1384.4	110	1484	398	805	874	122	13.08	3.11	2.79	10.36	11.25	1.66	30.37	748.44	9.5423
15:00:12	1384.65	109	1500	399	824	898	136	13.11	3.07	2.72	10.32	11.36	2.16	35.4	744.03	9.5501
15:00:35	1384.9	108	1492	392	820	894	117	13.11	3.06	2.68	10.32	11.39	1.99	38.71	744.64	9.5564
15:01:04	1385.15	108	1479	394	818	878	117	13.08	3.13	2.68	10.34	11.11	1.63	32.46	746.19	9.5641
15:01:29	1385.4	108	1473	395	818	874	97	13.08	3.2	2.68	10.35	11.2	1.86	35.32	746.45	9.5712
15:01:54	1385.65	108	1486	392	833	910	134	13.1	3.1	2.56	10.33	11.32	1.82	36.04	745.68	9.5781
15:02:20	1385.9	108	1483	393	832	896	122	13.08	3.24	2.67	10.34	11.47	2.06	33.86	746.56	9.5852
15:02:45	1386.15	108	1485	393	835	878	93	13.08	3.3	5	10.34	11.37	1.8	36.5	748.19	9.5925
15:03:15	1386.4	107	1471	391	826	879	109	13.09	3.3	2.64	10.36	11.2	1.68	30	746.44	9.6006
15:03:43	1386.65	107	1461	393	818	882	105	13.09	3.39	3.15	10.37	11.47	2.01	32.32	746.69	9.6083
15:04:12	1386.9	107	1475	391	826	893	122	13.09	3.34	3.12	10.36	11.32	1.77	30.68	748.94	9.6159
15:04:43	1387.15	107	1474	390	831	898	113	13.07	3.33	3.14	10.35	11.39	1.83	32.14	747.16	9.6234
15:05:08	1387.4	107	1461	389	814	874	109	13.04	3.31	3.13	10.37	11.32	1.84	32.36	747.48	9.631
15:05:35	1387.65	107	1460	391	816	870	101	13.05	3.32	3.09	10.37	11.38	2.04	27.63	747.68	9.6418
15:06:06	1387.89	107	1469	391	833	878	101	13.05	3.25	2.98	10.37	11.39	2.02	32.02	747.62	9.6489
15:06:25	1388.15	108	1469	392	816	886	130	13.05	3.53	3.31	10.35	11.68	2.34	31.06	749.17	9.6558
15:07:05	1388.38	108	1476	395	818	888	117	13.02	3.17	2.98	10.36	11.39	2.27	30.23	748.42	9.6648
15:07:31	1388.63	108	1476	393	824	870	89	13.06	3.24	3.13	10.36	11.54	2.13	34.42	748.68	9.6719
15:08:01	1388.87	108	1461	393	836	858	93	13.06	2.95	2.84	10.35	11.06	1.68	28.18	748.91	9.6801
15:08:26	1389.13	108	1472	391	822	886	85	13.05	3.22	2.94	10.37	11.3	1.77	32.83	749.17	9.6875
15:08:57	1389.38	107	1462	391	816	868	93	13.05	3.29	2.94	10.36	11.54	2.2	31.76	749.44	9.6956
15:09:28	1389.63	107	1466	390	822	878	105	13.05	3.32	2.94	10.36	11.5	1.82	30.95	749.69	9.7036
15:09:52	1389.88	107	1463	390	814	878	117	13.05	3.05	2.81	10.38	11.2	1.56	35.02	749.92	9.711
15:10:21	1390.13	108	1461	393	810	862	97	13.06	3.03	2.81	10.35	11.15	1.46	31.45	750.17	9.7191
15:10:47	1390.38	107	1472	391	826	898	122	13.06	3.16	2.7	10.34	11.3	1.77	38.51	750.42	9.7262
15:11:14	1390.63	108	1469	393	817	862	101	13.05	3.06	2.5	10.34	11.2	1.58	32.74	750.67	9.734
15:11:41	1390.88	109	1480	396	814	870	105	13.05	2.93	2.36	10.34	11.54	1.98	33.01	750.94	9.7414
15:12:07	1391.13	108	1468	393	826	874	105	13.05	3.08	2.81	10.34	11.33	1.65	24.37	751.19	9.7486
15:12:36	1391.38	109	1473	395	830	908	134	13.05	2.94	2.72	10.34	11.04	1.34	32.45	751.43	9.7555
15:13:01	1391.63	108	1462	396	840	935	162	13.07	3.02	2.46	10.33	11.08	1.48	35.24	751.68	9.7628
15:13:26	1391.88	108	1469	395	822	882	109	13.07	2.86	2.2	10.34	11.11	1.48	36.38	751.93	9.7701
15:13:53	1392.13	108	1464	396	817	874	97	13.06	2.67	1.85	10.34	10.85	1.01	33.78	752.18	9.7781
15:14:17	1392.38	108	1462	394	823	882	113	13.07	1.49	0.37	10.33	10.75	0.85	37.14	752.43	9.7847

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/26/08																
Starting Depth =	1321.27			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1362.14			Bit Size =	4.75												
Total Depth Drilled =	990.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	63.72			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1071.36			Pipe (ft) =	962.68			Collar (ft)=	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	On Bit
15:14:42	1372.63	108	1447	384	838	878	97	13.05	1.89	0.36	10.32	10.87	0.79	30.66	752.68	9.7915
15:15:04	1372.85	108	1467	393	858	915	113	13.09	2.81	2.19	10.31	11.2	1.68	40.8	752.94	9.7578
15:15:28	1373.13	107	1459	391	851	906	109	13.07	2.85	2.22	10.32	11.32	1.84	37.02	753.17	9.8544
15:15:54	1373.36	107	1459	391	857	923	128	13.07	2.89	2.06	10.81	11.32	1.94	35.91	753.36	9.8116
15:16:19	1373.63	108	1459	393	821	856	138	13.05	2.86	2.09	10.24	11.11	1.48	39.77	753.63	9.8185
15:16:46	1373.84	110	1461	398	726	825	143	12.97	2.25	0.58	10.42	10.72	0.77	24.63	753.85	9.8269
15:17:19	1374.03	108	1461	384	777	874	169	12.98	2.83	2.15	10.41	11.2	1.56	32.76	754.07	9.8351
15:17:43	1374.35	107	1469	390	834	850	169	13.07	2.89	2.12	10.81	11.61	2.42	47.82	754.33	9.8417
15:18:05	1374.63	107	1463	388	828	907	251	13.07	2.76	2.15	10.33	11.39	1.84	38.98	754.62	9.8491
15:18:29	1374.78	107	1515	391	878	983	178	13.11	2.7	1.87	10.35	11.32	1.82	44.4	754.83	9.8548
15:18:36	1376.03	105	1515	385	879	1500	211	11.06	2.66	2.25	11.74	13.86	4.84	95.03	755.08	9.882
15:18:19	1375.28	105	1539	384	912	1508	162	11.03	2.82	2.27	12.36	13.66	2.6	38.04	755.53	9.8586
15:19:41	1376.53	106	1538	386	883	963	134	11.04	2.83	2.02	12.37	13.89	2.73	36.8	755.56	9.8748
15:20:07	1376.78	106	1573	387	911	1089	251	11.04	3.07	2.49	12.36	14.27	3.42	34.93	755.82	9.882
15:20:28	1376.03	106	1554	388	918	1073	231	11.05	3.18	2.48	12.35	14.34	3.57	46.98	756.05	9.8879
15:20:52	1376.28	107	1524	389	893	1117	365	10.98	3.23	2.76	12.42	14.15	3.83	34.74	756.22	9.8844
15:21:22	1376.41	109	1512	390	782	955	239	10.97	2.82	2.25	13.53	13.14	1.72	16.91	756.46	9.909
15:21:52	1376.63	108	1546	393	828	970	182	10.99	2.44	1.44	12.46	13	0.98	26.25	756.69	9.9113
15:22:22	1376.78	108	1537	395	715	820	255	12.45	2.09	0.53	10.94	12.75	2.51	17.64	756.82	9.9198
15:22:53	1376.88	110	1508	399	694	748	161	12.8	1.52	0.36	10.58	10.88	0.57	9.4	756.9	9.9279
15:23:22	1376.93	109	1507	397	703	871	332	12.82	2.23	1.16	10.58	11.11	1.17	8.67	756.97	9.9363
15:23:48	1377.18	107	1503	395	870	1064	196	12.92	2.85	2.85	10.48	13.48	3.8	87.97	757.23	9.9423
15:24:14	1377.43	109	1468	395	784	858	211	12.81	2.17	0.84	10.57	10.98	0.81	32.25	757.48	9.9505
15:24:44	1377.58	108	1539	394	785	865	134	13.74	2.69	0.67	10.84	10.92	0.6	17.66	757.63	9.9566
15:25:14	1377.7	104	1503	398	681	766	158	12.7	1.02	0.37	10.88	10.98	0.58	15.26	757.75	9.9671
15:25:46	1377.9	107	1464	401	765	935	304	13.8	2.86	2.44	10.58	11.71	2.16	23.25	757.95	9.9753
15:26:07	1378.15	107	1497	399	696	835	139	12.89	2.76	2.05	10.49	11.9	2.83	38.49	758.2	9.982
15:26:31	1378.4	108	1502	392	696	815	120	12.81	2.72	1.84	10.47	11.79	2.97	36.83	758.45	9.9889
15:27:01	1378.59	109	1465	397	737	880	251	12.79	2.58	1.71	10.63	11.33	1.44	22.86	758.64	9.9965
15:27:27	1378.84	107	1468	398	649	843	199	12.86	2.87	3.03	10.52	13	4.67	54.3	758.88	10.0041
15:27:52	1379.09	107	1464	395	830	966	122	12.88	2.56	2.56	10.48	11.61	2.01	36.24	759.13	10.0111
15:28:15	1379.34	108	1482	392	835	923	158	12.87	3.18	2.01	10.51	11.59	1.65	38.01	759.38	10.0176
15:33:31	1379.57	108	1165	416	809	781	337	17.19	2.84	3.39	6.68	11.55	11.75	34.3	759.6	10.0236
15:32:51	1379.79	107	1385	417	729	781	184	14.92	2.81	3.23	9.87	11.42	3.11	33.38	759.8	10.0349
15:34:21	1379.69	108	1401	415	728	797	126	14.59	2.48	1.4	9.67	11.01	2.56	27.25	760.04	10.0453
15:34:51	1380.17	108	1337	420	646	740	194	13.98	2.52	1.76	9.91	11.56	3.65	21.16	760.21	10.0545
15:35:21	1380.24	107	1277	419	590	643	130	13.92	2.7	2.11	9.65	11.65	3.66	8.82	760.31	10.0635

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 3/26/96						
Starting Depth =	1031.27	Bit Type =	Walker McDonald MF 6RR				
Ending Depth =	1325.14	Bit Size =	4.75				
Total Depth Drilled =	293.87	Bit Nozzles =	8, 9, 12, 12				
Hours On Bit =	5.53	Mud Type =	Water Based				
Average ROP =	53.12	Mud Weight (lbs/gal)	8.61				
Drillstring (ft) =	1071.36	Pipe (ft) =	662.68	Collar (ft)=	408.68		

TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet OnBit	Hours OnBit
15:35:31	1380.29	107	1281	420	589	685	89	13.9	2.96	2.52	9.08	11.61	3.59	6.31	760.34	10.0564
15:36:21	1380.92	107	1289	419	591	631	81	13.86	3.05	2.76	10.01	11.63	3.61	3.25	760.39	10.07167
15:36:51	1380.34	107	1281	419	596	648	85	13.75	2.99	2.58	10.14	11.75	3.54	2.01	760.38	10.0805
15:37:21	1380.36	107	1283	423	589	1158	843	13.66	2.94	2.53	10.24	12.11	4.05	1.35	760.41	10.08633
15:37:50	1380.8	106	1274	411	514	1020	1046	13.43	3.11	2.97	10.46	11.85	2.82	31.25	760.68	10.10114
15:38:20	1380.75	106	1331	397	-18	-5	24	13.36	2.79	2.31	10.6	11.3	1.56	17.69	760.8	10.1087
15:38:50	1380.78	107	1322	391	-17	-5	26	13.3	2.75	1.97	10.59	11.44	1.77	4.35	760.83	10.1118
15:39:20	1380.51	108	1328	392	-16	-8	28	13.29	2.71	1.88	10.6	11.56	2.08	9.46	760.85	10.1263
15:39:50	1380.84	107	1330	388	-16	3	38	13.23	2.81	1.98	10.59	11.61	2.21	3.09	760.91	10.1346
15:40:20	1380.86	107	1348	393	-17	3	32	13.07	2.83	2.15	10.62	11.78	2.2	2.13	760.91	10.1425
15:40:50	1380.88	107	1362	388	-17	-5	24	13.01	2.84	2.27	10.68	11.63	1.84	3.26	760.92	10.1513
15:41:20	1380.9	106	1374	387	-16	-5	24	13	2.87	2.33	10.69	11.68	1.7	2.65	760.96	10.1595
15:41:50	1380.93	106	1414	388	-15	-5	28	13	3.03	2.58	10.83	11.46	1.83	3.57	760.99	10.1681
15:42:20	1380.92	105	1459	385	119	1459	1459	13.03	5.63	4.63	10.64	14.29	7.75	0.82	761.03	10.1764
15:42:50	1381.1	107	1320	388	20	593	573	13.1	3.27	3.48	10.78	12.61	5.61	21.78	761.06	10.1847
15:43:20	1381.15	107	1353	391	-16	-5	30	13.01	2.78	2.21	10.66	12.04	2.35	2.14	761.2	10.193
15:43:50	1381.16	107	1327	389	-14	-9	20	13.01	2.83	1.67	10.67	12.09	2.42	2.33	761.23	10.2013
15:44:20	1381.16	107	1328	391	-14	-1	26	13	2.87	1.67	10.67	12.03	2.79	1.93	761.24	10.2096
15:44:50	1381.16	107	1327	391	-14	7	41	13	2.93	1.68	10.67	12.23	2.73	0.82	761.24	10.2179
15:45:20	1381.2	108	1332	393	-14	-5	29	13	2.6	1.74	10.67	12.28	2.62	1.16	761.26	10.2263
15:45:50	1381.19	107	1318	391	246	1053	1116	13	3.93	3.47	10.69	13.66	3.66	7.07	761.28	10.2346
15:46:20	1381.21	108	1309	391	246	723	745	13	3.64	2.66	10.67	12.84	3.76	6.64	761.28	10.2429
15:46:50	1381.23	107	1321	390	-16	-5	24	13	3.13	2.57	10.67	11.89	2.18	1.47	761.28	10.2513
15:47:20	1381.23	108	1321	391	-15	-5	28	13	3.06	3.19	10.67	11.84	3.18	0.53	761.29	10.2596
15:47:50	1381.16	108	1323	420	414	1522	1546	13	3.44	3.67	10.67	12.97	4.4	4	761.31	10.2681
15:48:20	1381.18	107	1316	445	721	787	146	12.69	3.03	3.63	11.18	13.52	5.05	2.36	761.31	10.2764
15:48:50	1381.21	107	1322	445	747	821	165	12.41	3.07	3.96	11.46	13.6	4.62	3.69	761.33	10.2847
15:49:20	1381.23	107	1358	444	756	820	146	12.43	3.15	4	11.46	13.52	4.28	2.67	761.33	10.293
15:49:50	1381.27	106	1408	442	803	1024	965	12.46	3.84	3.7	11.44	13.29	8.53	5.26	761.33	10.3013
15:50:20	1381.28	106	1305	440	772	983	930	12.47	3.13	2.65	11.45	13.5	8.35	12.74	761.43	10.3096
15:50:50	1381.41	107	1317	446	855	743	108	12.43	3.08	2.74	11.45	13.67	4.64	3.67	761.46	10.3179
15:51:20	1381.44	107	1321	445	859	767	136	12.42	3.2	2.75	11.45	13.74	4.67	3.11	761.49	10.3262
15:51:50	1381.46	107	1321	446	868	767	132	12.41	3.15	2.77	11.46	13.67	4.64	2.8	761.5	10.3345
15:52:20	1381.48	108	1315	446	866	769	166	12.42	3.13	2.8	11.46	13.74	4.72	2.38	761.56	10.3428
15:52:50	1381.5	108	1310	446	878	748	138	12.41	3.2	2.86	11.46	13.67	4.72	2.97	761.58	10.3514
15:53:20	1381.52	107	1311	447	873	744	138	12.41	3.17	3.04	11.46	13.47	4.62	2.36	761.58	10.3597
15:53:50	1381.54	107	1315	447	873	749	138	12.41	3.15	2.98	11.46	13.51	4.63	2.28	761.61	10.368

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/25/96																
Starting Depth =	1301.27			Bit Type =	Walker McDonald MP6(R)												
Ending Depth =	1382.14			Bit Size =	4.75												
Total Depth Drilled =	380.87			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	6.53			Mud Type =		Water Based											
Average ROP =	53.73			Mud Weight (lbs/gal)		8.60											
Drillstring (ft) =	1071.58			Pipe (ft) =	662.08			Collar (ft)=	408.88								

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
15:54:20	1301.58	108	1234	449	668	757	134	12.42	3.2	2.6	11.44	13.64	4.5	2.46	761.91	10.3764
15:54:50	1301.58	107	1458	447	850	2543	2107	12.5	8.81	8.23	11.38	13.67	4.93	3.28	761.66	10.3847
15:55:20	1301.58	108	1365	451	678	1324	856	12.72	5.1	2.84	11.14	13.45	5.58	11.51	761.74	10.383
15:55:50	1301.71	107	1303	446	661	736	162	12.53	3.25	3.05	11.38	13.45	4.43	8.13	761.77	10.4013
15:56:20	1301.73	107	1288	447	638	728	158	12.53	3.24	3.15	11.38	13.46	4.52	2.63	761.79	10.4056
15:56:50	1301.75	108	1293	449	647	716	142	12.53	3.21	3.01	11.33	13.45	4.62	2.21	761.83	10.4179
15:57:20	1301.77	108	1306	448	658	724	156	12.53	3.36	3.42	11.33	13.46	4.52	3.46	761.83	10.4288
15:57:50	1301.78	108	1302	449	658	720	134	12.53	3.35	3.24	11.35	13.52	4.57	2.52	761.85	10.4345
15:58:20	1301.82	108	1312	449	664	744	160	12.53	3.31	2.65	11.33	13.53	4.31	3.22	761.89	10.4401
15:58:50	1301.84	107	1314	447	661	740	160	12.52	3.14	2.9	11.34	13.38	4.38	2.5	761.89	10.4514
15:59:20	1301.86	107	1307	448	658	736	126	12.53	3.36	3.26	11.33	13.38	4.31	2.63	761.91	10.4567
15:59:50	1301.88	108	1308	449	659	724	134	12.53	3.13	2.89	11.33	13.33	4.31	2.57	761.95	10.466
16:00:20	1301.9	108	1302	451	642	704	142	12.53	3.25	3.04	11.33	13.46	4.45	2.09	761.95	10.4763
16:00:50	1301.91	109	1299	451	633	704	108	12.52	3.22	3.19	11.34	13.46	4.52	1.42	761.97	10.4845
16:01:20	1301.93	108	1293	449	634	712	142	12.52	3.15	2.87	11.34	13.46	4.57	2.13	762.01	10.4926
16:01:50	1301.96	107	1286	447	630	708	134	12.53	3.36	3.19	11.38	13.45	4.45	2.04	762.02	10.5013
16:02:20	1301.96	107	1287	447	624	696	150	12.51	3.26	3.18	11.34	13.5	4.48	2.18	762.02	10.5096
16:02:50	1301.97	107	1278	448	623	704	166	12.51	3.02	3.14	11.34	13.6	4.79	0.68	762.02	10.5179
16:03:20	1301.98	107	1279	446	621	684	130	12.51	3.23	2.89	11.34	13.57	4.73	1.27	762.04	10.5262
16:03:50	1301.99	107	1291	446	623	694	138	12.51	3.17	2.85	11.34	13.52	4.62	1.41	762.04	10.5345
16:04:20	1302	108	1286	448	628	696	150	12.5	3.1	2.96	11.35	13.55	4.72	1.13	762.06	10.5431
16:04:50	1302.02	108	1289	449	633	702	146	12.5	3.12	2.98	11.35	13.62	4.93	1.41	762.06	10.5514
16:05:20	1302.03	108	1289	449	634	692	136	12.5	3.22	3.12	11.35	13.65	4.79	1.03	762.06	10.5597
16:05:50	1302.04	107	1288	448	629	698	142	12.5	3.17	3.08	11.34	13.6	4.86	1.05	762.1	10.568
16:06:20	1302.05	107	1286	447	633	686	134	12.5	3.18	3.01	11.34	13.55	4.81	1.48	762.1	10.5763
16:06:50	1302.06	107	1286	447	628	686	130	12.5	3.25	3.03	11.34	13.56	4.48	1.04	762.12	10.5846
16:07:20	1302.07	107	1286	446	625	682	138	12.49	3.08	2.93	11.35	13.62	4.67	1.51	762.12	10.5929
16:07:50	1302.09	108	1292	449	624	688	130	12.5	3.14	3.01	11.34	13.65	4.76	1.85	762.15	10.6012
16:08:20	1302.1	108	1284	448	623	688	130	12.49	3.09	3.11	11.35	13.62	4.81	1.39	762.15	10.6095
16:08:50	1302.11	107	1282	447	625	680	117	12.5	3.34	3.43	11.34	13.69	5.13	1.74	762.17	10.6178
16:09:20	1302.12	107	1282	447	624	688	126	12.49	3.26	3.24	11.34	13.67	5.07	1.1	762.17	10.6264
16:09:50	1302.13	108	1285	450	622	680	122	12.5	3.34	3.24	11.34	13.64	5.07	1.71	762.2	10.6347

DOE high power mortar test Amaco Catoosa Test Site

Well No. 23	Date: 9/27/96																
Starting Depth =	1362.40			Bit Type =	Walker McDonald MF 63H												
Ending Depth =	1450.02			Bit Size =	4.75												
Total Depth Drilled	87.62			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	9.73			Mud Type =		Water Based											
Average ROP =	11.80			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1418.60			Pipe (ft) =	1010.83				Collar (ft) =	438.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	On Bit	
7:46:30	1362.4	103	1218	395	90	106	24	14.6	1.93	0.22	7.14	10.24	10.46	21.68	762.45	10.6477	
7:46:58	1362.41	108	1369	393	92	104	24	11.81	1.89	0.38	10.14	10.24	0.36	1.95	762.45	10.6508	
7:47:50	1362.44	110	1406	401	314	1355	1256	11.72	3.7	3.87	10.24	12.57	5.17	34.12	762.51	10.6727	
7:48:26	1362.46	109	1415	396	91	104	26	11.46	3.31	2.92	10.48	12.47	4.07	1.98	762.51	10.6803	
7:48:50	1362.47	110	1417	399	91	104	24	11.47	3.05	2.61	10.48	12.62	3.66	1.25	762.51	10.6839	
7:49:20	1362.47	110	1428	400	92	104	24	11.48	3.1	2.64	10.48	12.5	4.69	0.64	762.53	10.6879	
7:49:50	1362.48	109	1419	397	92	104	26	11.47	3.16	2.6	10.48	12.5	4	1.41	762.53	10.7003	
7:50:20	1362.49	108	1407	396	94	104	24	11.47	2.99	2.52	10.48	12.18	3.69	1.03	762.57	10.7145	
7:50:50	1362.5	111	1401	402	92	104	24	11.48	3.12	2.78	10.48	12.4	3.68	1	762.57	10.7206	
7:51:20	1362.52	109	1399	397	94	108	26	11.48	3.15	2.64	10.47	12.5	4.17	1.66	762.57	10.7311	
7:51:50	1362.52	110	1398	399	94	104	24	11.48	2.98	2.48	10.47	12.4	3.9	0.56	762.57	10.7394	
7:52:20	1362.53	110	1401	399	95	108	26	11.5	2.91	2.37	10.48	12.23	3.78	0.6	762.57	10.7477	
7:52:50	1362.54	109	1398	398	94	108	26	11.5	3.04	2.56	10.48	12.54	4.06	1.2	762.59	10.756	
7:53:20	1362.55	109	1397	398	95	108	26	11.5	3.04	2.53	10.45	12.45	4.09	1.22	762.61	10.7643	
7:53:50	1362.56	110	1403	398	96	108	26	11.51	2.97	2.52	10.44	12.35	3.78	1.05	762.61	10.7726	
7:54:20	1362.56	110	1409	399	94	108	26	11.51	3.01	2.42	10.44	12.26	3.69	0.84	762.61	10.7813	
7:54:50	1362.57	109	1410	397	95	108	26	11.51	3.05	2.6	10.44	12.35	3.95	0.76	762.64	10.7905	
7:55:20	1362.58	109	1416	396	95	108	26	11.52	2.85	2.45	10.43	12.26	3.68	0.73	762.64	10.7975	
7:55:50	1362.58	110	1422	398	95	112	29	11.52	2.84	2.39	10.43	12.3	3.8	1.01	762.64	10.8061	
7:56:20	1362.58	109	1424	397	94	108	26	11.52	2.89	2.21	10.42	12.23	3.81	1.3	762.64	10.8148	
7:56:50	1362.6	110	1429	394	94	104	24	11.52	2.87	2.25	10.42	12.16	3.54	0.62	762.66	10.8228	
7:57:20	1362.61	110	1429	399	95	108	26	11.53	2.78	2.09	10.42	11.96	3.23	0.65	762.66	10.8311	
7:57:50	1362.62	110	1429	401	95	104	24	11.53	2.83	2.11	10.42	12.18	3.73	1.44	762.68	10.8398	
7:58:20	1362.63	108	1412	395	95	108	26	11.53	3	2.44	10.42	12.39	3.9	1.16	762.68	10.8477	
7:58:50	1362.64	107	1413	390	93	108	26	11.52	2.91	2.39	10.42	12.14	3.82	1.58	762.68	10.8566	
7:59:20	1362.65	108	1457	395	95	108	24	9.78	2.65	2.36	12.17	14.31	5.51	1.78	762.72	10.8648	
7:59:50	1362.67	108	1466	393	95	108	26	9.91	2.63	1.71	12.94	14.22	2.58	1.57	762.72	10.8729	
8:00:20	1362.68	108	1466	394	96	108	24	8.94	2.5	1.53	13.01	14.15	2.35	1.41	762.73	10.8812	
8:00:50	1362.7	108	1516	393	95	108	26	8.65	2.91	1.46	13	14.1	2.27	2.29	762.74	10.8905	
8:01:20	1362.72	109	1519	397	96	108	26	8.68	2.39	1.13	12.97	13.91	1.8	6.12	762.81	10.9078	
8:01:50	1362.78	110	1542	396	95	108	26	8.87	2.84	1.54	12.93	14.1	2.28	3.48	762.81	10.9261	
8:02:20	1362.8	110	1507	400	95	104	24	8.95	2.57	1.71	13	14.24	2.69	2.43	762.86	10.9349	
8:02:50	1362.82	109	1492	393	95	108	24	8.95	2.69	1.7	13	14.36	2.7	2.01	762.86	10.9423	
8:03:20	1362.83	109	1496	395	94	104	24	8.96	2.67	1.67	13	14.36	2.6	1.55	762.9	10.9331	
8:03:50	1362.85	110	1479	398	93	104	24	8.95	2.58	1.61	12.69	14.39	2.82	1.73	762.9	10.9189	
8:04:20	1362.86	108	1423	394	91	104	24	8.84	2.65	1.96	13	14.41	2.6	1.68	762.92	10.9477	
8:04:50	1362.86	110	1497	401	91	104	24	8.84	2.69	1.76	13	14.31	2.66	2.14	762.92	10.9563	

DOE high power mortor test Amaco Catoosa Test Site

Well No: 23	Date: 2/27/96			Bit Type =	Walker McDonald M76H												
Starting Depth =	1382.40			Bit Size =	4.75												
Ending Depth =	1450.90			Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled	67.50			Mud Type =		Water Based											
Hours On Bit =	6.73			Mud Weight (lbs/gal)		8.90											
Average ROP =	11.80			Pipe (ft) =	1010.82			Collar (ft)=	408.69								
Drillstring (ft) =	1419.50																
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	SPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	t's	t's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
8:05:20	1382.9	109	1511	395	96	104	28	8.84	2.65	1.68	13.01	14.22	2.47	2.4	762.94	10.9646
8:05:50	1382.52	109	1536	396	89	104	28	8.85	2.65	1.74	13	14.17	2.36	2.36	762.93	10.9729
8:06:20	1382.64	110	1496	401	68	100	24	8.64	2.58	2.58	13.01	14.24	2.53	2.61	762.93	10.9812
8:06:50	1382.85	111	1482	403	63	100	24	8.63	2.58	2.16	13.01	14.34	2.58	1.96	763	10.9895
8:07:20	1382.97	109	1479	398	68	100	28	8.83	2.62	2.21	13.02	14.36	2.78	2.04	763.02	10.9978
8:07:50	1382.98	108	1479	397	85	96	28	8.83	2.61	2.15	13.01	14.27	2.7	2.37	763.05	11.0061
8:08:20	1383	108	1476	394	85	96	24	8.82	2.63	2.18	13.02	14.36	2.78	1.35	763.06	11.0144
8:08:50	1383.03	109	1506	398	84	96	28	8.82	2.64	2.23	13.02	14.31	2.66	2.65	763.1	11.0227
8:09:20	1383.11	108	1457	394	302	1263	1211	8.97	5.81	5.76	11.96	16.08	10.7	8.96	763.17	11.031
8:09:50	1383.21	110	1368	404	1136	1364	320	14.15	3.81	3.84	7.81	10.27	5.28	10.83	763.27	11.0475
8:10:20	1383.33	110	1282	403	1061	1129	188	13.58	3.94	3.57	8.6	12.59	7.44	2.62	763.28	11.0562
8:10:50	1383.36	110	1282	403	1061	1129	188	13.58	3.94	3.57	8.6	12.59	7.44	2.62	763.28	11.0645
8:11:20	1383.36	110	1280	400	1018	1064	83	11.49	3.5	3.82	10.47	13	5.24	3.48	763.32	11.0728
8:11:50	1383.38	110	1284	400	995	1024	61	11.48	4.04	3.96	10.48	13.12	5.46	1.85	763.33	11.0728
8:12:20	1383.3	109	1356	396	1017	1077	109	10.95	3.63	3.6	11.01	14.43	6.89	2.58	763.36	11.0811
8:12:50	1383.32	110	1354	401	1056	1105	81	9.98	3.72	3.48	12.01	14.27	4.72	2.78	763.38	11.0895
8:13:20	1383.36	111	1366	404	1087	1113	85	9.98	3.48	3.31	11.99	14.27	4.81	3.24	763.41	11.0978
8:13:50	1383.4	109	1368	398	1097	1145	105	10	3.69	3.37	11.97	14.15	4.52	3.1	763.47	11.1061
8:14:20	1383.46	109	1432	397	1119	1166	98	10.01	3.22	2.65	11.98	13.55	3.33	6.83	763.51	11.1144
8:14:50	1383.54	106	1486	393	1141	1196	106	10.03	3.08	2.47	11.03	13.33	2.97	10.31	763.61	11.1227
8:15:20	1383.67	106	1482	398	1113	1165	101	10.05	3.29	2.79	11.94	13.5	3.38	8.36	763.66	11.131
8:15:50	1383.72	109	1474	395	1143	1188	101	10.04	3.01	2.42	11.92	13.26	2.85	12.04	763.77	11.1393
8:16:20	1383.84	108	1477	393	1139	1160	69	10.05	3.08	2.41	11.92	13.31	2.92	14.43	763.86	11.1476
8:16:50	1383.96	108	1482	395	1134	1182	89	10.05	2.99	2.31	11.91	13.4	3.11	13.93	763.96	11.1559
8:17:20	1384.05	109	1475	396	1118	1202	170	10.04	3	2.23	11.92	13.57	3.57	12.91	764.04	11.1642
8:17:50	1384.1	109	1430	398	1084	1292	211	10	3.35	2.64	11.96	13.86	4.02	6.92	764.15	11.1725
8:18:20	1384.13	110	1404	399	1043	1150	170	9.96	3.9	3.73	11.98	14.08	4.5	5.88	764.16	11.1811
8:18:50	1384.16	110	1391	400	1024	1112	142	9.98	4.13	4.15	11.98	14.18	4.5	3.24	764.23	11.1894
8:19:20	1384.19	109	1383	395	1011	1083	134	9.98	4	3.78	11.97	14.23	4.62	5.13	764.26	11.1977
8:19:50	1384.21	109	1378	398	1003	1068	113	9.97	4.04	3.87	11.98	14.34	4.76	2.42	764.26	11.206
8:20:20	1384.24	109	1370	397	994	1052	105	9.96	3.62	3.84	11.98	14.46	5	4.65	764.3	11.2143
8:20:50	1384.27	110	1367	400	989	1040	97	9.97	3.95	4.01	11.99	14.35	4.74	3.36	764.32	11.2227
8:21:20	1384.29	110	1371	402	987	1032	89	9.98	3.57	3.84	11.98	14.31	4.81	2.39	764.34	11.2310
8:21:50	1384.32	110	1383	398	991	1048	85	9.98	3.54	3.32	11.97	14.29	4.86	3.52	764.37	11.2396
8:22:20	1384.35	109	1390	396	990	1052	105	9.69	3.64	3.25	11.97	14.13	4.5	3.86	764.44	11.2479
8:22:50	1384.39	111	1383	402	971	1020	93	9.69	3.72	3.72	11.96	14.17	4.64	4.18	764.44	11.2562
8:23:20	1384.41	110	1351	401	961	1012	97	9.89	3.71	3.6	11.96	14.27	4.81	2.76	764.48	11.2645
8:23:50	1384.55	110	1342	401	1137	1800	672	10.09	3.52	3.13	11.98	13	4.81	16.27	764.61	11.2728

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/27/96						
Starting Depth =	1362.93	Bit Type =	Walker McDonald MP66H				
Ending Depth =	1460.68	Bit Size =	6.75				
Total Depth Drilled	67.62	Bit Nozzles =	8, 8, 12, 12				
Hours On Bit =	5.73	Mud Type =	Water Based				
Average ROP =	11.80	Mud Weight (lbs/gal)	8.33				
Drillstring (ft) =	1418.30	Pipe (ft) =	1013.62	Collar (ft)=	405.68		

TIME HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	ROCK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
8:26:20	1384.8	111	1400	405	1007	1121	186	10	3.74	3.09	11.95	14.17	4.74	9.04	764.58	11.28511
8:24:50	1384.63	111	1376	404	970	1044	138	9.99	3.84	3.9	11.96	14.29	5.07	3.5	764.58	11.20364
8:25:20	1384.67	110	1366	403	976	1060	130	9.96	3.98	3.82	11.96	14.19	4.84	4.06	764.71	11.29777
8:25:50	1384.75	111	1525	405	1187	3478	1855	10.07	4.85	5.25	11.87	14.1	4.57	13.46	764.86	11.3508
8:26:20	1385	110	1536	401	1186	1287	319	10.12	4.46	4.93	11.82	14.27	4.69	28.79	765.06	11.3143
8:26:50	1385.01	111	1452	405	1046	1182	176	10	3.39	3.58	11.95	13.79	4.09	7.98	765.12	11.3229
8:27:20	1385.13	110	1469	402	1120	1395	367	10.01	3.81	4.33	11.83	14.91	5.65	7.38	765.19	11.3312
8:27:50	1385.23	110	1500	401	1094	1214	168	10.02	4.55	5.54	11.82	14.34	4.98	12.84	765.28	11.3395
8:28:20	1385.26	111	1419	402	1012	1186	174	9.97	3.33	2.96	11.87	13.93	4.46	5.2	765.35	11.3478
8:28:50	1385.3	110	1383	401	973	1030	65	9.95	3.25	3.08	11.89	13.96	4.17	8.36	765.35	11.3561
8:29:20	1385.32	111	1378	404	958	1012	97	9.95	3.32	3.19	11.89	14.03	4.31	2.58	765.39	11.3645
8:29:50	1385.34	110	1366	396	952	960	91	9.95	3.36	3.3	11.89	13.91	4.07	1.55	765.39	11.3728
8:30:20	1385.35	110	1383	405	955	1030	85	9.94	3.42	3.31	12	14	4.26	1.8	765.43	11.3811
8:30:50	1385.38	111	1388	403	963	1012	83	9.93	3.43	3.45	12	13.93	4.07	2.8	765.43	11.3894
8:31:20	1385.4	110	1375	400	970	1013	89	9.94	3.35	3.18	12	13.96	4.14	2.04	765.45	11.3977
8:31:50	1385.43	109	1369	394	969	3048	109	9.94	3.46	3.27	12	13.91	4.02	2.89	765.48	11.406
8:32:20	1385.46	109	1408	397	1030	1038	117	9.95	3.31	3.03	11.98	13.91	3.95	3.45	765.51	11.4144
8:32:50	1385.5	110	1413	399	1026	1088	142	9.95	3.05	2.89	11.98	13.76	3.97	4.5	765.54	11.4227
8:33:20	1385.55	110	1398	400	983	1081	178	9.96	3.29	3.09	11.98	13.91	4.31	5.86	765.59	11.4312
8:33:50	1385.59	110	1357	398	938	1023	162	9.84	3.48	3.69	11.97	13.12	4.6	4.41	765.64	11.4395
8:34:20	1385.61	111	1337	402	915	979	117	9.84	3.78	3.67	11.98	14.19	4.56	2.58	765.67	11.4478
8:34:50	1385.63	110	1362	405	935	1004	113	9.85	3.68	3.45	11.98	14.03	4.28	2.76	765.68	11.4561
8:35:20	1385.66	110	1358	398	940	1016	134	9.84	3.7	3.73	11.98	13.98	4.09	3.75	765.71	11.4644
8:35:50	1385.68	110	1358	399	926	992	103	9.84	3.7	3.66	11.98	14.05	4.39	3.05	765.75	11.4727
8:36:20	1385.72	110	1357	399	923	971	93	9.93	3.29	3.46	12	14	4.31	3.97	765.79	11.481
8:36:50	1385.75	111	1363	403	923	962	105	9.94	3.78	3.74	11.99	13.93	4.12	3.16	765.79	11.4893
8:37:20	1385.78	109	1417	397	972	1065	120	9.94	3.49	3.29	11.98	13.79	3.85	3.47	765.82	11.4977
8:37:50	1385.84	110	1457	402	1005	1093	134	9.96	3.2	2.85	11.98	13.68	3.54	7.33	765.9	11.5061
8:38:20	1385.93	109	1570	398	1102	1425	468	10.02	3.95	3.69	11.9	14.46	5.03	11.16	766	11.5146
8:38:48	1386.16	109	1857	397	1167	3819	879	10.13	5.5	3.56	11.79	13.69	4.24	33.05	766.33	11.5228
8:39:18	1386.36	110	1869	408	1116	1302	154	10.05	2.78	2.08	11.86	13.24	2.68	24.62	766.43	11.5309
8:39:42	1386.57	109	1579	397	1110	1226	186	10.07	2.82	2	11.86	13.29	2.99	22.08	766.61	11.5385
8:40:18	1386.77	109	1547	398	1132	1243	223	10.07	2.81	1.84	11.84	13.24	2.93	23.86	766.82	11.5469
8:40:48	1386.88	109	1476	397	1014	1097	142	10	3.12	2.68	11.92	13.58	3.47	13.81	766.88	11.5552
8:41:18	1386.99	110	1478	408	1017	1085	136	9.98	3.18	2.67	11.94	13.6	3.45	12.71	767.04	11.5636
8:41:48	1387.19	109	1647	396	1108	2207	1864	10.1	2.56	2.32	11.82	13.5	3.23	24.24	767.24	11.5721
8:42:18	1387.4	110	1576	400	1092	1396	304	10.05	2.77	2.36	11.85	13.38	3.09	25.32	767.46	11.5804

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 9/27/88																
Starting Depth =	1382.40			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1450.02			Bit Size =	4.75												
Total Depth Drilled	67.62			Bit Nozzles =		8, 9, 12, 12											
Hours On Bit =	5.73			Mud Type =		Water Based											
Average ROP =	11.80			Mud Weight (lbs/gal)		8.35											
Drillstring (ft) =	1418.59			Pore (ft) =	1310.82				Collar (ft)=	403.60							

TIME	BIT DEPTH	SLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	SPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
8:42:48	1387.62	111	1607	402	1122	1231	211	10.06	2.78	1.91	11.84	13.86	3.09	26.59	767.87	11.5368
8:43:18	1387.77	111	1481	402	1061	1145	273	10	3.42	3.12	11.92	13.69	3.81	17.98	767.85	11.5971
8:43:48	1387.61	109	1436	397	957	1133	263	9.96	3.66	3.22	11.88	13.72	3.73	4.75	767.68	11.6054
8:44:18	1388	108	1554	399	1163	1296	178	10.05	2.75	2.06	11.85	13.31	2.75	23.61	768.08	11.6137
8:44:48	1388.22	110	1553	401	1087	1247	251	10.06	2.95	2.43	11.85	13.69	2.78	26.5	768.27	11.622
8:45:18	1388.31	110	1415	402	953	1086	154	9.96	3.33	3.12	11.85	13.48	3.29	10.33	768.36	11.6303
8:47:01	1388.38	107	1286	391	937	1050	358	11.15	3.44	3.28	16.75	13.84	15.61	25.39	768.46	11.6445
8:47:31	1388.43	108	1361	392	953	1012	113	9.82	3.31	3.02	11.86	13.81	4.12	6.35	768.48	11.6532
8:48:01	1388.48	108	1365	393	942	1004	117	9.83	3.44	3.21	11.87	13.83	4.14	6.2	768.57	11.6615
8:48:31	1388.53	108	1358	394	946	1012	134	9.94	3.48	3.16	11.88	13.88	3.93	5	768.58	11.6698
8:49:01	1388.58	105	1571	385	1141	2312	1580	10.06	3.1	2.58	11.84	13.56	3.62	15.02	768.73	11.6781
8:49:31	1388.93	106	1534	385	1102	1265	312	10.08	3.52	2.61	11.82	13.68	3.66	20.75	768.97	11.6864
8:50:01	1388.99	107	1369	390	957	1016	117	9.96	3.51	3.28	11.85	13.81	3.85	7.81	769.04	11.6945
8:50:31	1389.05	106	1382	392	960	1020	117	9.94	3.42	3.19	11.86	13.82	3.49	6.72	769.09	11.7028
8:51:01	1389.11	106	1371	392	966	1020	101	9.95	3.62	3.62	11.99	13.88	3.84	6.68	769.16	11.7111
8:51:31	1389.18	108	1362	394	966	1006	97	9.95	3.18	2.88	11.96	13.78	3.97	8.06	769.21	11.7195
8:52:01	1389.19	108	1359	394	952	1012	109	9.94	3.18	2.78	11.96	13.69	3.61	4.94	769.28	11.7278
8:52:31	1389.25	108	1356	392	952	1008	142	9.96	3.15	2.51	11.95	13.57	3.52	7.02	769.3	11.7361
8:53:01	1389.44	107	1528	391	1169	1828	244	10.08	3	2.56	11.84	13.26	3.08	22.15	769.48	11.7445
8:53:31	1389.53	107	1481	391	1054	1154	162	10.02	3.09	2.61	11.88	13.22	3.04	10.78	769.55	11.7528
8:54:01	1389.7	106	1476	388	1043	1125	150	10.01	3.15	3.05	11.98	13.28	3.89	13.32	769.78	11.7611
8:54:31	1389.76	107	1433	391	1016	1158	174	9.96	3.39	3.1	11.93	13.36	3.64	6.47	769.81	11.7695
8:55:01	1389.89	107	1507	389	1095	1158	148	10.02	3.07	2.16	11.87	13.02	2.54	15.56	769.95	11.7781
8:55:31	1390.13	107	1391	389	1177	1380	322	10.1	2.7	2.05	11.79	13.09	3.5	29.59	770.2	11.7867
8:56:01	1390.38	107	1389	391	1246	2583	1750	10.14	2.97	2.24	11.75	13.29	3.64	30.33	770.44	11.7937
8:56:31	1390.53	110	1378	402	934	1502	782	11.07	4.58	4.3	16.82	13.48	7.54	18.9	770.58	11.803
8:57:01	1390.62	108	1389	395	1074	1388	494	10.78	3.71	3.67	11.11	13.48	4.67	11.57	770.67	11.8113
8:57:31	1390.86	108	1314	394	1062	1278	316	10.83	3.57	3.48	11.06	13.17	4.09	36.87	770.9	11.8196
8:58:01	1391.09	111	1310	398	887	979	158	10.7	4.03	4.45	11.18	13.96	5.6	9.95	770.95	11.8279
8:58:31	1391.32	111	1266	403	827	932	105	10.13	4.31	4.69	11.73	14.55	6.19	2.52	770.98	11.8363
8:59:01	1391.33	108	1319	393	827	1012	148	9.87	4.1	4.53	11.92	14.33	5.07	1.67	770.98	11.8446
8:59:31	1391.87	108	1391	394	1008	1137	319	10	3.44	3.2	11.89	13.75	3.93	4.76	771.04	11.8529
9:00:01	1391.98	107	1437	391	1048	1118	126	10.03	2.69	2.37	11.85	13.38	3.06	11.07	771.11	11.8613
9:00:31	1391.11	107	1436	388	1015	1101	120	10.03	2.84	2.45	11.86	13.31	3.26	12.88	771.25	11.8696
9:01:01	1391.26	107	1395	390	990	1064	138	10.02	3.36	2.65	11.87	13.43	3.59	10.84	771.32	11.8781
9:01:31	1391.34	107	1381	391	987	1038	105	10	3.08	2.86	11.88	13.5	3.84	8.3	771.39	11.8864
9:02:01	1391.41	108	1367	394	956	1008	105	10	3.19	2.81	11.88	13.72	3.97	8.49	771.46	11.8947

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/00																
Starting Depth =	1382.40			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1450.02			Bit Size =	4.75												
Total Depth Drilled	67.62			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	5.73			Mud Type =		Water Based											
Average ROP =	11.80			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1419.50			Pipe (ft) =	1010.82			Collar (ft)=	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled	
9:02:31	1391.47	107	1363	391	956	1004	48	9.98	3.37	3.08	11.8	13.09	3.69	7.1	771.91	11.582	
9:03:01	1391.62	108	1387	391	927	1005	122	9.98	3.84	3.74	11.8	14	4.28	6.31	771.58	11.8113	
9:03:31	1391.85	109	1398	395	884	951	117	9.96	3.97	4.04	11.92	14.29	4.81	3.95	771.6	11.9196	
9:04:01	1391.87	109	1394	396	885	927	101	9.94	4.06	4.48	11.94	14.42	5.22	3.18	771.64	11.9275	
9:04:31	1391.89	109	1390	396	858	892	77	9.94	4.08	4.61	11.95	14.51	5.34	1.58	771.64	11.9362	
9:05:01	1391.89	109	1377	396	859	918	93	9.93	4.09	4.8	11.94	14.38	5.34	1.58	771.64	11.9445	
9:05:31	1391.6	108	1228	395	881	998	117	9.93	4.14	4.56	11.96	14.39	4.96	0.59	771.65	11.9531	
9:06:01	1391.62	108	1381	395	915	1080	150	9.92	3.74	4.08	11.96	14.22	4.64	2.59	771.68	11.9614	
9:06:31	1391.65	108	1428	392	1016	1154	235	9.95	3.58	3.4	11.92	13.68	3.75	2.78	771.71	11.9697	
9:07:01	1391.81	107	1540	388	1118	1201	186	10.06	3.11	2.46	11.82	13.31	2.97	15.82	771.87	11.978	
9:07:22	1392.06	107	1662	392	1257	1364	271	10.18	3.22	2.85	11.89	13.36	3.42	42.82	772.12	11.9838	
9:07:52	1392.17	109	1411	428	994	1192	271	10	3.81	3.95	11.85	14.03	4.33	13.48	772.23	11.9921	
9:08:22	1392.32	110	1352	428	931	992	113	9.95	3.9	3.94	11.89	14.15	4.52	5.28	772.27	12.0004	
9:08:52	1392.45	110	1316	432	905	963	73	9.94	4.14	4.64	11.94	14.29	4.96	3.28	772.3	12.0087	
9:09:22	1392.61	109	1328	429	918	967	82	9.93	3.84	4.07	11.95	14.15	4.69	2.78	772.31	12.0171	
9:09:52	1392.8	108	1414	426	1064	1141	230	9.96	3.58	3.38	11.92	13.59	3.97	4.2	772.34	12.0259	
9:10:22	1392.44	108	1539	425	1067	1178	146	10.02	3.83	2.18	11.85	13.24	2.94	16.7	772.48	12.0338	
9:10:42	1392.49	107	1588	432	1165	1328	308	10.13	3.29	3.18	11.74	13.26	3.52	32.52	772.74	12.0416	
9:11:12	1392.88	108	1528	428	1094	1243	247	10.07	3.83	3.2	11.8	13.8	3.59	23.51	772.65	12.0499	
9:11:49	1393.42	108	1414	427	977	1437	563	10.01	3.86	4.31	11.88	14.12	4.4	17.01	773.09	12.0583	
9:12:19	1393.05	109	1392	430	911	947	69	9.95	3.73	3.8	11.92	14	4.31	3.82	773.1	12.0666	
9:12:49	1393.06	109	1383	431	921	959	81	9.94	3.89	3.89	11.92	14.17	4.57	4.22	773.13	12.0749	
9:13:19	1393.13	109	1367	430	950	1050	191	9.96	3.86	3.96	11.91	14.06	4.5	5.57	773.21	12.0833	
9:13:49	1393.2	108	1388	431	960	1029	93	9.96	3.71	3.74	11.91	14.05	4.31	8.03	773.35	12.0915	
9:14:19	1393.34	108	1416	427	956	1066	117	9.97	3.92	4.02	11.89	13.81	3.83	9.61	773.32	12.0998	
9:14:49	1393.36	108	1425	428	937	1081	158	10	3.8	3.72	11.86	13.91	4.02	13.01	773.44	12.1081	
9:15:19	1393.47	107	1417	428	937	1077	154	10.01	3.65	3.51	11.86	13.98	4.26	9.59	773.51	12.1164	
9:15:49	1393.6	107	1456	425	1036	1105	138	10.04	3.29	3.28	11.82	13.52	3.73	16.25	773.86	12.125	
9:16:19	1393.77	107	1511	425	1096	1972	418	10.05	3.47	3.01	11.78	13.67	4.07	26.42	773.85	12.1333	
9:16:33	1394.02	106	2050	418	1568	3738	2030	10.43	3.51	2.62	11.42	13.52	4.28	65.5	774.12	12.137	
9:17:03	1394.24	106	1521	430	1072	1798	940	10.07	3.71	3.85	11.79	13.67	3.9	25.96	774.29	12.1453	
9:17:33	1394.36	106	1410	432	966	1081	199	10.01	3.74	3.86	11.85	13.84	4.09	15	774.41	12.1536	
9:18:03	1394.53	106	1388	434	893	939	101	9.98	4.01	4.4	11.88	14.22	4.79	9.58	774.46	12.162	
9:18:33	1394.41	110	1386	434	873	910	81	9.92	4.27	5.07	11.93	14.39	4.74	2.07	774.48	12.1703	
9:19:03	1394.43	108	1392	432	885	935	97	9.93	4.08	4.72	11.95	14.17	4.85	2.69	774.48	12.1786	
9:19:33	1394.48	108	1313	425	913	998	85	9.93	4.17	4.58	11.92	14	4.36	2.49	774.5	12.1869	
9:20:03	1394.48	108	1317	433	913	997	81	9.94	4.18	4.58	11.92	14.03	4.36	3.24	774.55	12.1955	

DOE high power mortor test Amaco Catoosa Test Site

Well No. #3	Date: 2/27/98																	
Starting Depth =	1382.45			Bit Type =	Walker McDonald MP68H													
Ending Depth =	1459.02			Bit Size =	4.75													
Total Depth Drilled	87.62			Bit Nozzles =		6, 9, 12, 12												
Hours On Bit =	6.72			Mud Type =		Water Based												
Average ROP =	31.80			Mud Weight (lbs/gal)		9.00												
On Bottom (ft) =	1419.50			Pipe (ft) =	1019.82			Collar (ft)=	408.60									
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
9:29:33	1384.9	108	1353	430	956	996	113	8.93	5.02	4.31	11.92	13.98	4.17	2.01	774.55	12.20398
9:31:03	1384.55	108	1456	426	1058	1125	182	8.98	3.63	3.8	11.87	13.73	4.21	6.88	774.6	12.21211
9:31:33	1384.85	107	1472	426	1058	1141	134	10.02	3.47	3.44	11.82	13.43	3.76	14.88	774.74	12.22083
9:32:03	1384.81	107	1471	425	1058	1133	138	10.04	3.2	3.17	11.81	13.45	3.59	16.22	774.89	12.22287
9:32:33	1384.69	107	1390	426	960	1137	423	19	3.73	3.61	11.84	14.05	4.67	14.23	774.67	12.227
9:33:03	1384.68	108	1351	429	825	967	85	9.06	3.89	4.01	11.89	14.34	4.93	5.64	775.01	12.23423
9:33:33	1385.02	108	1322	429	826	859	91	9.06	3.56	3.34	11.88	14.26	5.03	4.69	775.09	12.23538
9:34:03	1385.07	107	1355	426	956	1048	194	9.66	3.6	3.8	11.87	14.29	4.88	8.89	775.11	12.23619
9:34:33	1385.19	107	1450	425	1048	1109	134	10.03	3.14	2.77	11.82	13.96	4.19	14.87	775.23	12.23782
9:35:03	1385.33	107	1479	424	1054	1170	174	10.07	3.59	3.19	11.78	13.74	4.31	17.34	775.39	12.23985
9:35:33	1385.5	107	1479	425	1051	1170	201	10.07	3.3	3.1	11.77	13.57	3.97	20.36	775.57	12.24211
9:36:03	1385.58	108	1357	430	931	953	99	9.66	3.87	3.48	11.87	14	4.43	9.35	775.62	12.24284
9:36:33	1385.63	108	1343	429	927	963	73	9.67	3.8	3.15	11.88	14.05	4.45	6.23	775.71	12.24398
9:37:03	1385.67	108	1343	432	921	961	89	9.68	3.23	3.16	11.88	14	4.52	5.41	775.73	12.24421
9:37:33	1385.74	108	1367	429	930	963	85	9.68	3.29	3.21	11.86	13.79	4.14	5.96	775.8	12.24504
9:38:03	1385.85	108	1434	430	969	1214	308	10.03	3.31	3.04	11.8	13.67	3.71	12.82	775.89	12.24637
9:38:33	1386.06	107	1442	426	1067	1259	289	10.13	3.23	3.31	11.73	13.33	3.28	24.53	776.11	12.2497
9:39:03	1386.37	108	1521	425	1084	1287	324	10.3	3.44	3.49	11.74	13.23	3.38	35.42	776.32	12.25263
9:39:33	1386.57	109	1407	430	945	1028	122	10.01	3.86	3.26	11.83	13.4	3.33	11.84	776.42	12.25538
9:40:03	1386.44	108	1383	431	929	967	89	9.68	3.58	3.37	11.84	13.55	3.45	8.62	776.49	12.25619
9:40:33	1386.54	108	1434	428	966	1077	174	10.02	3.21	3.13	11.81	13.43	3.05	12.68	776.6	12.25762
9:41:03	1386.72	108	1509	426	1060	1135	150	10.08	3.91	3.27	11.79	13.08	2.82	21.43	776.78	12.25985
9:41:33	1386.84	108	1430	428	968	1044	138	10.01	3.38	3.56	11.82	13.29	3.21	14.42	776.9	12.26071
9:42:03	1386.99	108	1451	428	1004	1081	155	10.03	3.47	3.55	11.8	13.19	3.04	16.32	777.05	12.26264
9:42:33	1387.14	108	1465	427	994	1079	146	10.03	3.41	3.46	11.8	13.31	3.23	15.5	777.19	12.26437
9:43:03	1387.27	108	1462	428	1061	1093	162	10.02	3.42	3.37	11.81	13.21	3.02	16.67	777.32	12.412
9:43:33	1387.47	108	1527	425	1054	1133	154	10.06	3.28	3.28	11.77	12.93	2.56	24.43	777.52	12.41993
9:44:03	1387.72	108	1527	425	1056	1141	150	10.06	3.58	3.36	11.78	12.92	2.54	25	777.74	12.42286
9:44:28	1387.97	106	1763	421	1703	24159	24459	10.21	3.65	4.09	11.81	13.17	3.67	36.32	777.92	12.42553
9:44:48	1388.22	110	1492	432	1063	2828	1661	13.01	3.71	4.67	8.8	11.63	6.34	45.86	778.26	12.441
9:45:18	1388.34	109	1388	431	891	955	109	12.97	3.75	4.18	9.29	11.44	4.92	14.3	778.29	12.44493
9:45:48	1388.47	109	1409	429	938	1004	146	12.91	3.69	3.77	9.2	10.89	4.17	16.29	778.55	12.44676
9:46:18	1388.59	109	1371	430	893	971	150	12.56	4.08	4.36	9.25	11.28	4.48	13.85	778.63	12.44662
9:46:48	1388.68	109	1385	429	877	927	93	12.54	3.69	4.31	9.27	11.36	4.84	10.83	778.72	12.44745
9:47:18	1388.75	110	1216	431	845	962	117	12.53	3.69	3.89	9.27	11.01	4.06	6.14	778.79	12.44828
9:47:48	1388.86	108	1392	428	834	868	101	12.53	4.02	4.61	9.25	11.68	5.1	7.03	778.86	12.44911
9:48:18	1388.96	109	1397	429	842	894	97	12.53	3.64	4.49	9.28	11.75	5.15	6.89	778.94	12.44994

DOE high power mortor test Amaco Catoosa Test Site

Well No. 22	Date: 2/27/96			Bit Type =	Walker McDonald MP58H													
Started Depth =	1342.43			Bit Size =	4.75													
Ending Depth =	1450.02			Bit Nozzles =		9, 9, 12, 12												
Total Depth Drilled	97.62			Mud Type =		Water Based												
Hours On Bit =	5.75			Mud Weight (lbs/gal)		9.09												
Average ROP =	11.80			Pipe (ft) =	3010.82				Collar (ft)=	408.68								
Outbound (ft) =	3419.50																	
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	F/HR	On Bit	On Bit
9:38:18	1398.95	110	1333	433	856	915	109	12.54	3.62	4.65	9.26	11.83	0.22	8.35	776	12.5077
9:39:18	1399.03	110	1326	432	850	915	97	12.54	4.19	4.56	9.36	11.73	5.1	9.52	778.1	12.516
9:39:48	1399.08	108	1337	431	853	947	139	12.17	4.17	4.69	9.83	12.06	6.05	6.96	779.13	12.5243
9:40:18	1399.18	110	1403	436	922	975	97	10.85	4.07	4.69	10.69	12.61	4.14	11.16	779.24	12.5336
9:40:48	1399.28	108	1419	438	950	1012	108	10.88	3.54	3.81	10.63	12.65	3.8	12.66	779.33	12.5409
9:41:18	1399.43	108	1434	427	975	1045	138	10.89	3.45	3.8	10.62	12.62	3.85	17.12	779.47	12.5481
9:41:48	1399.53	108	1375	426	926	975	97	10.85	3.71	4.18	10.95	12.85	4.07	12.63	779.58	12.5575
9:42:18	1399.62	108	1368	427	920	971	93	10.85	4.68	4.7	10.95	12.87	4.25	10.66	779.67	12.5651
9:42:48	1399.71	107	1358	428	917	968	93	10.87	4.13	4.61	10.94	12.87	4.33	10.76	779.76	12.5734
9:43:18	1399.79	109	1361	430	909	947	81	10.86	4.12	4.53	10.98	12.85	4.31	9.49	779.85	12.5828
9:43:48	1399.88	108	1367	429	918	951	66	10.87	3.98	4.25	10.94	12.69	4.31	10.71	779.93	12.5911
9:44:18	1399.97	109	1374	431	930	983	105	10.87	3.64	4.05	10.94	12.89	4.23	10.37	780.03	12.5994
9:44:48	1400.07	108	1379	432	927	967	77	10.87	3.86	4.44	10.93	12.95	4.36	12.44	780.12	12.6077
9:45:18	1400.18	108	1384	433	936	983	89	10.87	3.98	4.23	10.93	12.78	4.19	12.99	780.23	12.616
9:45:48	1400.31	108	1414	428	974	1058	154	10.9	3.85	4.32	10.9	12.83	4.14	16.19	780.38	12.6243
9:46:18	1400.54	107	1535	424	1093	1208	168	11	3.83	4.44	10.8	12.82	3.81	27.66	780.59	12.6326
9:46:33	1400.79	108	1667	423	1191	1389	336	11.16	3.83	3.95	10.63	12.69	6.26	57.96	780.83	12.6372
9:46:58	1401.04	107	1578	427	1114	1247	211	11.06	3.77	4.22	10.78	12.82	3.96	35.82	781.08	12.6411
9:47:18	1401.28	107	1063	423	1217	1340	207	11.16	3.81	4.27	10.62	12.54	4.07	52.5	781.35	12.6469
9:47:34	1401.54	107	1627	495	1153	1260	174	11.11	3.86	4.36	10.69	12.54	3.85	49.69	781.69	12.6538
9:47:53	1401.79	107	1624	426	1113	1236	158	11.12	3.81	4.08	10.65	12.47	3.71	35.65	781.87	12.6592
9:48:09	1402.04	108	1643	428	1182	1299	284	11.13	3.66	3.64	10.65	12.47	3.85	57.9	782.06	12.6638
9:48:28	1402.29	107	1556	425	1183	1360	352	11.13	3.81	3.99	10.67	12.54	3.85	46.44	782.34	12.669
9:48:34	1402.54	108	1537	430	1076	1194	198	11.01	3.8	4.11	10.78	12.66	3.87	34.83	782.56	12.6761
9:49:24	1402.74	109	1484	431	1025	1097	117	10.84	3.83	4.18	10.65	12.58	3.81	24.02	782.79	12.6844
9:49:54	1402.92	108	1475	427	1023	1027	138	10.89	3.59	3.83	10.66	12.71	3.88	21.99	782.99	12.6928
9:50:29	1403.17	107	1567	426	1116	1267	240	11.05	3.93	3.81	10.74	12.42	3.73	35.34	783.23	12.6989
9:50:49	1403.43	107	1603	424	1149	1218	134	11.09	3.82	3.48	10.7	12.5	3.64	44.86	783.52	12.7059
9:50:59	1403.68	108	1621	427	1160	1243	162	11.12	3.52	3.28	10.65	12.52	3.69	45.87	783.72	12.7111
9:51:17	1403.93	107	1656	428	1169	1364	367	11.14	3.54	3.28	10.65	12.64	4.06	52.57	784.01	12.7157
9:51:36	1404.18	106	1558	426	1094	1232	126	11.04	3.53	3.38	10.76	12.54	3.81	40	784.24	12.722
9:52:04	1404.43	107	1555	424	1116	1193	148	11.03	3.48	3.21	10.77	12.57	3.81	36.93	784.49	12.7286
9:52:31	1404.68	107	1520	427	1082	1142	130	10.99	3.44	3.21	10.8	12.59	3.64	33.02	784.73	12.7353
9:52:52	1404.93	107	1611	426	1169	1364	324	11.1	3.49	3.16	10.69	12.54	3.75	41.68	784.98	12.7423
9:53:14	1405.18	107	1560	424	1115	1186	136	11.05	3.52	3.01	10.74	12.39	3.28	41.06	785.23	12.7486
9:53:40	1405.43	108	1544	428	1152	1188	126	11.02	3.28	2.79	10.77	12.64	3.52	35.75	785.48	12.7551
9:54:01	1405.66	108	1507	428	1150	1251	170	11.11	3.17	2.61	10.68	12.21	3.13	43.02	785.75	12.7615

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/96																	
Starting Depth =	1382.40			Bit Type =	Walker McDonald MP66R													
Ending Depth =	1480.02			Bit Size =	4.75													
Total Depth Drilled	97.62			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	5.73			Mud Type =		Water Based												
Average ROP =	11.90			Mud Weight (lbs/gal)		9.00												
Collaring (ft) =	1418.50			Pipe (ft) =	3016.82				Collar (ft)=	408.60								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
9:54:17	1405.93	108	1627	425	1173	1289	162	11.16	3.21	2.73	19.65	12.35	3.3	36.39	786.88	12.7658
9:54:28	1406.16	108	1696	429	1156	1363	184	11.11	3.19	2.68	19.68	12.33	3.28	42.73	786.23	12.7718
9:54:39	1406.49	107	1638	425	1187	1371	162	11.14	3.62	2.59	19.64	12.23	3.18	54.96	786.45	12.7761
9:55:19	1406.68	107	1657	425	1291	1532	223	11.16	3.14	2.81	19.63	12.08	3.04	56.87	786.74	12.7807
9:55:30	1406.93	107	1585	427	1118	1239	203	11.04	3.05	2.47	19.75	12.35	3.76	40.64	787	12.787
9:55:53	1407.18	107	1588	427	1154	1388	334	11.09	2.93	2.3	19.7	12.26	3.16	45.5	787.26	12.7924
9:56:15	1407.43	108	1586	429	1136	1298	166	11.06	3.09	2.93	19.73	12.15	3.11	40.26	787.47	12.7987
9:56:36	1407.68	108	1588	427	1143	1302	162	11.07	2.97	2.44	19.71	12.11	3.05	43.15	787.74	12.8048
9:56:51	1407.84	108	1678	428	1212	1544	251	11.18	3.08	2.59	19.56	12.11	3.14	56.25	787.99	12.8088
9:57:08	1408.19	108	1795	431	1268	1633	304	11.26	3.09	2.43	19.52	11.97	3.21	60.68	788.23	12.8138
9:57:15	1408.44	107	1788	428	1314	1464	365	11.32	3.63	2.51	19.46	11.78	2.9	68	788.49	12.8198
9:57:34	1408.69	108	1701	428	1250	1634	460	11.18	3.06	2.47	19.6	11.87	2.78	49.6	788.78	12.8258
9:57:45	1408.94	108	1782	427	1301	1429	365	11.29	3.06	2.54	19.49	11.87	2.82	63.28	788.99	12.8307
9:57:57	1409.19	105	1852	416	1446	1725	518	11.35	3.02	2.77	19.43	11.64	3.21	75.44	789.25	12.8371
9:58:11	1409.44	107	1736	425	1241	1481	478	11.15	3.25	2.72	19.63	12.25	3.59	61.4	789.51	12.8311
9:58:31	1409.67	108	1512	430	1077	1271	381	10.93	2.73	1.58	19.85	12.4	3.36	27.44	789.73	12.8364
9:58:41	1409.79	110	1427	434	1008	1155	329	10.86	2.69	1.8	19.92	12.48	3.42	13.8	789.95	12.8417
9:58:43	1409.89	109	1408	433	995	1101	243	10.85	2.83	2	19.93	12.66	3.57	12.57	789.96	12.8396
10:00:11	1410.01	109	1406	431	881	1058	231	10.85	2.66	1.88	19.94	12.78	3.47	14.49	790.08	12.8043
10:00:41	1410.13	109	1397	433	871	1064	229	10.85	2.81	1.98	19.93	12.71	3.57	13.54	790.17	12.8726
10:01:11	1410.23	108	1398	433	868	1078	230	10.85	2.63	2.41	19.92	12.86	3.57	12.93	790.28	12.881
10:01:45	1410.35	106	1381	432	867	1077	271	10.84	2.64	2.19	19.93	12.71	3.64	14.37	790.37	12.8869
10:02:11	1410.48	109	1405	430	1037	1182	240	10.89	2.86	2.16	19.88	12.4	3.09	30.63	790.53	12.8976
10:02:33	1410.74	109	1852	430	1230	1615	628	11.13	3.52	3.02	19.65	12.09	3.08	44.36	790.78	12.9053
10:02:48	1410.86	105	1849	429	1143	1390	448	11.07	3.41	3.3	19.7	12.9	3.53	57.68	791.02	12.9076
10:14:07	1411.16	105	885	394	84	88	34	21.25	1.84	0.27	1.52	2.2	2.09	28.89	791.21	12.92
10:14:07	1411.34	107	1329	331	84	88	34	15.66	1.82	0.32	7.21	10.44	8.74	21.45	791.36	12.9263
10:16:01	1411.39	107	1535	383	85	89	34	12.82	1.88	0.41	10.28	10.83	0.77	38.09	791.84	12.9349
10:16:31	1411.77	107	1458	393	84	88	34	12.46	1.86	0.35	10.41	11.01	1.61	21.62	791.82	12.9432
10:16:61	1411.96	106	1444	397	86	90	36	12.46	1.86	0.37	10.41	10.95	0.53	21.72	792	12.9515
10:16:31	1412.1	107	1418	399	85	89	34	12.46	1.88	0.33	10.43	10.7	0.55	17.86	792.15	12.9598
10:17:01	1412.27	107	1428	398	86	90	34	12.46	1.86	0.31	10.4	10.66	0.5	19.37	792.31	12.9682
10:17:31	1412.37	105	1313	394	85	89	34	12.43	1.89	0.25	10.44	10.72	0.62	12.5	792.42	12.9765
10:18:01	1412.41	109	1138	396	85	89	34	12.37	1.88	0.36	10.5	11.39	1.51	4.1	792.46	12.9848
10:18:31	1412.43	109	1065	396	85	103	28	12.37	1.95	0.33	10.5	10.72	0.61	3.08	792.48	12.9931
10:19:01	1412.45	109	1021	397	85	96	24	12.38	2	0.35	10.5	10.75	0.53	1.7	792.49	13.0014
10:19:31	1412.46	109	1064	398	85	96	24	12.39	1.93	0.36	10.49	10.75	0.67	1.19	792.51	13.01

DOE high power mortor test Amaco Catoosa Test Site

Well No. 22	Date: 2/2/06				
Starting Depth =	1392.40	Bit Type =	Walker McDonald MP61H		
Ending Depth =	1490.02	Bit Size =	4.75		
Total Depth Drilled	97.62	Bit Nozzles =	9, 9, 10, 12		
Hours On Bit =	5.73	Mud Type =	Water Based		
Average ROP =	11.80	Mud Weight (lbs/gal)	9.00		
Collaring (ft) =	1418.50	Pipe (ft) =	1010.83	Collar (ft)=	408.80

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	Gs	Gs	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
10:20:01	1412.47	110	895	393	84	96	24	12.38	2.02	0.44	10.49	11.36	1.17	1.63	792.51	13.0183
10:20:31	1412.48	109	897	397	86	96	26	12.35	1.96	0.38	10.48	10.72	0.6	1.46	792.53	13.0208
10:21:01	1412.5	110	899	399	86	96	20	12.39	1.97	0.84	10.49	10.72	0.53	1.6	792.56	13.0343
10:21:31	1412.52	109	1021	398	86	96	20	11.18	1.88	6.35	11.69	13.69	2.47	2.39	792.58	13.0433
10:22:01	1412.54	108	1058	394	86	96	24	10.48	1.94	0.31	12.42	13.02	0.69	2.4	792.58	13.0516
10:22:31	1412.56	108	1064	395	86	96	26	10.48	1.97	0.32	12.41	13.05	0.63	2.33	792.6	13.0599
10:23:01	1412.57	109	1061	395	86	104	25	10.48	1.96	0.32	12.41	12.68	0.6	2.53	792.62	13.0681
10:23:31	1412.59	108	1064	396	86	96	24	10.47	1.95	0.33	12.4	12.73	0.62	2.39	792.65	13.0764
10:24:01	1412.61	109	1061	396	86	96	24	10.47	1.97	0.33	12.4	12.68	0.58	2.67	792.66	13.0847
10:24:31	1412.63	108	1057	395	85	96	25	10.48	1.96	0.33	12.41	12.71	0.6	2.4	792.68	13.093
10:25:01	1412.65	108	1056	397	83	96	26	10.48	1.97	0.35	12.41	12.86	0.53	2.65	792.7	13.1013
10:25:31	1412.66	109	1061	395	83	96	24	10.46	1.96	0.33	12.42	12.85	1.13	1.61	792.71	13.1096
10:26:01	1412.68	109	1063	396	83	96	26	10.45	1.96	0.35	12.42	12.89	0.67	2.61	792.73	13.1179
10:26:31	1412.7	109	1069	395	83	96	24	10.43	1.96	0.38	12.42	12.8	0.86	1.76	792.75	13.1262
10:27:01	1412.71	109	1077	395	81	96	26	10.43	1.96	0.36	12.43	12.73	0.57	1.53	792.77	13.1345
10:27:31	1412.73	108	1061	395	80	92	26	10.43	2	0.39	12.42	12.79	0.65	2.5	792.79	13.1428
10:28:01	1412.75	109	1072	397	80	92	24	10.45	1.99	0.36	12.42	12.78	0.69	2.56	792.8	13.1512
10:28:31	1412.77	108	1062	396	80	92	24	10.44	1.99	0.32	12.42	12.71	0.6	2.42	792.82	13.1595
10:29:01	1412.79	109	1063	396	80	92	24	10.44	1.97	0.34	12.43	12.89	0.62	1.98	792.84	13.1681
10:30:01	1412.85	108	1431	433	1951	2519	1158	10.57	2.31	0.5	12.28	12.78	1.08	23.75	792.92	13.1947
10:30:31	1412.92	109	1382	435	1907	2644	1416	10.53	2.3	0.66	12.33	12.93	1.13	7.75	793.01	13.1933
10:31:01	1412.96	109	1367	437	1851	2661	1640	10.5	2.26	0.64	12.35	13.06	1.32	7.53	793.09	13.2016
10:31:31	1413.1	108	1426	434	2006	2981	1734	10.53	3.23	2.62	13.33	16.6	2.3	18.3	793.15	13.2099
10:32:01	1413.3	108	1358	433	2140	3075	1077	10.65	3.76	3.37	13.21	13.45	2.35	24.11	793.39	13.2182
10:32:24	1413.55	108	1500	430	2132	2997	1673	10.69	2.5	0.76	12.17	12.69	1.01	40.17	793.62	13.2265
10:32:45	1413.8	107	1821	427	2117	3438	2374	10.7	2.11	0.69	12.16	13.42	2.78	41.54	793.86	13.2348
10:33:15	1414.03	108	1523	432	2027	3238	2652	10.68	2.15	0.79	12.17	13.29	1.91	36.13	794.1	13.2389
10:33:45	1414.3	108	1479	434	1958	2527	1272	10.67	3.1	2.51	12.29	13.4	2.42	22.1	794.24	13.2473
10:34:15	1414.54	108	1483	432	2000	2616	1353	10.6	2.99	2.37	12.25	13.21	2.11	18.65	794.44	13.2556
10:34:39	1414.69	108	1487	430	2008	2657	1426	10.65	2.23	0.74	12.21	12.89	0.96	38.62	794.63	13.2621
10:35:09	1414.75	109	1457	429	1992	2442	1278	10.56	2.96	2.33	12.29	13.4	2.25	19.07	794.81	13.2704
10:35:39	1414.96	108	1456	431	1938	2507	1381	10.6	3.65	1.91	12.25	12.97	1.51	25.63	795.06	13.2787
10:36:09	1415.11	107	1418	429	1915	2361	1290	10.55	2.16	0.72	12.3	13.26	1.89	30.14	795.11	13.287
10:36:24	1415.35	107	1483	428	1930	2361	1248	10.62	2.13	0.67	12.23	12.85	1.56	35.58	795.41	13.2938
10:37:09	1415.62	108	1515	428	1937	2577	1264	10.64	2.13	0.74	12.21	12.59	0.86	34.38	795.67	13.3019
10:37:39	1415.87	105	1662	423	1863	2867	1742	10.77	2.3	1.01	12.07	13.24	2.16	53.58	795.92	13.3061
10:38:09	1416.12	107	1629	426	1818	3089	1827	10.68	2.12	0.83	11.96	13.17	2.11	71.58	796.16	13.3102

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/98																	
Starting Depth =	1382.49			Bit Type =	Walker McDonald MP68H													
Ending Depth =	1480.02			Bit Size =	4.75													
Total Depth Drilled	97.62			Bit Nozzles =		9, 9, 12, 12												
Hours On Bit =	5.73			Mud Type =		Water Based												
Average ROP =	11.80			Mud Weight (lbs/gal)		8.90												
Drillstring (ft) =	1419.50			Pipe (ft) =	1019.62				Collar (ft)=	486.80								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
10:37:59	1416.87	107	1598	428	1760	2381	1276	10.68	2.2	0.76	12.16	12.97	0.81	38.19	796.44	13.31278
10:38:17	1416.62	107	1618	435	1749	2255	1037	10.74	2.27	0.83	12.13	12.96	0.83	80.43	798.00	13.33236
10:38:36	1416.87	107	1618	431	1690	2087	717	10.72	2.14	0.84	12.13	12.84	0.93	48.19	798.93	13.34791
10:38:55	1417.04	106	1455	435	1518	1769	555	10.53	2.69	2.06	12.32	13.38	2.08	26.17	797.09	13.33503
10:39:13	1417.16	107	1460	431	1516	1766	630	10.51	2.75	2.1	12.34	13.48	2.37	14.43	797.21	13.33448
10:39:32	1417.28	109	1443	436	1517	1813	726	10.49	2.84	2.19	12.35	13.69	2.56	14.37	797.33	13.35291
10:40:36	1417.42	106	1447	430	1537	1871	818	10.5	2.86	2.44	12.35	13.62	2.61	17.12	797.46	13.36112
10:41:06	1417.66	106	1515	433	1504	2029	964	10.55	2.91	2.26	12.39	13.64	2.68	15.44	797.63	13.36855
10:41:24	1417.81	105	1738	434	1911	3828	1856	10.75	2.72	1.81	12.69	13.29	2.35	51.11	797.69	13.37746
10:41:37	1418.06	107	1967	429	1964	3645	1905	11.02	2.39	1.08	11.82	13.33	3.38	72.56	798.12	13.37911
10:42:01	1418.31	106	1945	437	1617	2174	1171	10.82	2.17	0.7	5.88	10.08	4.91	35.39	798.36	13.38449
10:42:21	1418.35	110	1188	442	1440	1706	867	10.58	2.11	0.65	5.85	7.56	1.53	4.95	798.46	13.38935
10:43:01	1418.48	108	1357	434	1525	1948	1005	13.37	2.19	0.86	9.46	10.68	3.76	15.26	798.54	13.40118
10:43:31	1418.59	108	1331	434	1612	2067	1176	12.48	3.66	0.58	10.34	10.77	1.05	12.69	798.71	13.40999
10:44:01	1418.73	106	1356	433	1673	2182	1151	12.5	2.07	0.57	10.33	10.82	1.22	17.36	798.82	13.41182
10:44:31	1418.87	107	1360	431	1772	2252	1211	12.56	2.12	0.64	10.27	10.88	0.79	17.11	798.92	13.42055
10:45:01	1419.08	107	1364	430	1768	2328	1248	12.54	2.11	0.64	10.28	10.88	0.79	28.21	799.15	13.43951
10:45:31	1419.38	107	1411	430	1813	2324	1207	12.59	2.14	0.67	10.24	10.8	0.79	22.56	799.35	13.44434
10:45:59	1419.63	108	1450	428	1832	2349	1207	12.63	2.08	0.58	10.19	10.68	1.27	32.83	799.59	13.45009
10:46:29	1419.78	107	1512	431	1855	2304	1136	12.66	2.13	0.63	10.14	10.8	1.13	44.21	799.64	13.45668
10:46:59	1420.03	106	1562	429	1901	2393	1155	12.74	2.09	0.65	10.08	10.9	1.01	47.05	800.09	13.462
10:47:29	1420.28	106	1587	429	1924	2412	1163	12.73	2.09	0.63	10.09	10.46	0.84	47.75	800.33	13.46672
10:47:51	1420.53	106	1479	430	1917	2470	1260	12.68	2.13	0.64	10.17	10.72	1.1	38.83	800.6	13.47136
10:47:59	1420.79	105	1437	433	1823	2361	1203	12.61	2.1	0.77	10.23	10.85	0.89	31.28	800.86	13.48018
10:48:29	1420.98	103	1377	434	1678	2209	1114	12.53	2.14	0.72	10.29	10.7	0.81	22.8	801.01	13.48901
10:48:59	1421.14	107	1358	432	1585	1939	836	12.5	2.13	0.67	10.32	10.69	0.73	19.1	801.12	13.49564
10:49:29	1421.29	108	1365	434	1619	2053	865	12.5	2.14	0.69	10.32	10.72	0.79	15.21	801.31	13.50067
10:49:59	1421.39	108	1360	436	1625	2061	855	12.51	2.12	0.69	10.31	10.7	0.83	15.4	801.49	13.515
10:50:29	1421.55	108	1352	438	1605	1962	723	12.53	2.13	0.81	10.3	10.85	0.79	19.12	801.59	13.52035
10:50:38	1421.8	106	1521	433	1779	2041	631	12.75	2.19	0.81	10.07	10.7	1.1	48.71	801.84	13.52985
10:50:58	1422.08	107	1546	432	1749	2059	579	12.73	2.13	0.64	10.09	10.36	0.72	46	802.09	13.53542
10:51:19	1422.3	106	1514	433	1733	2156	805	12.68	2.12	0.64	10.14	10.49	0.65	44.38	802.26	13.53986
10:51:45	1422.55	106	1491	435	1686	2077	951	12.65	2.13	0.58	10.16	10.9	0.81	34.58	802.51	13.54471
10:52:01	1422.8	107	1671	431	1851	2367	1346	12.92	2.09	0.67	9.99	11.27	2.35	55.29	802.68	13.55114
10:52:16	1423.05	107	1661	432	1799	2077	1052	12.73	2.19	0.84	10.09	11.32	2.37	62.31	803.05	13.55657
10:52:46	1423.2	108	1709	436	1666	2247	1256	12.53	2.1	0.67	10.26	10.7	0.84	18.03	803.29	13.564
10:53:16	1423.41	108	1685	436	1653	2284	1304	12.5	2.13	0.65	10.31	10.63	0.72	33.42	803.46	13.57251

DOE high power mortor test Amaco Catoosa Test Site

Well No. #3	Date: 2/27/96																
Starting Depth =	1382.48			Bit Type =	Walker McDonald MP68H												
Ending Depth =	1450.02			Bit Size =	4.75												
Total Depth Drilled	67.62			Bit Nozzles =	8, 8, 12, 12												
Hours On Bit =	5.73			Mud Type =	Water Based												
Average ROP =	11.80			Mud Weight (lbs/gal)	8.90												
Drillstring (ft) =	1419.69			Pipe (ft) =	1010.82			Collar (ft)=	408.88								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HHMMSS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	DrlBit	DrlBit	
10:53:45	1423.59	108	1370	435	1706	2286	1323	13.9	2.08	0.62	10.21	10.77	0.81	18.57	803.84	13.5896	
10:54:16	1425.79	108	1429	434	1736	2563	1950	12.64	2.11	0.61	10.27	10.72	0.68	28.57	803.83	13.5480	
10:54:32	1424.61	107	1537	435	1752	2312	1236	12.68	2.11	0.58	10.14	10.56	0.61	53.69	804.07	13.5835	
10:54:46	1424.26	107	1633	436	1854	3001	1989	12.68	2.21	0.94	10.13	11.49	2.32	87.16	804.3	13.5881	
10:55:06	1424.51	108	1611	428	1768	2266	1134	13.74	2.13	0.59	10.07	10.77	1.27	46.41	804.58	13.5915	
10:55:23	1424.77	108	1483	433	1718	2308	1356	12.65	2.12	0.7	10.21	10.6	0.74	35.48	804.89	13.5970	
10:55:54	1425.09	108	1524	432	1762	2824	1207	12.65	2.09	0.67	10.16	10.65	1.03	43.11	805.11	13.6184	
10:56:16	1425.27	107	1526	431	1683	2764	1037	12.64	2.19	0.73	10.17	10.44	0.62	36.11	805.36	13.6233	
10:56:38	1425.52	108	1629	427	1775	2110	764	12.78	2.16	0.75	10.03	10.32	0.65	68.54	805.58	13.6277	
10:56:51	1425.77	108	1623	431	1702	2700	721	12.74	2.07	0.68	10.07	10.41	0.69	60.67	805.82	13.6322	
10:57:04	1426.02	107	1766	428	1813	2788	1665	12.62	2.17	0.79	9.98	11.25	2.23	71.31	806.1	13.6376	
10:57:17	1426.27	107	1654	429	1718	2015	766	12.77	2.13	0.69	10.04	10.34	0.67	90.59	806.32	13.6383	
10:57:34	1426.52	107	1613	429	1709	2154	1021	12.72	2.08	0.6	10.08	10.53	0.77	84.3	806.61	13.6439	
10:57:51	1426.76	107	1653	430	1803	2851	1686	12.71	2.09	0.92	10.03	11.45	1.94	53.47	806.86	13.6488	
10:58:07	1427.03	107	1682	428	1778	2308	1203	12.7	2.08	0.69	10.1	10.65	1.03	64.75	807.09	13.6534	
10:58:20	1427.28	108	1615	432	1839	3897	3003	12.63	2.3	0.83	10.2	10.56	0.69	40.79	807.36	13.6584	
10:58:51	1427.53	107	1532	435	1622	2083	936	12.6	2.16	0.74	10.2	10.46	0.57	42.75	807.82	13.6654	
10:59:11	1427.78	108	1562	432	1662	2561	999	12.66	2.11	0.67	10.18	10.51	0.72	45.77	807.82	13.6768	
10:59:27	1428.03	108	1567	428	1636	2985	881	12.68	2.19	0.81	10.12	10.59	0.93	96.14	808.09	13.6751	
10:59:53	1428.28	108	1489	432	1568	1863	713	12.56	2.2	0.62	10.24	10.43	0.81	34.54	808.33	13.6828	
11:00:30	1428.53	108	1478	430	1565	1840	698	12.51	2.19	0.85	10.25	11.06	1.32	33.17	808.6	13.68	
11:00:44	1428.78	107	1509	431	1575	1859	620	12.57	2.16	0.68	10.23	10.58	0.74	37.16	808.82	13.6966	
11:01:14	1429.03	108	1442	433	1636	1777	535	12.51	2.21	0.83	10.29	10.7	1.05	25	809.05	13.7052	
11:01:35	1429.24	108	1536	431	1612	2126	822	12.61	2.29	1.01	10.19	10.68	1.29	37.06	809.28	13.7118	
11:01:52	1429.49	108	2032	422	1864	3195	2094	12.61	2.13	0.54	9.95	11.23	2.06	72.85	809.59	13.7162	
11:02:03	1429.74	108	1672	426	1756	2764	1685	15.35	2.21	0.56	7.43	11.15	4.28	71.36	809.61	13.7187	
11:02:38	1429.98	109	1511	437	1461	1966	1051	15.61	2.1	0.56	6.97	7.36	1.24	28.67	809.82	13.722	
11:03:53	1430.16	108	1532	434	1548	2025	1143	15.63	2.19	0.73	6.95	7.4	0.96	21.72	810.25	13.7353	
11:04:38	1430.24	108	1237	434	1488	1927	1089	15.72	2.16	0.77	7.05	7.42	1.03	8.04	810.29	13.7436	
11:04:53	1430.32	109	1257	434	1481	1948	1122	15.69	2.18	0.81	7.09	7.48	0.72	10.3	810.39	13.7518	
11:05:33	1430.43	108	1262	431	1488	1976	1175	15.68	2.14	0.77	7.1	7.48	0.77	12.73	810.47	13.7605	
11:05:53	1430.48	108	1262	433	1505	2028	1203	15.68	2.18	0.78	7.09	7.48	0.67	6.5	810.6	13.7688	
11:06:33	1430.56	108	1281	430	1511	2102	1292	15.71	2.08	0.83	7.07	7.42	0.79	9.53	810.65	13.7771	
11:06:53	1430.72	108	1283	431	1513	2049	1272	15.71	2.34	0.82	7.06	7.49	0.84	19.57	810.79	13.7854	
11:08:38	1430.81	108	1286	432	1501	2041	1252	15.68	2.13	0.7	7.06	7.49	0.84	10.86	810.87	13.7937	
11:07:08	1431.01	107	1307	428	1989	3089	1256	15.65	2.13	0.79	6.92	7.37	1.03	24.4	811.12	13.852	
11:07:19	1431.26	107	1428	423	1628	2853	1065	15.55	2.08	0.63	6.82	7.31	0.77	57.82	811.33	13.8583	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 28	Date: 2/27/96				Bit Type =	Walker McDonald MP88H												
Starting Depth =	1392.40				Bit Size =	4.75												
Ending Depth =	1490.02				Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled	97.62				Mud Type =		Water Based											
Hours On Bit =	5.79				Mud Weight (lbs/gal)		9.00											
Average ROP =	11.80				Pipe (ft) =	1010.82			Collar (ft)=	438.60								
Drillstring (ft) =	1449.42																	
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT		HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs		KIPS	Gs	Gs	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit	
11:07:43	1431.82	108	1804	432	1583	2073	1184		15.66	2.11	0.67	6.68	7.3	1.05	37.44	811.57	13.8132	
11:08:13	1431.72	108	1831	433	1524	2048	1107		15.78	2.19	0.75	6.58	7.4	1.41	24.23	811.61	13.8215	
11:08:43	1431.82	109	1231	437	1384	1810	1013		15.67	2.15	0.73	7.1	7.85	0.83	13.46	811.67	13.8298	
11:09:13	1431.9	109	1311	435	1388	1704	1013		15.87	2.09	0.8	7.1	7.49	0.79	9.36	811.68	13.8381	
11:09:43	1431.93	109	1312	438	1384	1862	1061		15.67	2.13	0.7	7.1	8.04	1.32	7.82	812.04	13.8464	
11:10:13	1432.04	109	1220	438	1422	1899	1086		15.63	2.17	0.74	7.03	7.42	0.69	8.47	812.1	13.8547	
11:10:43	1432.2	108	1329	438	1535	2048	1215		15.8	2.14	0.69	6.97	7.47	1.01	19.56	812.26	13.863	
11:11:13	1432.45	108	1341	436	1630	2203	1292		15.83	2.08	0.68	6.94	7.37	0.83	31.48	812.5	13.8731	
11:11:43	1432.68	73	1152	313	1718	2742	1949		15.78	2.07	0.65	7.63	8.49	2.18	15.82	812.63	13.8794	
11:12:13	1432.72	108	1331	437	1485	1972	1036		15.79	2.12	0.75	6.87	7.89	1.05	16.45	812.78	13.8877	
11:12:43	1432.91	109	1328	437	1418	1773	786		15.79	2.11	0.68	6.97	7.29	0.63	23.42	812.99	13.898	
11:13:13	1433.01	110	1286	440	1378	1633	804		15.72	2.09	0.67	7.04	7.85	1.16	12.11	813.07	13.9043	
11:13:43	1433.15	109	1278	437	1436	1863	762		15.75	2.15	0.73	7.04	7.44	0.93	10.68	813.19	13.9126	
11:14:07	1433.4	107	1404	430	1602	1988	741		15.94	2.17	0.69	6.82	7.4	0.93	35.12	813.64	13.9158	
11:14:37	1433.61	109	1229	437	1432	1757	583		15.72	2.13	0.73	7.04	7.61	0.98	13.37	813.57	13.9201	
11:15:07	1433.58	107	1176	432	1395	1638	486		15.7	2.10	0.69	7.06	7.37	0.85	9.26	813.63	13.9364	
11:15:37	1433.63	108	1169	435	1364	1638	476		15.7	2.21	0.71	7.06	7.37	0.89	5.79	813.69	13.945	
11:16:07	1433.68	109	1184	437	1364	1619	483		15.7	2.13	0.71	7.06	7.37	0.82	5.68	813.74	13.9533	
11:16:37	1433.77	108	1205	433	1407	1652	504		15.72	2.22	0.81	7.04	7.35	0.82	10.5	813.81	13.9616	
11:17:07	1433.85	107	1201	432	1463	1761	622		15.78	2.25	0.83	6.99	7.42	0.81	10.68	813.91	13.9699	
11:17:37	1433.98	108	1275	435	1368	1741	685		15.78	2.21	0.83	6.96	7.32	0.96	15.59	814.05	13.9781	
11:18:07	1434.05	108	1189	437	1384	1599	563		15.69	2.15	0.73	7.08	7.44	0.96	7.79	814.1	13.9865	
11:18:37	1434.1	108	1175	435	1386	1620	568		15.68	2.15	0.7	7.07	7.37	0.72	6.64	814.16	13.9948	
11:19:07	1434.16	108	1174	436	1372	1672	564		15.68	2.15	0.71	7.08	7.78	0.86	7.21	814.17	14.0031	
11:19:37	1434.22	108	1178	436	1375	1673	580		15.68	2.16	0.75	7.07	7.37	0.82	6.77	814.27	14.0114	
11:20:07	1434.27	108	1178	436	1380	1602	566		15.69	2.1	0.68	7.06	7.35	0.82	5.85	814.33	14.0197	
11:20:37	1434.32	108	1214	437	1418	1777	796		15.71	2.18	0.7	7.04	7.35	0.83	5.84	814.38	14.028	
11:21:07	1434.41	108	1235	437	1436	1834	852		15.73	2.1	0.68	7.01	7.52	1.15	30.97	814.5	14.0363	
11:21:37	1434.5	108	1248	436	1428	1880	1000		15.78	2.21	0.76	6.96	10.22	3.42	10.77	814.56	14.0446	
11:22:07	1434.63	109	1302	436	1515	2956	2060		12.62	2.14	0.69	9.63	10.53	1.86	1.28	814.66	14.0529	
11:22:17	1434.76	108	1706	434	1679	3809	2131		13.28	2.21	0.75	9.47	10.96	2.35	80.31	814.84	14.0555	
11:22:38	1435.01	108	1431	434	1638	2357	1462		13.02	2.13	0.82	9.73	10.22	1.24	42.68	815.1	14.0615	
11:23:08	1435.13	108	1358	434	1617	2186	1256		12.82	2.14	0.83	9.82	10.33	1.44	14.13	815.18	14.0702	
11:23:38	1435.36	107	1427	431	1623	2304	1418		13	2.08	0.64	9.75	10.22	1.03	23.54	815.42	14.0778	
11:24:08	1435.48	108	1324	435	1515	2069	1232		12.66	2.1	0.82	9.86	10.27	1.51	12.02	815.54	14.0855	
11:24:38	1435.62	108	1346	435	1587	2073	1238		12.62	2.09	0.83	9.86	10.32	0.91	28.77	815.7	14.0943	
11:25:08	1435.78	108	1327	434	1479	2029	1211		13.68	2.08	0.68	9.81	10.27	0.81	12.18	815.82	14.1025	

DOE high power mortor test Amaco Catoosa Test Site

Well No. 33	Date: 2/27/96																
Starting Depth =	1382.40			Bit Type =	Walker McDonald XP60H												
Ending Depth =	1457.62			Bit Size =	4.75												
Total Depth Drilled	57.62			Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	5.73			Mud Type =		Water Based											
Average ROP =	11.30			Mud Weight (lbs/gal)		9.00											
Drillstring (ft) =	1419.30			Pipe (ft) =	1019.80			Collar (ft)=	436.60								

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:26:19	1419.43	108	1231	437	1326	1426	1069	12.81	2.25	0.61	9.94	10.25	0.72	8.01	815.64	14.1111
11:26:35	1419.57	108	1293	464	1442	1867	871	12.28	3.28	0.52	9.96	10.32	0.79	4.57	815.94	14.1377
11:27:05	1419.83	108	1314	462	1465	2013	1193	12.82	3.29	2.9	9.93	10.82	2.06	7.95	815.98	14.139
11:27:35	1420.15	107	1363	442	1613	2251	1278	12.96	3.38	2.85	10.09	11.75	3.06	29.65	816.26	14.1443
11:28:03	1420.4	107	1479	437	1755	2436	1507	12.93	2.13	0.75	10.72	11.18	1.03	33.49	816.44	14.1518
11:28:19	1420.65	107	1578	438	1880	2486	1265	12.16	2.22	0.83	10.59	11.13	1.05	52.4	816.7	14.1597
11:28:49	1420.82	108	1340	445	1539	2205	1337	11.86	2.13	0.73	10.66	11.63	1.48	31.42	816.89	14.165
11:29:19	1420.94	108	1354	441	1521	2016	1138	11.86	2.14	0.69	10.62	11.27	0.74	12.98	816.96	14.1733
11:29:49	1421.06	108	1375	436	1459	1873	1078	11.89	2.11	0.73	10.65	11.2	0.75	18.15	817.15	14.1816
11:30:19	1421.24	107	1560	437	1486	2585	1746	12.03	2.16	0.81	10.71	11.78	2.61	30.75	817.38	14.1898
11:30:49	1421.56	110	1436	446	1626	3171	2379	11.93	2.13	0.69	10.82	11.97	2.23	26.56	817.63	14.1982
11:31:19	1421.81	109	1294	444	1502	2110	1248	11.9	2.31	0.64	10.85	11.97	0.68	5.79	817.69	14.2065
11:31:49	1421.71	108	1382	441	1680	2366	1361	11.89	3.3	3.72	10.85	11.73	2.01	12.14	817.79	14.2148
11:32:19	1421.89	108	1405	440	1782	2438	1400	11.95	2.15	0.73	10.81	11.32	1.08	39.96	818.03	14.2231
11:32:49	1422.15	108	1415	441	1746	2562	1584	11.93	2.19	0.79	10.81	11.2	0.81	22.15	818.23	14.2314
11:33:19	1422.27	108	1398	442	1730	2523	1576	11.86	2.34	1.07	10.87	11.93	1.63	14.38	818.38	14.2397
11:33:49	1422.43	108	1451	440	1750	2575	1564	11.92	2.88	2.42	10.83	11.87	2.15	27.14	818.54	14.248
11:34:19	1422.63	108	1374	441	1690	2592	1754	11.66	3.28	1.13	10.89	11.75	1.48	16.01	818.71	14.2564
11:34:49	1422.78	108	1386	443	1525	2272	1438	11.82	3.44	3.17	10.91	12.39	2.68	18.91	818.81	14.2647
11:35:19	1422.96	108	1436	441	1519	2198	1341	11.92	3.25	2.63	10.82	11.82	2.12	35.51	819.03	14.273
11:35:49	1423.2	108	1428	441	1508	2068	1223	11.91	2.12	0.68	10.82	11.37	1.06	27.68	819.19	14.2813
11:36:19	1423.39	108	1439	440	1562	1911	1139	11.86	3.59	3.23	10.88	12.3	2.85	23.14	819.38	14.2896
11:36:49	1423.55	108	1415	441	1267	1729	946	11.84	3.43	2.32	10.91	12.59	3.19	18.97	819.59	14.2982
11:37:19	1423.8	108	1360	442	1165	1579	857	11.74	3.75	3.65	11	12.73	3.67	6.13	819.66	14.3065
11:37:49	1423.93	108	1362	443	1147	1420	774	11.74	4.1	4.39	11	12.54	3.46	3.82	819.67	14.3148
11:38:19	1423.66	110	1316	446	1141	1485	729	11.74	3.85	4.11	10.99	12.63	3.73	4.13	819.74	14.3231
11:38:49	1423.72	109	1361	444	1138	1445	686	11.76	3.84	3.85	10.97	12.78	3.88	7.19	819.78	14.3314
11:39:19	1423.76	109	1332	444	1114	1419	644	11.76	3.59	3.7	10.87	12.69	3.83	7.72	819.85	14.3397
11:39:49	1423.88	108	1366	442	1130	1364	596	11.76	3.77	3.99	10.85	12.71	3.84	10.68	819.94	14.348
11:40:19	1423.98	107	1375	444	1135	1360	538	11.79	3.55	3.6	10.84	12.85	3.83	12	820.03	14.3563
11:40:49	1424.06	108	1393	442	1127	1338	488	11.78	3.93	3.94	10.84	13.05	4.4	10.18	820.11	14.3646
11:41:19	1424.17	108	1411	444	1095	1281	429	11.81	3.76	3.79	10.82	13.14	4.74	12.58	820.23	14.3729
11:41:49	1424.29	108	1410	443	1094	1303	456	11.82	3.82	3.76	10.81	13.09	4.67	14.84	820.34	14.3813
11:42:19	1424.41	108	1400	444	1274	1644	798	11.84	3.39	3.13	10.85	12.67	3.35	13.97	820.47	14.3896
11:42:49	1424.54	110	1418	446	1346	1633	828	11.81	2.91	2.58	10.91	12.4	2.97	15.3	820.59	14.3982
11:43:19	1424.68	110	1373	446	1307	1646	830	11.78	2.91	2.65	10.94	12.28	2.94	14.8	820.71	14.4065
11:43:49	1424.71	109	1379	448	1283	1453	616	11.77	2.59	2.86	10.95	12.38	2.8	5.82	820.81	14.4148

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/2/99			Bit Type =	Walker McDonald MF 6SR												
Starting Depth =	1382.46			Bit Size =	4.75												
Ending Depth =	1450.03			Bit Nozzles =	9, 9, 12, 12												
Total Depth Drilled	67.57			Mud Type =	Water Based												
Hours On Bit =	5.79			Mud Weight (lb/gal)	8.90												
Average ROP =	11.67			Pipe ID =	1910.82				Collar ID=	498.60							
Drilling ID =	1419.56																
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
11:44:59	1442.81	105	1403	429	1252	1510	885	11.77	2.96	2.43	10.04	12.48	2.94	12.29	825.87	14.4231
11:44:49	1442.82	110	1344	429	1296	1725	1061	11.77	3.02	2.02	10.85	12.4	1.55	0.48	825.88	14.4314
11:45:19	1442.87	111	1276	428	1313	1706	1005	11.75	2.98	0.81	10.96	11.93	0.72	6.15	825.93	14.4397
11:45:49	1442.93	108	1259	424	1318	1706	993	11.75	2.99	0.57	10.96	11.8	0.65	6.77	821	14.448
11:46:19	1443.01	108	1269	425	1347	1713	1009	11.76	2.98	0.59	10.95	11.25	0.55	-1.6	821	14.4563
11:46:49	1443.04	108	1273	427	1343	1709	997	11.76	2.92	0.52	10.95	11.49	1.05	3.31	821.03	14.4646
11:47:19	1443.01	108	1274	428	1338	1717	967	11.77	3.1	0.63	10.94	11.27	0.86	5.75	821.01	14.4732
11:47:49	1443.05	108	1268	426	1346	1741	1017	11.77	3.3	0.75	10.94	11.53	1.13	5.36	821.13	14.4815
11:48:19	1443.66	108	1320	434	1376	1816	1078	11.78	3.76	2.11	10.92	12.14	2.56	0.25	821.13	14.4898
11:48:49	1443.09	106	1404	421	1362	2013	1219	11.8	3.23	2.77	10.91	12.45	3.04	3.62	821.2	14.4981
11:49:19	1443.21	108	1340	432	1562	2280	1493	11.81	2.98	2.41	10.89	13.11	2.66	15.21	821.28	14.5064
11:49:49	1443.27	108	1333	431	1984	2977	1918	11.82	2.49	1.92	10.88	13.76	2.18	7.76	821.32	14.5147
11:50:19	1443.3	108	1321	431	2659	3292	1454	11.82	3.06	2.18	10.88	11.89	2.39	3.71	821.32	14.523
11:50:49	1443.34	108	1289	428	1997	2120	1348	11.8	2.3	0.91	10.9	11.27	0.78	4.68	821.36	14.5314
11:51:19	1443.43	108	1346	423	1668	2307	1380	11.81	3.84	2.35	10.89	12.35	2.32	10.63	821.54	14.5397
11:51:49	1443.51	107	1372	396	1417	2118	2085	11.84	2.82	2.19	10.89	12.31	2.68	9.24	821.66	14.548
11:52:19	1443.6	107	1391	393	1921	2089	1252	11.84	3.16	2.56	10.88	12.3	2.92	10.37	821.71	14.5563
11:52:49	1443.73	107	1405	391	1917	3005	2220	11.84	3.76	2.3	10.88	12.06	2.7	16.05	821.79	14.5646
11:53:19	1443.91	106	1394	438	1734	2507	1673	11.82	2.15	0.75	10.78	11.18	0.89	22.03	822.01	14.5733
11:53:49	1442.13	105	1430	434	1838	2458	1697	11.82	3.06	2.06	10.77	12.26	2.82	25.58	822.14	14.5816
11:54:19	1442.38	106	1365	436	1726	2466	1710	11.82	2.43	0.64	10.8	11.28	0.89	15.82	822.35	14.5899
11:54:49	1442.34	109	1362	438	1758	2519	1661	11.82	3.68	2.31	10.84	12.5	2.99	10.24	822.49	14.5981
11:55:19	1442.51	108	1322	438	1762	2571	1746	11.87	3.19	2.41	10.82	12.93	3.73	20.3	822.67	14.6064
12:00:52	1442.72	110	1101	433	1866	2227	3608	17.3	2.04	0.64	6.8	6.83	0.63	18.31	822.82	14.62
12:01:22	1442.78	109	1154	431	1463	2128	1454	14.87	3.04	0.51	9.44	11.44	3.39	6.04	822.86	14.6283
12:01:52	1442.84	108	1238	427	1485	2223	1538	13.58	3.06	3.04	11.06	12.58	2.39	7.18	822.93	14.6366
12:02:22	1442.97	108	1443	424	1485	2292	1446	13.16	3.04	2.83	10.96	12.28	3.26	15.13	822.98	14.6449
12:02:52	1443.06	108	1347	432	1371	1721	978	13.1	3.38	3.26	11.01	12.28	2.8	10.01	823.15	14.6533
12:03:22	1443.1	108	1317	430	1228	1687	814	13.04	2.98	0.58	11.07	11.44	0.74	4.7	823.19	14.6616
12:03:52	1443.14	108	1285	429	1286	1632	803	13.04	2.94	0.56	11.08	11.71	1.01	5.16	823.23	14.6699
12:04:22	1443.2	107	1262	428	1277	1858	883	13.05	3.12	0.67	11.09	11.36	0.67	6.88	823.29	14.6782
12:04:52	1443.26	107	1278	427	1286	1868	875	13.06	3.06	0.62	11.05	11.48	0.77	7.29	823.34	14.6865
12:05:22	1443.33	107	1277	425	1276	1944	847	13.05	3.12	0.7	11.05	11.58	0.81	10.69	823.4	14.6948
12:05:52	1443.37	106	1278	429	1284	1611	774	13.04	2.15	0.68	11.07	11.48	0.84	3.81	823.47	14.7031
12:06:22	1443.43	107	1341	424	1288	3628	796	13.03	3.44	3.07	11.08	12.43	2.68	6.46	823.5	14.7114
12:06:52	1443.47	106	1368	422	1291	1817	498	13.03	3.46	3.15	11.08	12.3	2.6	5.43	823.52	14.72
12:07:22	1443.48	107	1380	423	1284	1421	498	13.03	3.67	3.62	11.08	12.4	2.75	2.49	823.53	14.7263

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/96																	
Starting Depth =	1382.40				Bit Type =	Walker McDonald M*63H												
Ending Depth =	1469.02				Bit Size =	4.75												
Total Depth Drilled	87.62				Bit Nozzles =		9, 9, 12, 12											
Hours On Bit =	5.75				Mud Type =		Water Based											
Average ROP =	11.80				Mud Weight (Surge)		8.35											
Drillstring (ft) =	1415.53				Pipe (ft) =	1010.83				Collar (ft)=	404.70							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HHMMSS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	On Bit	On Bit
12:07:52	1443.49	106	1371	428	1210	1458	555	13.01	3.44	3.16	11.08	12.62	2.7	0.15	823.58	14.7366
12:08:22	1443.52	106	1356	427	1256	1522	624	13.01	3.5	3.28	11.1	12.28	2.47	3.41	823.59	14.7449
12:08:52	1443.86	106	1319	427	1241	1615	783	13	3.06	2.86	11.1	12.23	2.33	4.2	823.6	14.7533
12:09:22	1443.58	106	1309	431	1275	1609	819	12.99	2.99	2.66	11.11	11.63	0.93	0.54	823.63	14.7615
12:10:22	1443.67	107	1314	423	1256	1668	822	12.99	2.96	0.61	11.1	11.63	0.96	1.62	823.66	14.7782
12:10:52	1443.81	107	1311	424	1263	1684	851	12.99	3.34	3.52	11.1	11.66	0.89	4.08	823.68	14.7865
12:11:22	1443.64	107	1315	425	1262	1676	835	12.99	2.97	0.55	11.11	11.66	0.86	3.58	823.69	14.7948
12:11:52	1443.66	107	1318	423	1256	1650	830	13	2.95	0.59	11.09	11.69	0.89	2.46	823.7	14.8034
12:12:22	1443.66	108	1324	427	1221	1737	878	13.01	2.13	0.69	11.09	11.59	0.93	1.9	823.73	14.8117
12:12:52	1443.69	108	1331	430	1321	1717	883	13.01	2.08	0.61	11.09	11.63	1.08	3.45	823.73	14.82
12:13:32	1443.71	108	1329	430	1308	1668	802	13.01	2.83	0.58	11.08	11.63	0.99	2.72	823.78	14.8283
12:13:52	1443.73	108	1340	434	1317	1672	826	13.02	2.85	0.55	11.08	11.61	1.01	1.3	823.78	14.8366
12:14:22	1443.73	107	1329	425	1339	1705	847	13.02	2.04	0.54	11.08	11.68	1.03	0.7	823.79	14.8449
12:14:52	1443.73	107	1316	427	1283	1695	839	13.01	2.03	0.58	11.08	11.63	0.96	0.83	823.82	14.8532
12:15:22	1443.77	107	1309	427	1337	1709	819	13.02	2.94	2.39	11.07	12.14	2.68	4.91	823.85	14.8615
12:15:52	1443.86	108	1363	422	1326	1698	871	13.05	2.98	2.44	11.04	12.21	2.47	10.03	823.91	14.8698
12:16:22	1443.89	108	1353	428	1282	1651	891	13.03	3	2.63	11.06	12.4	2.44	3.34	823.95	14.8781
12:16:52	1443.92	108	1342	428	1272	1672	778	13.01	2.98	2.31	11.07	12.16	2.23	3.23	823.98	14.8864
12:17:22	1443.95	107	1342	427	1266	1638	839	13.02	2.97	1.69	11.07	11.85	1.41	4.25	824	14.895
12:17:52	1443.98	108	1345	430	1262	1642	871	13.03	2.84	1.63	11.08	11.8	1.26	1.01	824.03	14.9033
12:18:22	1444.03	108	1358	432	1275	1658	800	13.03	2.56	1.53	11.08	11.8	1.38	4.08	824.08	14.9116
12:18:52	1444.01	108	1364	436	1290	1571	816	13.03	2.56	1.47	11.05	11.8	1.36	1.74	824.07	14.9199
12:19:22	1444.07	108	1364	431	1278	1634	870	13.06	2.96	2.6	11	12.38	2.61	7.02	824.13	14.9283
12:19:52	1444.08	108	1365	432	1446	2035	1179	13.06	2.13	0.69	11.02	11.68	1.15	1.51	824.19	14.9366
12:20:22	1444.14	108	1284	430	1465	2045	1236	13.05	2.08	0.61	11.03	11.68	1.15	7.38	824.19	14.9449
12:21:22	1444.17	108	1286	429	1448	1919	1088	13.02	2.09	0.55	11.06	11.85	1.32	4.66	824.24	14.9615
12:21:52	1444.21	107	1311	429	1414	1887	1003	12.72	2.69	0.56	11.36	11.96	1.17	4.1	824.3	14.9699
12:22:22	1444.21	107	1356	428	1378	1741	835	12.83	2.17	0.65	11.25	11.85	1.05	0.67	824.3	14.9782
12:22:52	1444.26	108	1288	429	1350	1810	685	12.82	2.12	0.67	11.25	11.8	1.03	5.68	824.32	14.9865
12:23:22	1444.3	107	1293	427	1315	1622	555	12.82	2.07	0.65	11.26	11.8	1.06	3.91	824.34	14.995
12:23:52	1444.31	108	1368	428	1285	1530	543	12.68	3	2.55	11.24	12.33	2.23	2.02	824.38	15.0033
12:24:22	1444.38	108	1400	425	1276	1498	498	12.55	3.04	2.53	11.23	12.38	2.32	5.79	824.43	15.0116
12:24:52	1444.43	108	1382	422	1262	1505	519	12.65	3.03	2.51	11.23	12.64	2.78	8.35	824.46	15.0199
12:25:22	1444.5	108	1422	425	1276	1525	543	12.66	3.1	2.56	11.21	12.47	2.75	8.35	824.55	15.0282
12:25:52	1444.56	107	1398	426	1257	1493	502	12.65	3.1	2.6	11.22	12.38	2.49	6.68	824.61	15.0365
12:26:22	1444.59	107	1404	427	1274	1567	550	12.65	3.23	2.68	11.23	12.47	2.68	3.51	824.66	15.0449
12:26:52	1444.75	107	1362	426	1281	1741	851	12.91	3.1	2.68	11.17	12.59	3.35	19.57	824.81	15.0532

DOE high power mortor test Amaco Catoosa Test Site

Well No. 31	Date: 2/27/96																	
Starting Depth =	1382.40			Bit Type =	Walker McDonald MF6H													
Ending Depth =	1459.00			Bit Size =	4.75													
Total Depth Drilled	87.60			Bit Nozzles =		9, 9, 12, 13												
Hours On Bit =	5.75			Mud Type =		Water Based												
Average ROP =	11.69			Mud Weight (lbs/gal)		8.65												
On String (ft) =	1419.50			Pipe (ft) =	1010.82				Collar (ft) =	408.68								
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HR:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled
12:27:22	1446.86	106	1456	431	1317	1579	643	12.86	3.19	2.8	11.19	12.85	2.66	12.86	834.9	15.98115
12:27:52	1446.94	106	1466	429	1304	1534	478	12.84	3.09	2.8	11.18	12.38	2.39	16.24	825	15.99056
12:28:22	1446.69	106	1466	431	1308	1555	551	12.91	3.02	2.56	11.16	13.36	2.9	17.8	825.13	15.99784
12:28:52	1446.21	106	1466	429	1305	1555	585	12.9	3.16	2.8	11.17	13.57	3.18	14.72	825.28	15.99867
12:29:22	1445.33	109	1478	434	1323	1618	553	12.89	3.14	2.68	11.18	12.47	2.8	14.43	825.58	15.9995
12:29:52	1445.41	108	1481	428	1334	1619	615	12.88	3.14	2.72	11.16	12.52	3.02	9.61	825.48	16.10033
12:30:22	1445.58	108	1460	428	1251	1481	486	12.87	3.08	2.68	11.3	13.4	2.73	18.34	825.58	16.11116
12:30:52	1445.51	107	1392	427	1195	1425	505	12.85	3.22	2.86	11.21	12.57	2.94	9.43	825.68	16.11983
12:31:22	1445.65	108	1354	431	1156	1394	547	12.82	3.31	3.08	11.24	12.59	2.68	4.19	825.71	16.1262
12:31:52	1445.7	108	1432	431	1280	1408	496	12.83	3.14	2.8	11.23	12.64	2.8	7.03	825.75	16.13385
12:32:22	1445.78	107	1433	427	1216	1417	479	12.84	3.25	2.89	11.23	12.57	2.82	10.28	825.84	16.1448
12:32:52	1445.69	108	1428	427	1263	1421	493	12.84	3.16	2.77	11.26	12.38	2.63	11.7	825.91	16.15515
12:33:22	1445.88	108	1377	429	1168	1350	478	12.87	3.31	3.03	11.24	12.64	3.02	5.87	826	16.16434
12:33:52	1446	108	1365	431	1149	1344	466	12.9	3.25	2.95	11.26	12.62	3.04	4.79	826.05	16.17
12:34:22	1446.03	108	1349	429	1138	1346	452	12.79	3.38	3.25	11.27	12.54	2.8	3.28	826.11	16.17835
12:34:52	1446.08	108	1351	429	1134	1356	494	12.79	3.33	3.22	11.28	12.59	2.7	3.65	826.12	16.18666
12:35:22	1446.1	108	1415	428	1198	1417	501	12.79	3.19	2.93	11.27	12.57	2.92	5.7	826.15	16.19448
12:35:52	1446.13	108	1518	428	1282	1518	527	12.79	3.23	2.86	11.27	12.62	2.8	3.49	826.21	16.20233
12:36:22	1446.35	108	1549	429	1315	1514	468	12.83	3.14	2.76	11.22	12.52	2.87	14.54	826.32	16.21116
12:36:52	1446.41	108	1543	428	1277	1519	553	12.83	3.18	2.79	11.22	12.69	3.18	18.93	826.47	16.22196
12:37:22	1446.93	111	1391	436	1126	1308	494	12.78	3.46	3.42	11.28	12.76	3.04	4.73	826.51	16.22982
12:37:52	1446.93	108	1394	435	1137	1320	460	12.75	3.4	3.21	11.31	12.81	3.06	4.16	826.53	16.23965
12:38:22	1446.8	108	1380	427	1149	1308	413	12.74	3.23	3.08	11.31	12.66	2.99	1.61	826.56	16.24448
12:38:52	1441.84	-1	244	12	81	202	138	22.46	1.8	0.56	8.61	8.93	0.81	3.73	826.64	16.25497
12:40:52	1441.82	-1	206	12	84	100	32	22.72	1.79	0.05	1.67	1.68	0.55	-0.13	826.59	16.25763
12:41:22	1441.83	-1	205	12	82	96	32	22.63	1.79	0.05	1.46	1.72	0.48	-0.03	826.59	16.25940
12:41:52	1441.82	-1	208	12	83	100	32	22.37	1.79	0.05	1.65	1.84	0.45	-0.18	826.59	16.26033
12:42:22	1441.83	-1	206	12	85	106	32	22.23	1.79	0.04	1.77	1.99	0.45	0.2	826.59	16.26015
12:42:52	1441.83	-1	204	12	84	103	32	22.06	1.8	0.05	1.94	2.19	0.5	-0.21	826.59	16.26098
12:43:22	1441.82	-1	203	12	84	100	32	21.91	1.8	0.05	2.08	2.27	0.43	-0.28	826.59	16.26181
12:43:52	1441.83	-1	201	12	84	100	32	21.82	1.8	0.06	2.17	2.31	0.43	0.4	826.59	16.26264
12:44:22	1441.83	-1	201	12	85	104	36	21.67	1.8	0.06	2.33	2.56	0.5	-0.23	826.59	16.26347
12:44:52	1441.83	-1	201	12	85	103	28	21.84	1.79	0.04	2.46	2.56	0.43	0.67	826.59	16.2643
12:45:22	1441.83	-1	200	12	85	104	32	21.44	1.8	0.06	2.55	2.75	0.36	0.09	826.59	16.26514
12:45:52	1441.82	-1	199	12	83	104	32	21.28	1.8	0.06	2.67	2.94	0.48	-0.47	826.58	16.26597
12:46:22	1441.82	-1	199	12	87	104	28	21.19	1.79	0.04	2.82	3.02	0.41	-0.04	826.58	16.2668
14:26:28	1446.8	106	1221	429	1231	1536	788	14.21	3.29	3.36	3.78	11.75	12.63	1.77	826.86	16.3726

DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/96																
Starting Depth =	1380.48			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1459.02			Bit Size =	4.75												
Total Depth Drilled	67.62			Bit Nozzles =		8, 9, 12, 13											
Hours On Bit =	5.73			Mud Type =		Water Based											
Average ROP =	11.80			Mud Weight (lbs/gal)		8.00											
Drillstring (ft) =	1418.60			Pipe (ft) =	1010.82				Collar (ft)=	408.80							

TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	ROCK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	OnBit	OnBit
14:26:28	1446.52	107	1433	420	1288	1938	571	11.88	3.86	3.81	10.21	11.8	3.73	1.95	826.88	15.3863
14:27:28	1446.53	106	1678	427	1403	2484	1531	11.88	3.95	4.44	10.17	12.4	5.65	1.73	826.7	15.3849
14:27:58	1446.78	106	1763	429	1495	2927	1543	11.92	4.15	4.31	10.13	12.38	5.01	15.69	826.81	15.4032
14:28:28	1446.81	106	1421	426	1252	1488	507	11.91	3.9	4.24	10.15	12.18	4.34	6.24	826.87	15.4115
14:28:58	1446.84	107	1436	432	1274	1809	535	11.92	3.94	4.27	10.14	12.56	4.38	3.72	826.89	15.4139
14:29:28	1446.87	106	1405	430	1243	1437	498	11.91	3.7	4.05	10.14	12.04	4.12	3.35	826.93	15.4202
14:28:58	1446.89	106	1403	428	1233	1417	470	11.91	3.73	4.17	10.14	11.99	4.31	2.2	826.91	15.4356
14:29:28	1446.88	106	1406	427	1247	1453	506	11.92	3.68	4.11	10.13	11.92	4.05	0	826.96	15.4448
14:30:28	1446.9	107	1431	431	1268	1481	498	11.93	3.51	3.98	10.12	12.04	4.24	0.95	826.96	15.4531
14:31:28	1446.92	108	1451	434	1288	1488	482	11.94	3.44	3.24	10.11	11.97	4.14	3.08	826.98	15.4614
14:31:58	1446.96	106	1471	436	1310	1480	458	11.96	3.35	3.39	10.09	11.94	4.26	4.94	827.01	15.4697
14:32:28	1447	106	1463	435	1312	1516	505	11.97	3.89	3.74	10.08	12.02	4.24	4.73	827.05	15.478
14:32:58	1447.05	107	1476	436	1304	1518	514	11.98	3.52	3.85	10.07	11.99	4.4	5.08	827.12	15.4863
14:33:28	1447.09	107	1479	437	1303	1518	494	11.99	3.55	3.63	10.06	11.97	4.4	4.95	827.15	15.4949
14:33:58	1447.12	108	1472	437	1299	1526	557	11.99	3.61	3.78	10.06	12.04	4.57	3.52	827.19	15.5032
14:34:28	1447.15	108	1529	428	1324	2539	1750	12.02	4.1	4.41	10.03	12.3	5.79	3.13	827.23	15.5115
14:34:58	1447.24	107	1595	433	1336	2923	1738	12.04	4.23	4.06	10	11.99	5.17	11.07	827.31	15.5198
14:35:28	1447.28	106	1429	436	1209	1440	503	12.01	3.77	3.48	10.04	12.04	4.52	5.15	827.34	15.5281
14:35:58	1447.3	106	1375	439	1171	1384	486	12.01	3.44	4.14	10.04	11.85	4.09	1.65	827.35	15.5364
14:36:28	1447.31	106	1376	438	1178	1388	476	12	3.61	3.94	10.04	11.97	4.09	1.74	827.35	15.5447
14:36:58	1447.34	107	1387	433	1188	1378	458	12.01	3.02	3.05	10.03	11.94	4.31	2.86	827.4	15.553
14:37:28	1447.36	108	1426	432	1200	1384	462	12.01	3.58	3.75	10.03	11.92	4.38	3.6	827.41	15.5614
14:37:58	1447.39	108	1412	435	1187	1372	474	12.01	3.74	4.13	10.03	12.08	4.38	0.42	827.43	15.5697
14:38:28	1447.4	108	1406	433	1182	1344	443	12.02	3.48	3.84	10.02	12.08	4.24	4.44	827.45	15.5781
14:38:58	1447.4	108	1398	438	1181	1340	429	12.01	3.83	3.93	10.02	11.85	4.07	9.41	827.46	15.5864
14:39:28	1447.42	108	1387	433	1158	1334	425	12.02	3.48	3.74	10.01	11.92	4	2.31	827.48	15.5949
14:39:58	1447.44	107	1382	429	1152	1334	466	12.01	3.76	4.08	10.02	11.97	4	2.36	827.49	15.6032
14:40:28	1447.45	106	1395	430	1151	1316	401	12.02	3.27	3.68	10.02	11.9	3.93	0.87	827.5	15.6115
14:40:58	1447.46	106	1388	434	1145	1312	387	12.01	3.38	3.58	10.02	11.78	3.81	0.78	827.51	15.6198
14:41:28	1447.47	106	1397	434	1146	1308	381	12.02	3.4	3.75	10.01	11.97	3.83	1.17	827.53	15.6281
14:41:58	1447.48	107	1396	429	1152	1336	417	12.02	3.26	3.66	10.01	11.75	3.78	1.74	827.55	15.6368
14:42:28	1447.5	106	1405	434	1150	1328	405	12.01	3.33	3.42	10.02	11.85	4.12	1.78	827.55	15.6447
14:42:58	1447.51	105	1417	436	1150	1332	408	12.02	3.75	4.13	10.01	11.92	4.07	1.83	827.56	15.653
14:43:28	1447.54	105	1419	435	1151	1332	417	12.01	3.86	3.9	10.02	11.85	3.93	3.06	827.59	15.6613
14:43:58	1447.56	107	1408	430	1147	1316	361	12.01	3.6	3.63	10.01	11.73	3.73	2.08	827.6	15.6696
14:44:28	1447.57	107	1400	430	1143	1303	365	12.01	3.5	3.65	10.01	11.68	3.86	1.51	827.62	15.6752
14:44:58	1447.58	107	1401	431	1140	1312	381	12.01	3.47	3.83	10.01	11.81	3.82	1.43	827.64	15.6836

DOE high power mortor test Amaco Catoosa Test Site

Well No. 21	Date: 2/27/96			Bit Type =	Walker NSDiamond MP68M												
Starting Depth =	1392.40			Bit Size =	6.75												
Ending Depth =	1460.22			Bit Nozzles =		9, 9, 12, 12											
Total Depth Drilled	67.82			Mud Type =		Water Based											
Hours On Bit =	5.73			Mud Weight (lbs/gal)		9.00											
Average ROP =	11.83			Pipe (ft) =	1019.82				Collar (ft)=	308.00							
Drillstring (ft) =	1419.53																

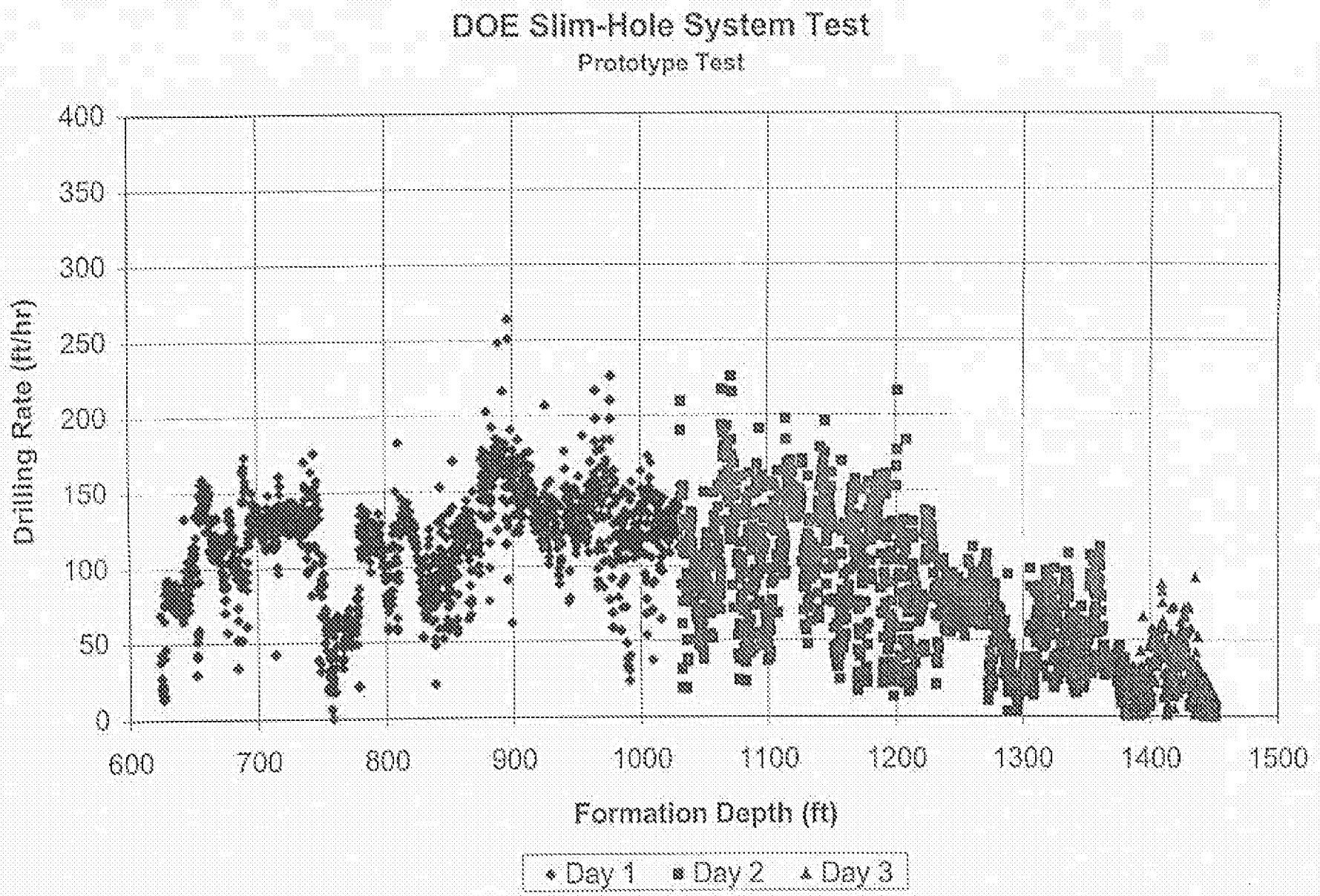
Time HH:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	HOOK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
14:45:28	1447.6	108	1388	434	1128	1259	381	12.01	3.56	3.81	10.62	11.65	3.73	2.32	827.85	15.6943
14:45:58	1447.62	107	1380	436	1116	1295	438	12	3.56	3.65	10.62	11.68	3.76	2.61	827.67	15.7032
14:46:28	1447.63	108	1368	432	1116	1324	482	12	3.61	3.73	10.62	11.69	3.85	1.67	827.69	15.7115
14:46:58	1447.65	109	1361	435	1114	1324	482	12	3.69	3.77	10.62	12.04	4.02	1.88	827.7	15.7198
14:47:28	1447.66	108	1384	431	1126	1303	401	11.99	3.46	3.68	10.03	11.75	3.73	0.84	827.71	15.7281
14:47:58	1447.67	107	1408	428	1128	1312	428	11.95	3.47	3.56	10.03	11.75	3.61	0.88	827.72	15.7364
14:48:28	1447.68	107	1411	431	1136	1324	421	11.95	3.52	3.56	10.02	11.75	3.56	1.08	827.74	15.7447
14:48:58	1447.71	108	1418	432	1139	1343	448	11.99	3.74	3.83	10.03	11.8	3.63	3.46	827.78	15.7553
14:49:28	1447.73	107	1427	429	1155	1362	462	11.99	3.76	4.11	10.03	11.8	4.21	2.27	827.8	15.7636
14:49:58	1447.74	107	1489	427	1217	1348	393	11.95	3.71	3.78	10.03	11.85	4.79	1.13	827.8	15.7669
14:50:28	1447.8	107	1706	428	1381	2582	1803	12.99	8.7	4.08	9.43	12.28	9.56	7.8	827.86	15.7782
14:50:58	1447.83	108	1464	434	1168	1387	514	11.94	3.86	4.6	10.37	12.23	5	3.63	827.89	15.7865
14:51:28	1447.85	109	1424	438	1152	1352	433	11.52	3.75	4.21	10.49	12.33	3.95	2.64	827.91	15.7948
14:51:58	1447.87	108	1412	432	1145	1336	421	11.54	3.64	4.57	10.47	12.33	3.97	2.24	827.93	15.8031
14:52:28	1447.89	108	1404	432	1140	1322	413	11.55	3.69	4.14	10.47	12.09	3.68	2.58	827.94	15.8114
14:52:58	1447.91	108	1402	435	1142	1328	905	11.56	3.61	4.31	10.47	12.21	3.89	2.08	827.96	15.8197
14:53:28	1447.91	108	1408	436	1148	1340	421	11.53	3.61	4.32	10.48	12.26	3.95	0.02	827.97	15.828
14:53:58	1447.93	107	1476	438	1145	1340	425	11.53	3.77	4.37	10.48	12.3	3.89	2.42	828	15.8364
14:54:28	1447.95	109	1429	438	1157	1356	433	11.53	3.75	4.21	10.47	12.33	4.33	2.69	828	15.8447
14:54:58	1447.95	107	1464	439	1165	1376	425	11.54	3.92	4.19	10.47	12.23	4.09	-0.19	828	15.8533
14:55:28	1448.01	108	1517	427	1248	1462	516	11.56	3.71	4.64	10.45	12.11	3.93	7.47	828.06	15.8616
14:55:58	1448.03	108	1367	431	1131	1332	488	11.54	3.6	4.37	10.47	12.38	4.62	1.61	828.1	15.8699
14:56:28	1448.06	107	1378	431	1163	1308	438	11.54	4.03	4.65	10.47	12.4	4.17	4.64	828.07	15.8782
14:56:58	1448.08	108	1398	439	1128	1330	464	11.54	3.87	4.35	10.47	12.4	5.01	2.38	828.12	15.8865
14:57:28	1448.09	108	1411	434	1145	1332	446	11.53	3.82	4.21	10.46	12.5	4.67	0.7	828.15	15.8948
14:57:58	1448.12	108	1418	434	1161	1335	439	11.54	3.86	4.41	10.46	12.35	4.52	3.29	828.19	15.9031
14:58:28	1448.15	108	1431	435	1161	1361	459	11.55	3.84	4.64	10.45	12.18	4.17	3.76	828.2	15.9114
14:58:58	1448.21	107	1442	432	1176	1369	433	11.50	3.85	3.86	10.44	12.26	4.24	7.97	828.27	15.9197
14:59:28	1448.27	108	1430	430	1167	1358	438	11.57	3.63	4.01	10.43	12.28	4.36	7.12	828.33	15.928
14:59:58	1448.33	108	1423	436	1158	1348	433	11.57	3.86	4.19	10.43	12.28	4.31	6.58	828.39	15.9363
15:00:28	1448.38	107	1488	430	1159	1352	433	11.57	3.75	4.35	10.43	12.23	4.21	8.67	828.43	15.9446
15:00:58	1448.44	107	1411	432	1148	1348	450	11.57	4.11	4.62	10.43	12.3	4.39	7.19	828.48	15.9529
15:01:28	1448.48	108	1394	435	1137	1299	446	11.58	4	4.64	10.45	12.35	4.39	4.83	828.53	15.9615
15:01:58	1448.51	108	1379	436	1100	1303	462	11.56	4.27	5.12	10.44	12.5	4.31	3.76	828.56	15.9698
15:02:28	1448.53	108	1391	438	1124	1344	478	11.56	3.98	4.53	10.44	12.4	4.36	1.93	828.58	15.9781
15:02:58	1448.57	107	1532	432	1252	1453	510	11.56	3.62	4.03	10.42	12.06	4.12	4.51	828.62	15.9865
15:03:28	1448.64	107	1499	433	1239	1453	498	11.56	3.7	3.92	10.41	12.11	4.13	9.11	828.69	15.9948

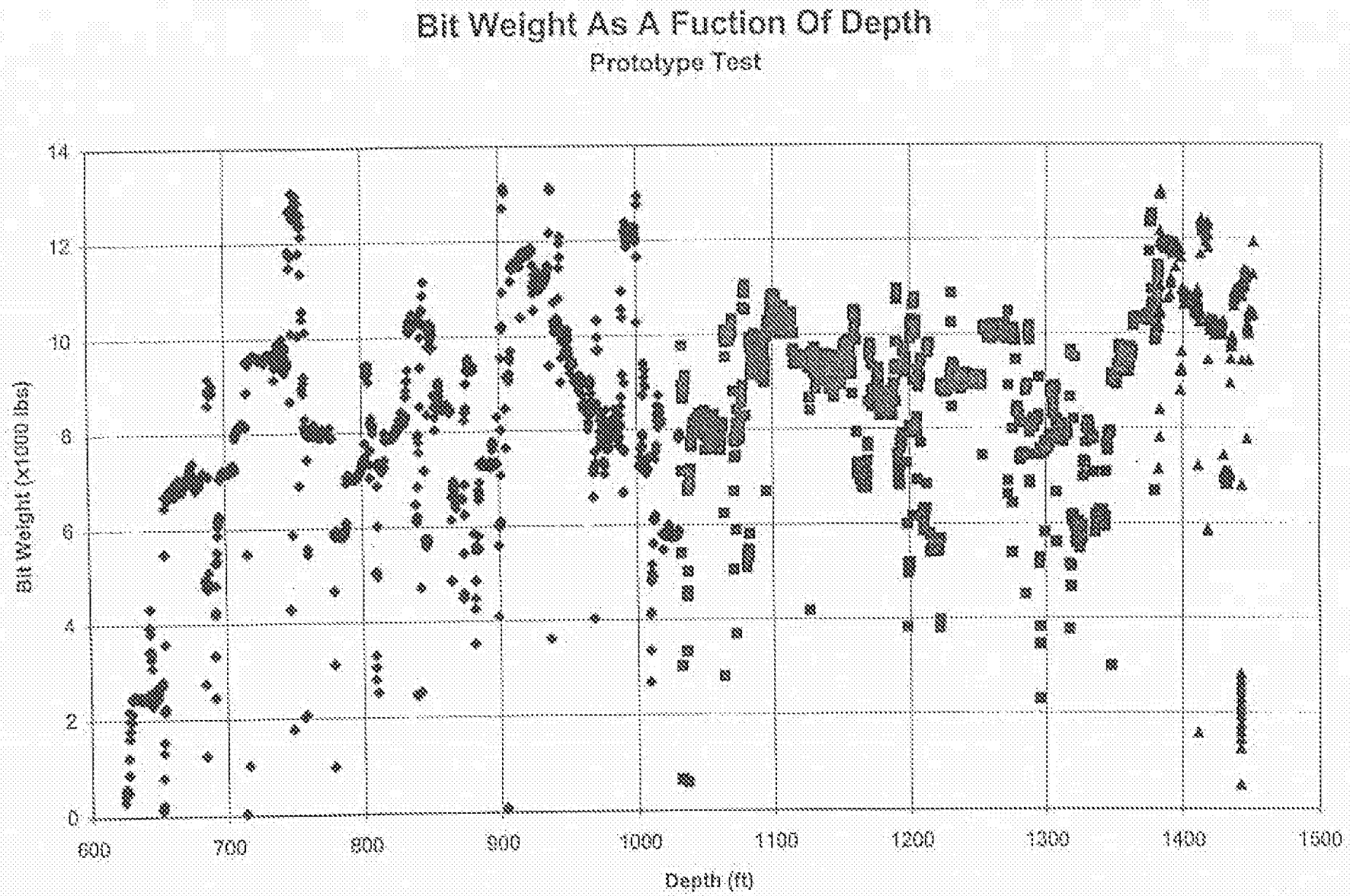
DOE high power mortor test Amaco Catoosa Test Site

Well No. 23	Date: 2/27/96			Bit Type =	Walker McDonald MP66H												
Starting Depth =	1382.40			Bit Size =	6.75												
Ending Depth =	1480.02			Bit Nozzles =		8, 8, 12, 12											
Total Depth Drilled	97.62			Mud Type =		Water Based											
Hours On Bit =	5.73			Mud Weight (lbs/gal)		9.0											
Average ROP =	11.80			Pipe (ft) =	1010.00			Collar (ft)=	458.60								
Drillstring (ft) =	1419.20																
TIME HR:MM:SS	BIT DEPTH FEET	FLOW GPM	PRES PSI	SPEED RPM	TORQUE ft-lbs	PEAK ft-lbs	DELT ft-lbs	ROCK LOAD KIPS	PEAK G's	DELTA G's	WOB KIPS	PEAK KIPS	DELTA KIPS	ROP FT/HR	Feet Drilled	Hours Drilled
15:03:58	1448.75	107	1592	431	1345	1802	583	11.58	3.84	4.11	10.6	12.14	4.14	10.08	828.27	16.0831
15:04:28	1448.76	109	1364	438	1127	1358	519	11.56	3.85	4.44	10.43	12.3	4.06	3.47	828.81	16.0414
15:04:58	1448.77	108	1382	436	1144	1358	474	11.58	4.02	4.51	10.43	12.09	3.93	1.86	828.83	16.0187
15:05:28	1448.84	107	1487	430	1254	1478	478	11.58	3.9	4.26	10.41	11.94	3.9	7.82	828.99	16.0295
15:05:58	1448.91	107	1458	438	1281	1441	514	11.58	3.81	4.05	10.43	12.09	4	8.32	829.16	16.0363
15:06:28	1448.94	107	1411	433	1168	1346	421	11.61	3.83	4.29	10.45	12.26	4.19	3.68	829	16.0449
15:06:58	1448.85	108	1405	435	1154	1344	417	11.59	3.92	4.38	10.44	12.09	4.17	1.99	829.03	16.0532
15:07:28	1448.89	108	1364	434	1140	1336	421	11.58	4.07	4.58	10.43	12.11	4.02	3.9	829.09	16.0615
15:07:58	1449.01	107	1427	431	1167	1378	446	11.57	3.86	4.22	10.41	12.03	3.97	2.81	829.26	16.0695
15:08:28	1449.07	105	1535	428	1321	1486	458	11.61	3.44	3.96	10.38	12.06	4.14	2.18	829.34	16.0781
15:08:58	1449.15	107	1504	433	1239	1445	456	11.62	3.5	3.88	10.37	12.16	4.07	3.18	829.49	16.0863
15:09:28	1449.13	107	1662	431	1346	2460	1746	11.6	3.66	4.19	10.37	12.78	6.88	2.52	829.36	16.0947
15:09:58	1449.24	108	1556	436	1230	2267	1395	11.59	3.66	3.76	10.39	12.69	6.27	13.98	829.58	16.101
15:10:28	1449.32	108	1507	434	1336	2507	1612	11.61	3.45	3.45	10.37	12.78	6.22	10.24	829.36	16.1114
15:10:58	1449.42	109	1474	438	1177	1868	446	11.58	3.59	3.67	10.4	12.18	4.24	11.63	829.47	16.1197
15:11:28	1449.45	108	1358	436	1068	1286	401	11.61	4.3	5.12	10.44	12.18	3.83	3.85	829.49	16.1283
15:11:58	1449.46	108	1359	433	1073	1247	353	11.62	4.1	5.01	10.46	12.33	3.9	-0.28	829.51	16.1368
15:12:28	1449.47	108	1373	433	1083	1289	385	11.63	4.05	4.71	10.46	12.18	3.83	2.2	829.53	16.1448
15:12:58	1449.49	108	1385	437	1095	1283	365	11.62	3.86	4.42	10.46	12.14	3.73	2.86	829.54	16.1532
15:13:28	1449.51	108	1391	436	1111	1271	352	11.62	3.84	4.36	10.45	12.14	3.86	2.88	829.56	16.1615
15:13:58	1449.54	107	1466	431	1123	1279	328	11.62	3.71	4.02	10.45	12.08	3.84	2.03	829.58	16.1698
15:14:28	1449.56	107	1416	439	1134	1276	320	11.58	3.79	4.13	10.45	12.08	3.78	2.02	829.61	16.1781
15:14:58	1449.58	108	1431	434	1147	1283	320	11.62	3.49	3.82	10.45	12.16	3.73	4.88	829.64	16.1864
15:15:28	1449.64	108	1453	432	1162	1303	312	11.63	3.5	3.69	10.44	11.97	3.52	6.31	829.7	16.1947
15:15:58	1449.71	108	1429	431	1149	1303	356	11.64	3.37	3.45	10.43	12.04	3.63	7.66	829.79	16.2031
15:16:28	1449.77	107	1425	430	1161	1298	346	11.64	3.4	3.44	10.43	12.11	3.73	7.28	829.87	16.2113
15:16:58	1449.83	107	1427	433	1135	1288	339	11.63	3.5	3.44	10.44	12.14	3.81	8.13	829.88	16.2196
15:17:28	1449.88	108	1429	432	1133	1287	368	11.63	3.33	3.25	10.44	11.94	3.68	6.31	829.93	16.2282
15:17:58	1449.93	108	1386	433	1080	1263	365	11.62	3.73	4	10.45	11.87	3.57	5.14	829.97	16.2365
15:18:28	1449.96	108	1385	436	1089	1258	356	11.61	4.06	4.62	10.46	12.06	3.59	3.15	830.01	16.2448
15:18:58	1449.97	107	1386	431	1089	1228	369	11.6	3.97	4.52	10.47	12.09	3.59	1.7	830.03	16.2532
15:19:28	1449.98	108	1425	427	1129	1303	389	11.6	3.86	3.99	10.46	12.14	3.76	0.91	830.05	16.2615
15:19:58	1450.01	107	1468	429	1185	1349	320	11.6	3.43	3.26	10.46	12.11	3.65	4.45	830.06	16.2698
15:20:28	1450.09	108	1523	428	1328	1401	281	11.58	3.43	3.04	10.43	12.18	3.95	8.28	830.14	16.2781
15:20:58	1450.19	108	1494	427	1251	1401	401	11.54	3.38	3.13	10.43	12.09	3.78	12.13	830.23	16.2864
15:21:28	1450.28	107	1467	430	1194	1384	421	11.53	3.33	3.12	10.43	12.19	4.05	12.17	830.34	16.2947
15:21:58	1450.35	108	1507	426	1324	1425	442	11.56	3.34	3.18	10.42	11.99	3.66	7.92	830.4	16.303

DOE high power mortor test Amaco Catoosa Test Site

Well No. #3	Date: 3/27/98																
Starting Depth =	1382.40			Bit Type =	Walker McDonald MP58H												
Ending Depth =	1450.02			Bit Size =	4.75												
Total Depth Drilled	67.62			Bit Nozzles =		5, 5, 12, 12											
Hours On Bit =	5.73			Mud Type =		Water Based											
Average ROP =	11.80			Mud Weight (lbs/gal)		8.90											
Drillstring (ft) =	1419.80			Pipe (ft) =	1010.82				Collar (ft)=	408.60							
TIME	BIT DEPTH	FLOW	PRES	SPEED	TORQUE	PEAK	DELT	HOOK LOAD	PEAK	DELTA	WOB	PEAK	DELTA	ROP	Feet	Hours	
HH:MM:SS	FEET	GPM	PSI	RPM	ft-lbs	ft-lbs	ft-lbs	KIPS	G's	G's	KIPS	KIPS	KIPS	FT/HR	Drilled	Drilled	
15:22:26	1450.44	107	1498	432	1167	1390	466	11.66	3.27	2.07	10.41	11.97	3.86	10.87	630.81	16.3016	
15:22:56	1450.52	107	1492	436	1136	1368	423	11.58	3.68	4.54	10.40	11.83	3.26	6.69	630.97	16.3159	
15:23:26	1450.54	106	1356	493	1069	1160	277	11.49	3.99	4.86	10.46	11.92	3.38	2.67	630.6	16.3282	
15:23:56	1450.55	106	1307	434	1068	1196	284	11.48	4.62	4.83	10.46	11.84	3.26	1.79	630.61	16.3365	
15:24:26	1450.57	108	1371	432	1076	1218	309	11.5	3.85	4.53	10.46	12.11	3.84	1.61	630.61	16.3448	
15:24:56	1450.64	108	1399	433	1117	1263	356	11.56	3.81	4.28	11.26	13.59	4.45	4.35	630.62	16.3581	
15:25:26	1450.69	106	1436	426	1158	1283	353	10	3.8	4.24	11.06	13.58	0.6	3.67	630.66	16.3614	
15:25:56	1450.69	107	1445	430	1185	1205	307	10.01	3.85	4.17	11.85	13.30	0.94	0.18	630.66	16.3697	
15:26:26	1450.61	107	1483	431	1133	1324	289	10.01	3.53	3.08	11.95	13.52	3.21	1.65	630.66	16.378	
15:27:26	1450.02	109	883	439	913	1128	466	24.16	2.09	0.87	-2.27	-2.01	0.57	2.12	630.7	16.3789	
15:27:56	1450.02	111	902	444	918	1130	306	24.16	2.04	0.6	-2.28	-2.03	0.53	-0.13	630.7	16.3789	
15:28:26	1450	110	903	441	935	1166	494	24.17	2.06	0.57	-2.26	-2.01	0.55	-1.49	630.7	16.3789	


DOE Slim-Hole System Test
Prototype Test
Drilling Rate (ft/hr)
400
350
300
250
200
150
100
50
0
600
700
800
900
1000
1100
1200
1300
1400
1500
Formation Depth (ft)
Day 1
Day 2
Day 3


Bit Weight As A Fuction Of Depth
Prototype Test
Bit Weight (x1000 lbs)
14
12
10
8
6
4
2
0
600
700
800
900
1000
1100
1200
1300
1400
1500
Depth (ft)

APPENDIX C
DOE High-Power Slim-Hole System
Catoosa Field Test No. 2

- BHA 1
- BHA 2
- BhA 3

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 8	Date: 12/14/98 to 12/15/98													
Starting Depth =	1596.63		Bit Type =	Walker McDonald MP66H							Average ROP Excluding Hard Streak			
Ending Depth =	1694.42		Bit Size =	4.75										
Total Depth Drilled	97.79		Bit Nozzles =	9, 9, 12, 12							Depth Drilled =	91.63		
Hours On Bit =	4.7650		Mud Type =	Water Based							Hours On Bit =	3.35		
Average ROP =	20.51		Mud Weight (lbs/gal) =	9.00							Average ROP =	27.32		
Drillstring (ft) =	1631.70		Pipe (ft) =	883.16		Collar (ft) =		748.54						

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
18:16:00	0.0000	1596.63	193	31	667	25.82	2.71		53.37	0.00	0.0000	0.0000		
18:16:16	0.0028	1596.88	108	219	396	28.81	-0.53		90.75	0.25	0.0028	0.0028		
18:17:07	0.0186	1597.14	88	993	315	28.27	-0.50		15.84	0.51	0.0158	0.0185		
18:18:07	0.0353	1596.90	78	849	288	28.63	-2.50		-14.15	0.27	0.0167	0.0353		
18:18:27	0.0408	1597.15	78	812	283	27.72	0.37	-0.09	47.15	0.52	0.0056	0.0408		
18:18:32	0.0450	1597.41	77	831	287	27.89	0.01	-0.83	59.38	0.78	0.0042	0.0450		
18:18:45	0.0458	1597.66	78	831	288	27.90	-0.10	-0.94	335.10	1.02	0.0008	0.0458		22.47
18:18:50	0.0472	1597.92	78	832	286	27.87	0.12	-0.42	196.50	1.29	0.0014	0.0472		
18:18:52	0.0478	1598.17	78	835	288	27.70	0.08	0.10	392.50	1.54	0.0006	0.0478		
18:18:56	0.0488	1598.42	78	836	289	27.84	-0.12	0.00	303.56	1.79	0.0008	0.0486	36.82	
18:18:59	0.0497	1598.68	78	838	288	27.70	0.11	0.02	348.67	2.05	0.0011	0.0497	38.54	362.29
18:19:01	0.0503	1598.94	77	840	287	27.69	0.10	0.06	409.57	2.31	0.0006	0.0503	96.84	
18:19:04	0.0511	1599.19	78	839	290	27.88	-0.08	0.02	313.50	2.56	0.0008	0.0511	148.63	
18:19:10	0.0528	1599.44	78	841	291	27.71	0.05	0.02	181.37	2.81	0.0017	0.0528	191.72	
18:19:16	0.0544	1599.68	78	845	290	27.68	0.10	0.06	158.38	3.05	0.0017	0.0544	241.41	213.88
18:19:21	0.0558	1599.94	80	847	294	27.67	0.13	0.07	183.63	3.31	0.0014	0.0558	228.00	
18:19:26	0.0569	1600.19	80	850	295	27.65	0.11	0.07	208.71	3.56	0.0011	0.0569	213.49	
18:19:31	0.0586	1600.45	80	853	295	27.83	-0.01	0.08	184.99	3.82	0.0017	0.0586	210.46	
18:19:35	0.0597	1600.70	80	855	296	27.85	0.14	0.09	248.40	4.07	0.0011	0.0597	205.20	191.37
18:19:39	0.0608	1600.95	80	856	297	27.81	0.16	0.11	266.71	4.32	0.0011	0.0608	204.39	
18:19:41	0.0614	1601.20	81	858	298	27.80	0.18	0.12	356.81	4.57	0.0006	0.0614	203.46	
18:19:44	0.0622	1601.46	81	861	298	27.88	0.12	0.12	331.75	4.83	0.0008	0.0622	204.36	
18:19:55	0.0650	1601.71	81	867	298	27.59	0.12	0.15	77.35	5.08	0.0033	0.0656	177.65	
18:19:58	0.0661	1601.96	81	873	300	27.74	0.06	0.13	373.37	5.33	0.0006	0.0661	194.67	187.22
18:20:03	0.0675	1602.21	81	876	301	27.73	0.07	0.11	378.52	5.58	0.0014	0.0675	194.57	
18:20:13	0.0703	1602.47	82	883	302	27.66	0.14	0.10	98.20	5.84	0.0028	0.0703	171.00	
18:20:14	0.0706	1602.72	82	887	302	27.69	0.11	0.10	871.60	6.09	0.0003	0.0706	160.05	
18:20:26	0.0739	1602.97	82	893	303	27.89	-0.05	0.05	74.34	6.34	0.0033	0.0739	156.24	129.86
18:20:34	0.0761	1603.23	83	902	307	27.77	0.04	0.05	125.97	6.60	0.0022	0.0761	149.24	
18:20:39	0.0775	1603.48	83	908	307	27.72	0.09	0.06	168.16	6.85	0.0014	0.0775	141.52	
18:20:47	0.0797	1603.73	84	916	308	27.72	0.06	0.06	117.37	7.10	0.0022	0.0797	129.71	
18:20:55	0.0819	1603.99	84	926	311	27.58	0.21	0.07	114.12	7.35	0.0022	0.0819	139.12	126.82
18:21:05	0.0847	1604.24	85	937	313	27.72	0.08	0.10	86.50	7.61	0.0025	0.0847	122.51	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1556.63			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	91.84		
Hours On Bit =	4.7900			Mud Type =	Water Based						Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =	9.6#						Average ROP	27.33		
Drillstring (ft) =	1631.70			Pipe (ft) =	883.36		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
18:21:17	0.0881	1604.49	86	953	317	27.52	0.18	0.13	76.77	7.86	0.0033	0.0881	118.92	
18:21:28	0.0911	1604.74	87	968	319	27.52	0.26	0.16	60.33	8.11	0.0031	0.0911	168.96	
18:21:30	0.0917	1604.89	87	975	319	27.54	0.28	0.20	426.42	8.36	0.0006	0.0917	167.53	102.86
18:21:34	0.0928	1605.25	87	988	320	27.59	0.22	0.21	242.83	8.62	0.0011	0.0928	120.71	
18:21:37	0.0936	1605.50	87	993	321	27.76	0.07	0.20	268.93	8.87	0.0008	0.0936	129.71	
18:21:41	0.0947	1605.75	87	997	320	27.62	0.18	0.20	244.03	9.12	0.0011	0.0947	121.81	
18:21:57	0.0992	1606.00	88	1008	323	27.66	0.13	0.18	56.20	9.37	0.0044	0.0992	118.74	134.67
18:22:21	0.1058	1606.25	89	1025	328	27.64	0.25	0.17	36.70	9.62	0.0067	0.1058	94.60	
18:22:49	0.1136	1606.51	90	1047	332	27.64	0.16	0.16	33.31	9.88	0.0078	0.1136	75.98	
18:23:15	0.1208	1606.76	92	1066	336	27.62	0.21	0.18	35.22	10.13	0.0072	0.1208	69.25	
18:23:27	0.1242	1607.01	93	1084	340	27.65	0.26	0.20	72.27	10.38	0.0033	0.1242	66.67	40.40
18:23:40	0.1278	1607.27	93	1094	341	27.56	0.21	0.22	70.92	10.64	0.0036	0.1278	69.14	
18:24:02	0.1339	1607.52	94	1109	345	27.53	0.25	0.22	41.43	10.89	0.0061	0.1339	66.22	
18:24:15	0.1375	1607.77	95	1127	349	27.55	0.24	0.23	74.14	11.14	0.0036	0.1375	51.72	
18:24:47	0.1464	1608.03	96	1147	352	27.61	0.18	0.23	58.82	11.40	0.0089	0.1464	44.13	48.60
18:24:48	0.1467	1608.28	97	1160	357	27.55	8.05	-1.43	711.10	11.66	0.0003	0.1467	48.21	
18:25:48	0.1633	1608.46	98	1162	358	27.58	-0.84	-1.66	10.33	11.83	0.0167	0.1633	28.43	
18:26:14	0.1709	1608.71	95	1180	360	27.56	0.22	-1.57	34.19	12.08	0.0072	0.1706	28.63	
18:26:48	0.1803	1608.97	98	1187	362	27.53	0.26	-1.57	27.08	12.34	0.0094	0.1806	27.35	
18:27:11	0.1864	1609.22	98	1183	361	27.51	0.25	-1.65	40.11	12.59	0.0064	0.1864	26.50	29.75
18:27:29	0.1911	1609.47	98	1182	361	27.50	0.23	6.02	54.52	12.84	0.0047	0.1911	34.74	
18:28:02	0.2006	1609.73	100	1205	366	27.58	0.24	0.26	25.34	13.10	0.0094	0.2006	33.16	
18:28:24	0.2067	1609.98	95	1144	350	27.53	0.27	0.27	41.30	13.35	0.0061	0.2067	31.95	
18:28:58	0.2161	1610.23	99	1185	361	27.54	0.25	0.27	27.15	13.60	0.0094	0.2161	31.55	33.68
18:29:22	0.2228	1610.48	98	1184	363	27.59	0.20	0.25	37.67	13.85	0.0067	0.2228	28.77	
18:29:37	0.2269	1610.74	99	1180	361	27.54	0.26	0.24	60.17	14.11	0.0042	0.2269	28.84	
18:29:59	0.2331	1610.99	100	1202	366	27.60	0.29	0.25	41.52	14.36	0.0061	0.2331	26.48	
18:30:36	0.2405	1611.24	99	1183	362	27.50	0.29	0.26	33.02	14.61	0.0075	0.2406	27.49	41.32
18:30:53	0.2481	1611.49	99	1197	365	27.60	0.29	0.27	34.15	14.86	0.0075	0.2481	26.61	
18:31:08	0.2517	1611.74	100	1215	369	27.47	0.31	0.29	70.59	15.11	0.0036	0.2517	27.49	
18:31:21	0.2558	1611.99	101	1229	369	27.54	0.24	0.28	60.29	15.36	0.0042	0.2558	26.88	
18:31:45	0.2628	1612.25	100	1213	366	27.58	0.29	0.27	36.36	15.62	0.0069	0.2628	26.46	26.45

DOE high power mortor test Amaco Catoosa Test Site — DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1586.63			Bit Type =	Walker McDonald MF68R						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	91.84		
Hours On Bit =	4.7000			Mud Type =		Water Based					Hours On Bit =	3.38		
Average ROP =	20.81			Mud Weight (lbs/gal) =		8.50					Average ROP	27.32		
Drillstring (ft) =	1631.79			Pipe (ft) =	853.16		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
18:16:00	0.0000	1586.63	183	31	657	25.82	2.71		53.37	0.00	0.0000	0.0000		
18:16:10	0.0028	1586.88	103	219	395	25.81	-0.52		90.78	0.25	0.0028	0.0028		
18:17:07	0.0185	1587.14	86	993	315	25.27	-0.56		15.84	0.51	0.0156	0.0183		
18:18:07	0.0353	1588.90	78	849	288	28.63	-2.56		-14.15	0.27	0.0167	0.0350		
18:18:27	0.0408	1587.15	76	812	283	27.72	0.37	-0.09	47.15	6.52	0.0056	0.0406		
18:18:42	0.0450	1587.41	77	831	287	27.86	0.01	-0.63	58.38	0.78	0.0042	0.0450		
18:18:45	0.0458	1587.66	78	831	289	27.96	-0.10	-0.54	335.10	1.03	0.0008	0.0458		22.47
18:18:50	0.0472	1587.82	78	832	289	27.97	0.12	-0.52	196.30	1.29	0.0014	0.0472		
18:18:52	0.0478	1588.17	78	835	288	27.79	0.08	0.10	392.50	1.54	0.0006	0.0478		
18:18:55	0.0486	1588.42	78	836	289	27.94	-0.12	0.09	303.68	1.79	0.0008	0.0486	36.92	
18:18:59	0.0497	1588.68	78	838	288	27.79	0.11	0.02	248.87	2.05	0.0011	0.0497	38.34	252.29
18:19:01	0.0503	1588.94	77	840	287	27.69	0.10	0.06	466.57	2.31	0.0006	0.0503	56.61	
18:19:04	0.0511	1589.19	78	838	290	27.88	-0.08	0.02	312.50	2.56	0.0008	0.0511	144.63	
18:19:10	0.0528	1589.44	78	841	291	27.71	0.09	0.02	151.37	2.81	0.0017	0.0528	181.72	
18:19:18	0.0544	1589.68	78	845	290	27.68	0.10	0.06	158.30	3.06	0.0017	0.0544	241.41	213.85
18:19:21	0.0553	1589.94	80	847	294	27.67	0.13	0.07	183.63	3.31	0.0014	0.0558	226.06	
18:19:25	0.0569	1600.19	80	850	295	27.68	0.11	0.07	205.71	3.56	0.0011	0.0569	233.49	
18:19:31	0.0586	1600.45	80	853	295	27.83	-0.01	0.08	154.69	3.82	0.0017	0.0586	210.46	
18:19:35	0.0597	1600.70	80	855	296	27.66	0.14	0.09	248.40	4.07	0.0011	0.0597	205.20	181.37
18:19:39	0.0608	1600.95	80	856	297	27.61	0.16	0.11	205.71	4.32	0.0011	0.0608	204.30	
18:19:41	0.0614	1601.20	81	858	298	27.66	0.18	0.12	358.81	4.57	0.0006	0.0614	203.40	
18:19:44	0.0622	1601.46	81	861	298	27.58	0.12	0.12	331.75	4.83	0.0008	0.0622	204.38	
18:19:58	0.0656	1601.71	81	867	298	27.59	0.32	0.15	77.38	5.08	0.0033	0.0655	177.65	
18:19:58	0.0681	1601.96	81	873	300	27.74	0.08	0.13	373.27	5.33	0.0036	0.0691	194.57	197.23
18:20:03	0.0675	1602.21	81	876	301	27.73	0.07	0.11	178.92	5.58	0.0014	0.0875	194.57	
18:20:13	0.0703	1602.47	82	882	302	27.66	0.14	0.10	98.20	5.84	0.0028	0.0703	171.00	
18:20:14	0.0706	1602.72	82	887	302	27.69	0.11	0.10	671.60	6.09	0.0003	0.0706	150.66	
18:20:26	0.0739	1602.97	82	893	303	27.86	-0.06	0.06	76.34	6.34	0.0033	0.0739	160.24	125.86
18:20:34	0.0761	1603.23	83	902	307	27.77	0.04	0.06	125.97	6.60	0.0022	0.0761	149.34	
18:20:38	0.0775	1603.48	83	908	307	27.72	0.09	0.06	166.38	6.85	0.0014	0.0775	141.52	
18:20:47	0.0797	1603.73	84	914	308	27.72	0.06	0.05	117.37	7.10	0.0022	0.0797	139.71	
18:20:55	0.0819	1603.99	84	923	311	27.56	0.21	0.07	114.12	7.36	0.0022	0.0819	139.12	136.62
18:21:05	0.0847	1604.24	85	937	312	27.72	0.09	0.10	90.50	7.61	0.0028	0.0847	122.51	

DOE high power mortor test Amaco Catoosa Test Site — DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1596.63			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =		8, 9, 12, 12					Depth Drilled =	96.84		
Hours On Bit =	4.7833			Mud Type =		Water Based					Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =		8.60					Average ROP	27.32		
Drillstring (ft) =	1631.79			Pipe (ft) =	893.18		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
18:32:05	0.2681	1612.50	98	1184	380	27.61	0.19	0.24	48.43	15.87	0.0053	0.2681	43.70	
18:32:27	0.2742	1612.75	89	1185	383	27.54	0.25	0.24	40.52	16.12	0.0061	0.2742	44.17	
18:32:54	0.2817	1613.00	99	1191	382	27.54	0.25	0.22	33.73	16.37	0.0075	0.2817	41.30	
18:33:06	0.2850	1613.20	96	1176	389	27.49	0.29	0.23	78.75	16.63	0.0033	0.2850	43.70	45.45
18:33:37	0.2936	1613.51	96	1180	390	27.55	0.23	0.24	26.65	16.88	0.0086	0.2936	42.79	
18:34:02	0.3006	1613.76	100	1193	386	27.60	0.27	0.26	35.80	17.13	0.0069	0.3006	43.24	
18:34:21	0.3058	1614.01	99	1180	391	27.51	0.27	0.26	48.30	17.38	0.0053	0.3058	41.61	
18:34:34	0.3094	1614.26	98	1189	390	27.47	0.32	0.28	66.77	17.63	0.0036	0.3094	42.34	40.91
18:35:34	0.3261	1614.34	99	1331	361	25.62	1.69	0.60	4.80	17.71	0.0167	0.3261	33.00	
18:36:34	0.3428	1614.54	100	1412	367	24.08	3.57	1.26	6.20	17.71	0.0167	0.3428	24.62	
18:37:34	0.3594	1614.44	101	1383	368	24.69	2.79	1.77	5.73	17.81	0.0167	0.3594	19.82	
18:38:34	0.3761	1614.62	89	1367	364	24.96	2.73	2.28	4.65	17.89	0.0167	0.3761	16.09	
18:39:34	0.3928	1614.87	95	1331	359	25.36	2.36	2.66	3.03	17.94	0.0167	0.3928	13.15	
18:40:34	0.4094	1614.73	97	1317	358	24.80	2.68	2.85	9.36	18.08	0.0167	0.4094	10.36	
18:41:34	0.4261	1614.76	95	1323	358	25.14	2.65	2.68	3.36	18.13	0.0167	0.4261	7.99	
18:42:34	0.4428	1614.81	98	1320	360	25.32	2.38	2.58	2.94	18.18	0.0167	0.4428	5.84	
18:43:34	0.4594	1614.87	96	1300	358	25.64	2.67	2.44	3.27	18.24	0.0167	0.4594	4.07	
18:44:34	0.4761	1614.91	96	1319	358	24.96	2.82	2.64	2.69	18.28	0.0167	0.4761	3.80	
18:45:34	0.4928	1614.98	99	1340	362	24.64	3.03	2.57	3.85	18.35	0.0167	0.4928	4.27	
18:46:34	0.5094	1613.54	97	1182	355	27.69	-0.90	1.88	-86.23	16.91	0.0167	0.5094	-6.06	
18:46:57	0.5158	1613.78	103	1253	361	26.05	-1.11	1.18	39.73	17.15	0.0064	0.5158	-5.22	
18:47:57	0.5325	1613.53	109	1361	396	28.11	-1.09	0.55	-16.07	16.89	0.0167	0.5325	-7.61	
18:48:39	0.5442	1613.77	109	1365	397	27.81	-0.01	-0.02	21.65	17.14	0.0117	0.5442	-6.98	
18:48:55	0.5486	1614.02	109	1361	397	27.95	0.32	-0.58	57.36	17.39	0.0044	0.5486	-6.04	
18:49:26	0.5572	1614.28	109	1366	398	27.59	0.19	-0.36	28.89	17.65	0.0086	0.5572	-4.63	
18:49:49	0.5639	1614.53	109	1359	399	27.87	0.23	-0.30	40.02	17.90	0.0064	0.5639	-3.26	
18:50:35	0.5764	1614.79	109	1374	398	27.58	0.28	0.15	19.78	18.16	0.0125	0.5764	-1.26	
18:51:35	0.5931	1614.86	106	1393	387	26.22	1.51	0.47	10.44	18.23	0.0167	0.5931	-0.59	
18:51:53	0.5981	1615.21	36	1398	353	22.21	4.88	1.40	51.81	18.58	0.0050	0.5981	15.65	3.29
18:52:54	0.6150	1614.98	103	1384	378	24.97	2.25	1.81	-83.35	17.45	0.0169	0.6150	2.92	
18:53:54	0.6317	1614.94	113	1390	413	28.13	-0.42	1.69	-2.79	17.81	0.0167	0.6317	5.24	
18:54:27	0.6408	1614.29	113	1385	411	27.81	-0.02	1.64	27.85	17.65	0.0092	0.6408	5.36	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1598.53			Bit Type =	Walker McDonnale MF68H						Average ROP Excluding Hard Streak			
Ending Depth =	1698.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	91.84		
Hours On Bit =	4.70.00			Mud Type =		Water Based					Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =		8.60					Average ROP	27.32		
Drillstring (ft) =	1631.70			Pipe (ft) =	883.16		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
18:54:48	0.6467	1614.56	113	1385	412	27.57	0.22	1.38	43.40	17.92	0.0058	0.6467	6.41	
18:55:08	0.6522	1614.80	115	1381	413	27.60	0.19	0.45	44.56	18.17	0.0056	0.6522	6.47	
18:55:49	0.6636	1615.05	113	1382	412	27.57	0.21	0.04	22.73	18.42	0.0114	0.6636	5.20	
18:56:49	0.6803	1615.16	102	1386	372	24.06	3.58	0.64	6.03	18.53	0.0167	0.6803	3.56	
18:57:36	0.6939	1615.41	91	1373	334	20.83	0.68	2.18	18.44	18.78	0.0136	0.6939	3.48	
18:58:36	0.7106	1614.77	114	1379	413	28.16	-0.56	1.64	-38.45	18.14	0.0167	0.7106	-3.81	
18:59:36	0.7272	1614.89	39	596	152	28.44	-0.62	1.78	7.58	18.27	0.0167	0.7272	7.31	
19:00:36	0.7439	1614.79	71	756	264	28.10	-0.29	1.68	-6.34	18.15	0.0167	0.7439	6.68	
19:01:36	0.7606	1614.75	112	1355	409	28.06	-0.85	9.77	-3.76	18.12	0.0167	0.7606	3.64	
19:02:23	0.7731	1615.09	114	1387	413	27.86	-0.01	-0.57	20.32	18.37	0.0125	0.7731	3.58	
19:02:37	0.7769	1615.25	113	1356	410	27.84	0.14	-0.35	65.61	18.62	0.0039	0.7769	3.81	
19:03:36	0.7933	1615.59	111	1532	405	25.50	2.26	0.22	16.13	18.87	0.0164	0.7933	3.47	
19:04:09	0.8014	1615.75	110	1725	400	22.11	5.45	1.37	31.47	19.12	0.0081	0.8014	4.87	
19:04:33	0.8082	1616.09	109	1648	398	18.79	8.72	3.36	32.99	19.37	0.0078	0.8082	5.12	
19:04:59	0.8164	1616.26	108	1660	399	20.13	7.36	4.77	34.96	19.63	0.0072	0.8164	14.56	4.81
19:05:59	0.8331	1615.86	113	1519	411	26.39	0.35	4.82	-22.92	19.25	0.0167	0.8331	8.26	
19:11:56	0.9322	1615.92	112	1333	408	27.57	0.21	4.42	33.91	19.29	0.0992	0.9320	6.10	
19:12:07	0.9353	1616.17	112	1338	407	27.36	0.21	3.37	82.69	19.54	0.0031	0.9353	8.13	
19:12:47	0.9464	1616.43	111	1352	405	24.83	2.83	2.19	22.97	19.69	0.0111	0.9464	8.25	
19:13:12	0.9533	1616.68	111	1604	403	19.86	7.60	3.24	35.55	20.05	0.0069	0.9533	8.11	
19:13:39	0.9606	1616.93	110	1620	400	19.39	7.86	3.74	33.37	20.30	0.0075	0.9608	8.53	
19:14:12	0.9700	1617.18	111	1642	403	19.32	8.12	5.32	27.45	20.55	0.0092	0.9700	8.48	5.83
19:14:41	0.9781	1617.43	111	1648	404	18.20	8.23	6.53	31.75	20.80	0.0081	0.9781	8.47	
19:15:01	0.9836	1617.68	113	1620	407	20.76	6.55	7.67	46.00	21.05	0.0056	0.9836	8.49	
19:16:02	1.0008	1618.35	111	1586	404	20.21	5.62	7.28	-2.86	21.52	0.0169	1.0006	13.55	34.75
19:16:35	1.0097	1618.40	111	1746	405	22.48	5.08	6.72	28.80	21.77	0.0092	1.0097	32.50	
19:17:19	1.0194	1618.85	112	1795	407	19.77	7.69	6.63	25.90	22.02	0.0097	1.0194	28.47	
19:17:39	1.0272	1618.90	111	1835	403	19.80	7.58	6.56	33.17	22.27	0.0078	1.0272	30.56	
19:18:05	1.0347	1619.16	112	1803	406	21.94	5.80	6.31	33.62	22.53	0.0075	1.0347	30.47	29.56
19:18:29	1.0414	1619.41	111	1878	404	19.47	7.96	6.79	37.53	22.78	0.0067	1.0414	30.79	
19:19:00	1.0503	1619.66	112	1813	406	19.67	7.76	7.31	28.83	23.03	0.0089	1.0503	31.69	32.73

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 8	Date: 12/14/98 to 12/15/98														
Starting Depth =	1586.63			Bit Type =	Walker McDonnald MF66R							Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75										
Total Depth Drilled	97.79			Bit Nozzles =		8, 9, 12, 12						Depth Drilled =	81.84		
Hours On Bit =	4.7000			Mud Type =		Water Based						Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =		9.00						Average ROP	27.33		
Drillstring (ft) =	1631.70			Pipe (ft) =	883.18		Collar (ft) =		748.54						

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
8:18:05	1.0500	1618.81	119	1497	433	28.33	0.35		-35.91	22.18	0.5300	1.0500		
8:18:37	1.0586	1619.06	119	1462	432	28.54	-1.35		30.02	22.43	0.0086	1.0586		
8:19:37	1.0753	1618.85	115	1396	421	26.56	-1.81		-13.04	22.22	0.0167	1.0753		
8:19:55	1.0814	1619.11	110	1277	400	25.60	-8.53		43.68	22.48	0.0061	1.0814		
8:20:55	1.0981	1619.06	110	1280	402	25.29	-8.41	-6.75	-16.24	22.43	0.0167	1.0981		
8:21:07	1.1003	1619.31	111	1284	403	25.13	0.71	-6.68	188.70	22.68	0.0022	1.1003		
8:21:26	1.1056	1619.56	110	1285	400	25.14	0.72	-6.28	48.32	22.93	0.0053	1.1056		
8:22:09	1.1178	1619.81	110	1603	401	25.72	4.95	1.09	20.87	23.18	0.0119	1.1175		14.81
8:22:36	1.1253	1620.06	110	1766	403	26.76	7.77	2.75	33.72	23.43	0.0075	1.1253		
8:23:06	1.1333	1620.32	111	1773	404	26.36	8.16	4.47	26.77	23.69	0.0083	1.1331	18.12	
8:23:37	1.1419	1620.57	111	1756	404	21.84	7.66	5.75	29.85	23.94	0.0086	1.1419	18.12	
8:24:08	1.1508	1620.83	111	1781	405	22.55	8.07	6.80	28.87	24.19	0.0086	1.1506	26.17	30.55
8:24:36	1.1583	1621.07	111	1751	405	23.14	8.50	6.91	32.68	24.44	0.0078	1.1583	25.47	
8:25:10	1.1678	1621.32	112	1717	407	22.90	5.76	6.53	28.09	24.69	0.0094	1.1678	32.41	
8:25:39	1.1756	1621.57	111	1685	406	20.62	7.91	6.46	31.43	24.94	0.0081	1.1756	29.91	
8:26:02	1.1822	1621.82	112	1790	407	22.62	5.99	6.25	38.97	25.19	0.0064	1.1822	29.48	31.58
8:26:33	1.1908	1622.07	112	1743	409	23.58	5.22	6.06	28.33	25.44	0.0086	1.1908	30.82	
8:26:59	1.1981	1622.32	113	1560	412	21.31	7.24	6.42	35.33	25.69	0.0072	1.1981	30.94	
8:27:23	1.2044	1622.57	114	1777	413	23.47	5.18	6.31	38.28	25.94	0.0064	1.2044	35.64	
8:27:57	1.2142	1622.82	116	1769	417	23.58	5.37	5.90	26.10	26.20	0.0097	1.2142	31.29	31.62
8:28:24	1.2217	1623.08	115	1852	417	22.98	6.33	5.87	33.20	26.45	0.0075	1.2217	31.75	
8:28:47	1.2281	1623.33	116	1790	417	23.16	5.44	5.91	30.20	26.70	0.0064	1.2281	32.41	
8:29:24	1.2383	1623.58	116	1772	418	23.30	5.35	5.69	24.95	26.95	0.0103	1.2383	32.03	
8:29:51	1.2458	1623.83	116	1854	420	23.83	6.79	5.64	30.44	27.20	0.0075	1.2458	32.29	31.58
8:30:22	1.2544	1624.08	116	1758	421	24.28	4.38	5.64	29.31	27.45	0.0086	1.2544	31.29	
8:30:54	1.2633	1624.34	116	1769	421	23.13	5.46	5.47	28.05	27.71	0.0089	1.2633	31.31	
8:31:21	1.2708	1624.59	115	1827	420	22.85	5.95	5.57	33.38	27.96	0.0075	1.2708	31.19	
8:31:58	1.2811	1624.84	116	1745	422	23.13	4.30	5.46	24.54	28.21	0.0103	1.2811	29.61	28.63
8:32:32	1.2906	1625.09	117	1784	425	24.22	4.48	4.95	28.48	28.46	0.0094	1.2906	29.59	
8:33:02	1.3003	1625.34	116	1762	427	24.52	4.14	4.90	25.92	28.71	0.0097	1.3003	28.75	
8:33:44	1.3106	1625.60	117	1772	428	24.76	3.96	4.80	24.58	28.97	0.0103	1.3106	27.52	
8:34:08	1.3172	1625.85	116	1826	428	23.09	5.48	4.51	39.04	29.22	0.0067	1.3172	28.77	27.97

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Visit No. 5	Date: 12/14/98 to 12/15/98													
Starting Depth =	1596.83			Bit Type =	Walker McDonnald MP58H						Average ROP Excluding Hard Streak.			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	91.84		
Hours On Bit =	4.7000			Mud Type =		Water Based					Hours On Bit =	3.38		
Average ROP =	20.81			Mud Weight (lbs/gal) =		9.00					Average ROP	27.33		
Drillstring (ft) =	1831.70			Pipe (ft) =	883.16		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
8:34:51	1.3292	1626.10	116	1780	426	24.86	3.80	4.37	20.52	29.47	0.0113	1.3292	27.24	
8:35:40	1.3428	1626.36	117	1767	427	21.74	4.88	4.45	18.61	29.72	0.0136	1.3428	25.70	
8:36:29	1.3508	1626.60	117	1803	427	25.18	5.61	4.53	31.62	29.97	0.0081	1.3508	26.85	
8:37:39	1.3675	1626.81	117	1706	427	21.65	4.98	4.53	12.55	30.18	0.0167	1.3675	22.97	19.09
8:37:47	1.3781	1627.17	118	1780	427	25.76	7.72	4.96	34.12	30.54	0.0106	1.3781	24.03	34.11
8:50:34	1.3781	1631.79	113	1313	412	29.60	5.72		48.53	35.16	0.0000	1.3781		
8:51:34	1.3947	1631.97	113	1307	418	25.16	6.56		10.12	34.98	0.0167	1.3947		
8:52:34	1.4114	1632.59	112	1292	418	25.21	6.43		1.14	34.96	0.0167	1.4114		
8:53:34	1.4281	1631.79	112	1295	418	29.68	6.34		11.69	35.16	0.0167	1.4281		
8:54:17	1.4400	1632.54	113	1302	418	25.64	6.16	0.44	20.64	35.41	0.0119	1.4400		
8:55:09	1.4544	1632.28	113	1614	418	24.61	4.41	3.18	17.44	35.66	0.0144	1.4544		
8:56:10	1.4692	1632.54	113	1694	418	23.66	5.94	3.95	17.17	35.91	0.0147	1.4692		
8:56:41	1.4800	1632.78	113	1795	413	22.81	6.06	4.38	23.17	36.16	0.0158	1.4800		9.81
8:57:14	1.4892	1633.04	113	1861	412	20.64	8.23	4.98	27.31	36.41	0.0092	1.4892		
8:57:47	1.4983	1633.23	114	1756	414	22.66	6.32	5.19	27.56	36.66	0.0092	1.4983	12.47	
8:58:30	1.5103	1633.55	114	1721	415	23.11	5.08	5.44	21.22	36.92	0.0119	1.5103	17.13	
8:59:01	1.5189	1633.80	114	1693	415	20.16	8.09	5.99	29.52	37.17	0.0086	1.5189	20.56	28.67
8:59:36	1.5286	1634.05	115	1770	417	22.45	6.43	7.07	25.22	37.42	0.0097	1.5286	22.48	
9:00:27	1.5428	1634.30	114	1707	414	23.44	5.50	6.52	17.06	37.67	0.0142	1.5428	21.69	
9:01:04	1.5531	1634.55	116	1818	419	21.60	6.84	6.64	24.36	37.92	0.0103	1.5531	22.92	
9:01:38	1.5625	1634.80	116	1796	426	23.62	6.37	6.59	26.52	38.17	0.0094	1.5625	24.21	22.93
9:02:24	1.5753	1635.06	115	1739	417	24.34	4.65	5.78	15.85	38.43	0.0128	1.5753	23.63	
9:03:11	1.5883	1635.31	116	1801	426	21.39	7.49	5.59	19.48	38.68	0.0131	1.5883	22.89	
9:04:04	1.6031	1635.55	116	1758	418	21.44	7.48	6.09	17.05	38.93	0.0147	1.6031	21.68	
9:04:55	1.6172	1635.81	116	1768	421	22.71	6.19	6.24	17.55	39.18	0.0142	1.6172	21.13	18.46
9:05:58	1.6259	1636.07	115	1949	419	21.89	7.00	6.55	29.31	39.44	0.0086	1.6259	21.23	
9:06:58	1.6342	1636.32	119	1876	422	22.31	6.51	6.63	30.07	39.69	0.0083	1.6342	21.61	
9:06:23	1.6433	1636.57	118	1848	430	22.06	6.73	6.75	27.63	39.94	0.0092	1.6433	22.07	
9:06:51	1.6494	1636.82	117	2020	426	19.00	9.46	7.19	41.74	40.19	0.0061	1.6494	23.56	31.34
9:07:13	1.6556	1637.07	117	2014	425	21.01	7.72	7.48	35.97	40.44	0.0061	1.6556	24.39	
9:07:38	1.6625	1637.32	119	1908	431	21.77	6.86	7.48	37.38	40.69	0.0069	1.6625	25.91	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1596.63			Bit Type =	Walker McDonnald MP58H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	8.75									
Total Depth Drilled	97.79			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	91.84		
Hours On Bit =	4.7000			Mud Type =		Water Based					Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =		9.00					Average ROP	27.33		
Drillstring (ft) =	1631.79			Pipe (ft) =	883.18		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
9:08:04	1.6827	1637.58	115	1973	420	19.21	9.41	9.06	34.81	40.55	0.0072	1.6807	27.89	
9:08:30	1.6789	1637.83	116	1995	423	19.15	9.45	8.89	34.23	41.29	0.0073	1.6759	30.72	38.73
9:09:03	1.6891	1638.09	117	1990	425	20.36	8.27	9.36	27.16	41.45	0.0092	1.6891	32.95	
9:09:33	1.6944	1638.33	116	1983	423	18.61	9.64	8.81	30.86	41.70	0.0083	1.6944	32.94	
9:09:55	1.7006	1638.58	118	1974	430	20.24	8.38	9.69	41.46	41.95	0.0061	1.7006	34.64	
9:10:24	1.7086	1638.83	117	1934	424	20.37	8.25	8.86	30.76	42.20	0.0081	1.7086	34.62	31.59
9:10:47	1.7150	1639.08	119	1993	431	19.88	8.63	8.69	39.63	42.46	0.0064	1.7150	34.63	
9:11:08	1.7208	1639.34	118	1940	428	20.94	7.70	8.56	42.94	42.71	0.0058	1.7208	34.77	
9:11:32	1.7275	1639.59	117	1936	426	20.60	7.84	8.16	37.77	42.96	0.0067	1.7275	34.62	
9:11:53	1.7333	1639.84	118	1961	430	19.63	8.87	8.56	43.68	43.21	0.0058	1.7333	35.53	40.85
9:12:13	1.7389	1640.09	117	1986	427	19.37	9.22	8.47	45.15	43.46	0.0056	1.7389	36.48	
9:12:38	1.7458	1640.35	117	1983	426	20.43	8.16	8.38	35.84	43.72	0.0069	1.7458	36.01	
9:12:59	1.7517	1640.60	118	1966	427	20.86	7.76	8.40	43.83	43.97	0.0058	1.7517	36.67	
9:13:21	1.7578	1640.85	117	2002	434	18.97	9.66	8.75	40.34	44.23	0.0061	1.7578	39.67	41.32
9:13:45	1.7644	1641.10	120	1932	435	21.53	7.14	8.39	38.08	44.47	0.0067	1.7644	40.66	
9:14:12	1.7718	1641.35	119	1912	431	21.17	7.50	8.04	33.83	44.72	0.0075	1.7718	39.86	
9:14:38	1.7778	1641.60	119	2024	432	18.87	9.59	8.34	44.51	44.97	0.0058	1.7778	39.86	
9:15:03	1.7851	1641.85	118	1935	428	20.80	7.85	8.56	29.82	45.22	0.0083	1.7851	38.56	35.29
9:15:23	1.7917	1642.10	117	2032	424	18.80	9.72	8.38	43.95	45.47	0.0058	1.7917	38.74	
9:15:51	1.8023	1642.35	117	1971	428	20.47	8.16	8.58	23.91	45.72	0.0105	1.8022	35.68	
9:16:32	1.8103	1642.60	118	2001	428	20.23	8.38	8.76	20.64	45.97	0.0080	1.8103	34.62	
9:17:01	1.8169	1642.85	117	2117	428	16.24	12.20	9.28	37.29	46.22	0.0061	1.8169	33.47	38.61
9:17:25	1.8225	1643.10	116	2114	428	16.87	9.69	9.63	36.37	46.47	0.0057	1.8226	33.21	
9:17:50	1.8350	1643.35	116	2074	428	18.10	10.42	9.77	27.00	46.72	0.0094	1.8350	31.89	
9:18:23	1.8417	1643.61	119	2210	433	17.09	11.40	10.42	38.06	46.98	0.0057	1.8417	32.41	
9:18:40	1.8464	1643.86	120	2163	435	16.74	9.82	10.71	53.85	47.23	0.0047	1.8464	32.94	36.75
9:19:04	1.8531	1644.11	117	2127	427	19.58	8.64	9.59	35.69	47.48	0.0067	1.8531	33.76	
9:19:27	1.8594	1644.37	116	2082	422	21.37	7.30	9.52	39.85	47.74	0.0064	1.8594	33.49	
9:19:46	1.8647	1644.62	116	2063	428	21.39	7.28	8.89	46.02	47.99	0.0053	1.8647	36.32	
9:20:11	1.8717	1644.87	120	1924	435	19.48	9.11	8.43	35.01	48.24	0.0069	1.8717	37.32	39.98
9:20:36	1.8784	1645.12	116	2110	433	14.46	13.82	9.26	32.09	48.49	0.0073	1.8794	37.49	
9:20:59	1.8850	1645.37	115	2106	419	16.74	11.75	9.87	45.89	48.74	0.0058	1.8850	38.18	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1585.63		Bit Type =	Walker McCosnalty MR6RH							Average ROP Excluding Hard Streak			
Ending Depth =	1684.42		Bit Size =	4.75										
Total Depth Drilled	97.79		Bit Nozzles =	3, 9, 12, 12							Depth Drilled =	81.84		
Hours On Bit =	4.7000		Mud Type =	Water Based							Hours On Bit =	3.35		
Average ROP =	20.81		Mud Weight (lbs/gal) =	9.00							Average ROP	27.32		
Drillstring (ft) =	1631.79		Pipe (ft) =	883.16	Collar (ft) =		748.64							

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Klps)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
9:21:24	1.8819	1645.63	118	2121	423	15.82	12.91	10.59	36.48	48.99	0.0069	1.8819	39.86	
9:21:44	1.8975	1645.87	116	2152	422	14.93	13.47	12.23	44.94	49.24	0.0056	1.8975	40.98	38.71
9:22:13	1.9053	1646.12	118	2101	427	17.63	10.89	12.59	32.71	49.49	0.0078	1.9053	38.35	
9:22:37	1.9122	1646.37	120	2109	426	16.55	12.68	12.38	35.29	49.74	0.0069	1.9122	38.20	
9:23:00	1.9186	1646.63	119	2177	435	16.03	12.41	12.51	40.72	50.00	0.0064	1.9186	38.20	
9:23:21	1.9244	1646.88	117	2052	423	19.70	8.89	11.71	41.88	50.25	0.0058	1.9244	37.94	37.48
9:23:42	1.9303	1647.13	116	2143	432	16.85	11.81	11.38	44.55	50.50	0.0058	1.9303	38.50	
9:23:51	1.9328	1647.39	114	2068	414	14.92	12.39	11.68	167.31	50.76	0.0025	1.9328	42.56	
9:24:42	1.9489	1647.89	119	2058	423	17.44	9.86	11.08	15.72	51.26	0.0161	1.9489	39.44	41.32
9:25:07	1.9569	1648.14	119	2082	434	17.34	11.15	10.83	48.24	51.51	0.0080	1.9569	40.68	
9:25:22	1.9581	1648.40	119	2092	432	17.41	11.59	11.27	61.36	51.77	0.0042	1.9581	41.78	
9:25:44	1.9642	1648.65	119	2125	432	15.64	12.79	11.46	40.93	52.02	0.0061	1.9642	42.90	
9:25:59	1.9683	1648.90	125	2113	435	16.46	12.01	11.39	58.02	52.27	0.0042	1.9683	45.09	51.94
9:26:19	1.9739	1649.15	119	2093	433	15.83	12.78	11.96	48.84	52.52	0.0056	1.9739	45.59	
9:26:42	1.9803	1649.40	118	2135	430	16.23	12.33	12.16	39.19	52.77	0.0064	1.9803	46.13	
9:27:03	1.9861	1649.65	117	2068	424	18.61	8.94	11.96	41.62	53.02	0.0058	1.9861	45.13	
9:27:27	1.9928	1649.90	116	2139	423	15.31	13.11	12.01	38.75	53.27	0.0067	1.9928	41.83	43.65
9:27:51	1.9994	1650.15	115	2170	420	15.10	13.31	12.27	37.75	53.52	0.0067	1.9994	41.75	
9:28:22	2.0081	1650.40	115	2147	417	16.22	13.19	12.36	25.17	53.77	0.0086	2.0081	41.72	
9:28:44	2.0142	1650.65	116	2345	422	17.31	11.18	12.15	41.35	54.03	0.0061	2.0142	40.26	
9:29:02	2.0192	1650.91	118	2089	429	20.40	8.23	11.80	50.35	54.28	0.0050	2.0192	41.09	38.27
9:29:33	2.0278	1651.16	119	1925	431	21.64	7.04	10.59	28.90	54.53	0.0086	2.0278	38.02	
9:29:49	2.0322	1651.41	118	2043	429	21.12	7.64	9.46	56.82	54.78	0.0044	2.0322	36.74	
9:30:14	2.0392	1651.67	119	1936	432	21.24	7.56	8.83	36.06	55.04	0.0069	2.0392	36.65	
9:30:38	2.0458	1651.92	117	2164	427	17.04	11.56	8.41	37.53	55.29	0.0067	2.0458	38.01	37.87
9:30:58	2.0508	1652.17	118	2170	429	17.15	11.53	9.07	58.71	55.54	0.0050	2.0508	39.10	
9:31:18	2.0564	1652.42	118	2006	429	20.07	8.68	9.39	85.34	55.79	0.0056	2.0564	39.85	
9:31:33	2.0611	1652.68	113	2100	413	22.28	6.64	8.19	52.38	56.05	0.0047	2.0611	42.97	
9:31:50	2.0658	1652.93	116	1977	427	22.32	6.70	9.02	53.91	56.30	0.0047	2.0658	43.94	55.50
9:32:10	2.0714	1653.18	113	1993	419	20.53	8.29	8.37	46.73	56.55	0.0056	2.0714	43.47	
9:32:25	2.0764	1653.44	118	2177	430	17.63	11.09	8.28	51.13	56.81	0.0050	2.0764	46.50	
9:32:50	2.0825	1653.69	118	2090	427	20.64	8.75	8.29	41.83	57.06	0.0061	2.0825	45.35	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1596.63			Bit Type =	Walker McDonald MF68H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	91.84		
Hours On Bit =	4.7000			Mud Type =	Water Based						Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =	9.00						Average ROP	27.32		
Drillstring (ft) =	1831.70			Pipe (ft) =	883.16		Collar (ft) =		748.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
9:33:11	2.0883	1653.94	117	1974	429	21.59	7.26	8.42	43.60	57.31	0.0058	2.0883	46.17	46.29
9:33:29	2.0983	1654.26	118	2151	430	20.04	8.74	8.83	46.25	57.67	0.0060	2.0983	48.00	
9:33:53	2.1090	1654.46	112	2077	405	19.62	9.17	9.81	37.41	57.82	0.0067	2.1090	45.37	
9:34:34	2.1114	1654.70	120	1907	436	20.35	9.46	9.48	22.59	58.07	0.0134	2.1114	41.45	
9:34:56	2.1183	1654.85	121	2035	438	17.34	11.34	9.00	36.42	58.32	0.0069	2.1183	39.67	33.87
9:35:28	2.1264	1655.21	118	1958	430	17.16	11.45	9.84	31.64	58.58	0.0081	2.1264	37.85	
9:35:45	2.1322	1655.46	118	2169	428	14.85	13.61	10.87	42.93	58.83	0.0058	2.1322	37.48	
9:35:54	2.1392	1655.72	118	2174	430	14.23	14.29	11.80	36.18	59.09	0.0069	2.1392	36.32	
9:36:41	2.1467	1656.07	116	2160	423	16.03	12.56	12.72	33.30	59.54	0.0075	2.1467	35.83	39.60
9:37:11	2.1550	1656.22	115	2109	428	14.10	14.39	13.33	30.51	59.69	0.0083	2.1550	34.98	
9:37:32	2.1608	1656.47	119	2126	431	12.74	15.68	14.17	42.87	59.94	0.0058	2.1608	33.63	
9:37:47	2.1650	1656.73	117	2138	424	15.87	12.71	13.93	61.02	60.10	0.0042	2.1650	35.08	
9:38:04	2.1697	1656.98	114	2195	416	15.80	12.76	13.62	53.66	60.35	0.0047	2.1697	36.03	43.81
9:38:26	2.1758	1657.23	116	2102	409	15.18	13.18	13.74	41.13	60.60	0.0061	2.1758	36.65	
9:38:57	2.1844	1657.48	115	2147	418	13.87	14.83	13.79	29.55	60.85	0.0086	2.1844	39.16	
9:39:21	2.1911	1657.73	116	2156	422	13.62	14.84	13.62	37.11	61.10	0.0067	2.1911	38.55	
9:39:36	2.1958	1657.99	117	2150	427	14.68	13.81	13.84	54.53	61.36	0.0047	2.1958	40.06	38.83
9:40:11	2.2050	1658.24	116	2111	422	15.59	12.97	13.89	26.26	61.61	0.0092	2.2050	38.91	
9:40:38	2.2125	1658.49	117	2156	424	14.50	13.84	13.98	32.82	61.86	0.0075	2.2125	39.48	
9:41:18	2.2236	1658.75	117	2079	424	13.31	15.15	14.08	22.76	62.12	0.0111	2.2236	38.32	
9:41:49	2.2322	1659.00	117	2107	425	12.86	15.62	14.22	29.42	62.37	0.0086	2.2322	37.77	37.76
9:42:20	2.2408	1659.25	117	2086	427	13.38	15.01	14.46	28.66	62.62	0.0086	2.2408	37.02	
9:42:57	2.2511	1659.50	117	2089	427	14.33	14.15	14.69	24.47	62.87	0.0103	2.2511	36.15	
9:43:30	2.2603	1659.75	116	2134	428	13.28	15.23	15.01	27.39	63.12	0.0092	2.2603	35.93	
9:44:02	2.2692	1660.00	117	2038	426	13.30	15.16	15.01	28.00	63.37	0.0089	2.2692	35.08	37.07
9:44:41	2.2800	1660.26	117	2067	424	14.58	13.83	14.70	23.45	63.63	0.0108	2.2800	34.97	
9:45:12	2.2886	1660.51	116	2186	431	13.81	14.70	14.63	28.83	63.88	0.0086	2.2886	34.16	
9:45:38	2.2959	1660.76	117	2178	424	16.39	12.20	14.33	35.47	64.13	0.0072	2.2959	33.24	
9:46:58	2.3014	1661.01	115	2069	417	19.38	9.34	13.07	43.83	64.38	0.0056	2.3014	32.06	31.84
9:46:32	2.3108	1661.26	117	2120	428	17.18	11.45	12.32	26.61	64.63	0.0094	2.3108	31.76	
9:46:57	2.3178	1661.51	121	2143	438	18.02	10.65	11.67	36.29	64.88	0.0069	2.3178	31.37	
9:47:28	2.3264	1661.76	119	2089	434	20.03	8.70	10.47	29.51	65.13	0.0086	2.3264	30.92	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98								
Starting Depth =	1696.63	Bit Type =	Walker McDonald MF66R				Average ROP Excluding Hard Streak:		
Ending Depth =	1694.42	Bit Size =	4.75						
Total Depth Drilled	97.79	Bit Nozzles =	8, 8, 12, 12				Depth Drilled =	91.84	
Hours On Bit =	4.7600	Mud Type =	Water Based				Hours On Bit =	3.36	
Average ROP =	20.61	Mud Weight (lbs/gal) =	9.00				Average ROP	27.32	
Drillstring (ft) =	1631.79	Pipe (ft) =	883.16	Collar (ft) =	748.64				

Time (HR:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
9:47:53	2.3333	1662.91	118	2064	429	17.59	11.04	10.24	36.42	65.38	0.0069	2.3333	30.94	31.30
9:48:17	2.3400	1662.26	116	2088	422	18.17	12.42	10.85	37.08	65.63	0.0067	2.3400	31.91	
9:48:43	2.3472	1662.61	115	2067	419	17.61	11.66	10.89	35.17	65.68	0.0072	2.3472	33.47	
9:49:10	2.3547	1662.76	118	2045	428	17.06	11.52	11.08	32.43	66.13	0.0075	2.3547	34.03	
9:49:42	2.3636	1663.02	120	1943	435	18.67	10.61	11.46	28.54	66.39	0.0089	2.3636	33.34	33.36
10:03:26	2.3636	1663.09	114	1357	415	29.49	0.30		118.32	66.46	0.0000	2.3636		
10:03:32	2.3653	1663.34	119	1355	428	29.60	0.20		169.70	66.71	0.0017	2.3653		
10:04:32	2.3819	1663.12	119	1384	433	29.65	0.17		-13.11	66.49	0.0167	2.3819		
10:05:17	2.3944	1663.38	119	1361	430	29.78	0.04		20.16	66.75	0.0125	2.3944		
10:06:59	2.4061	1663.63	115	1663	418	23.18	8.32	3.41	21.50	67.00	0.0117	2.4061		
10:08:04	2.4131	1663.88	118	2083	429	14.65	14.49	4.24	38.06	67.25	0.0069	2.4131		
10:08:48	2.4197	1664.13	115	2149	417	14.20	14.93	7.19	38.82	67.50	0.0067	2.4197		38.53
10:09:51	2.4286	1664.40	118	2101	414	13.51	10.25	9.21	267.59	67.77	0.0008	2.4286		
10:07:52	2.4375	1664.66	118	2001	428	16.84	11.49	11.50	-0.33	68.03	0.0169	2.4375		
10:08:11	2.4428	1664.92	115	2177	420	14.80	14.35	13.10	85.64	68.29	0.0053	2.4428	28.12	
10:08:32	2.4486	1665.17	118	2147	428	17.56	12.92	12.65	44.18	68.54	0.0058	2.4486	21.96	35.09
10:08:00	2.4564	1665.42	117	2104	427	18.40	10.93	11.85	32.86	68.79	0.0078	2.4564	30.56	
10:09:19	2.4617	1665.67	120	2123	435	16.56	12.67	12.33	46.96	69.04	0.0053	2.4617	34.07	
10:09:39	2.4672	1665.92	120	2165	435	15.25	13.91	12.82	44.93	69.29	0.0056	2.4672	37.47	
10:10:05	2.4753	1666.17	121	2041	439	17.24	12.01	12.35	31.34	69.54	0.0081	2.4753	35.80	37.50
10:10:39	2.4839	1666.42	118	2061	418	15.13	14.03	12.71	28.74	69.79	0.0086	2.4839	35.83	
10:11:04	2.4908	1666.68	119	2212	432	12.44	15.60	13.84	37.19	70.05	0.0069	2.4908	32.44	
10:11:36	2.4975	1666.93	119	2126	433	14.41	14.73	14.26	37.59	70.30	0.0067	2.4975	37.83	
10:11:50	2.5036	1667.18	118	2328	428	11.65	17.37	14.85	41.69	70.55	0.0061	2.5036	37.15	35.65
10:40:47	2.5036	1666.60	118	1406	430	29.51	-0.02		16.48	69.97	0.0000	2.5036		
10:33:51	2.5047	1666.85	119	1403	431	29.53	0.38		230.82	70.22	0.0011	2.5047		
10:49:59	2.5058	1667.11	117	1405	428	29.40	0.39		223.05	70.48	0.0011	2.5058		
10:50:28	2.5150	1667.36	120	1528	435	26.04	3.57		28.21	70.73	0.0092	2.5150		
10:50:55	2.5226	1667.61	116	2007	421	20.66	9.31	3.73	32.82	70.98	0.0075	2.5226		
10:51:25	2.5308	1667.87	119	2072	431	18.63	11.27	4.98	31.17	71.24	0.0083	2.5308		

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98														
Starting Depth =	1896.63			Bit Type =	Walker McDonnald MP68H						Average ROP Excluding Hard Streak				
Ending Depth =	1994.42			Bit Size =	4.75										
Total Depth Drilled	97.79			Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	61.84			
Hours On Bit =	4.7000			Mud Type =	Water Based						Hours On Bit =	3.35			
Average ROP =	20.81			Mud Weight (lbs/gal) =	8.60						Average ROP	27.32			
Drillstring (ft) =	1631.70			Pipe (ft) =	883.16		Collar (ft) =		748.54						

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
10:51:54	2.5389	1668.12	120	2035	438	19.66	9.72	8.85	31.17	71.49	0.0081	2.5389		43.09
10:52:27	2.5481	1668.37	117	1994	424	21.26	8.16	8.41	27.64	71.74	0.0092	2.5481		
10:52:56	2.5561	1668.63	116	2062	430	18.31	10.69	9.89	31.72	72.00	0.0081	2.5561		
10:53:18	2.5622	1668.88	117	2223	425	15.86	13.69	10.75	41.80	72.25	0.0061	2.5622	38.90	
10:53:44	2.5694	1669.13	116	2097	423	18.73	12.49	10.89	34.38	72.50	0.0072	2.5694	35.28	33.95
10:54:10	2.5767	1669.38	115	2155	419	16.26	12.64	11.63	33.89	72.75	0.0072	2.5767	32.05	
10:54:33	2.5831	1669.63	121	2178	440	15.73	13.45	12.68	40.95	73.00	0.0064	2.5831	33.36	
10:55:00	2.5906	1669.88	121	2120	440	17.46	11.80	12.85	34.03	73.25	0.0075	2.5906	33.36	
10:55:29	2.5988	1670.13	118	2053	430	17.58	11.71	12.48	30.62	73.50	0.0081	2.5988	33.34	34.29
10:55:53	2.6053	1670.38	117	2078	424	14.64	14.54	12.69	36.57	73.75	0.0067	2.6053	34.19	
10:56:16	2.6117	1670.64	118	2123	430	16.40	12.84	12.67	39.33	74.01	0.0064	2.6117	35.69	
10:56:45	2.6197	1670.89	118	2163	428	16.37	12.86	12.75	30.76	74.26	0.0081	2.6197	35.53	
10:57:09	2.6261	1671.14	118	2131	430	14.82	14.77	13.34	39.68	74.51	0.0064	2.6261	35.07	36.73
10:57:33	2.6328	1671.39	122	2134	441	15.68	13.52	13.51	36.63	74.76	0.0067	2.6328	35.69	
10:58:02	2.6411	1671.64	119	2022	434	17.83	11.46	12.90	25.48	75.01	0.0083	2.6411	35.07	
10:58:26	2.6475	1671.89	119	2200	431	14.24	14.91	13.31	39.68	75.26	0.0064	2.6475	35.07	
10:58:48	2.6539	1672.18	117	2134	425	15.91	13.36	13.41	39.29	75.52	0.0064	2.6539	35.84	36.35
10:59:21	2.6631	1672.40	119	2001	434	17.84	11.45	12.78	27.59	75.77	0.0092	2.6631	35.22	
10:59:47	2.6703	1672.65	117	2094	424	14.54	14.68	13.17	35.38	76.02	0.0072	2.6703	34.72	
11:00:14	2.6778	1672.90	119	2214	434	14.91	14.27	13.73	33.60	76.27	0.0075	2.6778	34.18	
11:00:40	2.6850	1673.16	119	2132	432	17.07	12.22	13.19	35.17	76.53	0.0072	2.6850	34.77	32.46
11:01:07	2.6925	1673.41	115	2167	419	16.27	12.69	13.12	33.73	76.78	0.0075	2.6925	34.18	
11:01:45	2.7031	1673.66	121	2057	435	16.58	12.40	13.09	23.47	77.03	0.0106	2.7031	32.30	
11:02:18	2.7122	1673.91	118	2116	426	14.85	14.36	13.53	27.88	77.28	0.0092	2.7122	31.92	
11:02:40	2.7183	1674.15	116	2163	422	16.66	13.62	12.90	39.60	77.53	0.0061	2.7183	32.05	30.60
11:03:08	2.7261	1674.41	123	2042	443	17.87	11.38	12.73	33.26	77.78	0.0078	2.7261	31.29	
11:03:25	2.7308	1674.66	116	2059	422	16.93	12.36	12.60	51.18	78.03	0.0047	2.7308	33.34	
11:04:08	2.7428	1674.92	118	2173	427	17.48	11.75	12.49	51.42	78.29	0.0119	2.7428	31.31	
11:04:36	2.7503	1675.17	120	2019	436	16.74	13.45	12.36	39.05	78.54	0.0075	2.7503	31.31	31.62
11:05:05	2.7586	1675.43	119	2084	433	13.97	15.16	12.81	29.09	78.80	0.0086	2.7589	30.72	
11:05:43	2.7686	1675.68	114	2089	415	14.30	14.85	13.51	26.06	79.05	0.0103	2.7692	29.61	
11:06:43	2.7853	1675.87	117	1992	426	26.42	1.33	11.31	-0.32	79.04	0.0167	2.7858	34.28	

DOE high power mortor test Amaco Catoosa Test Site — DOE HP Motor No. 1

Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1595.63			Bit Type =	Walker McDonald MP63H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	91.84		
Hours On Bit =	4.7500			Mud Type =		Water Based					Hours On Bit =	3.38		
Average ROP =	20.81			Mud Weight (lbs/gal) =		9.00					Average ROP	27.33		
Drillstring (ft) =	1531.70			Pipe (ft) =	883.16		Collar (ft) =		248.54					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
11:07:16	2.7950	1675.92	117	1888	436	22.15	7.33	10.43	27.53	79.29	0.0092	2.7950	24.28	
11:07:44	2.8028	1676.18	116	2068	421	19.13	10.22	9.78	33.65	79.55	0.0078	2.8028	23.82	19.24
11:08:15	2.8114	1676.43	116	2039	421	18.42	10.66	8.93	29.21	79.80	0.0086	2.8114	23.69	
11:08:31	2.8214	1676.68	121	1973	438	16.87	12.42	8.44	25.20	80.05	0.0100	2.8214	23.31	
11:09:09	2.8264	1676.93	120	2119	437	14.53	14.68	11.19	49.41	80.30	0.0050	2.8264	24.04	
11:09:34	2.8333	1677.18	120	2144	436	15.24	13.98	12.44	39.80	80.55	0.0069	2.8333	24.20	32.79
11:10:05	2.8419	1677.44	119	2085	433	16.87	13.29	13.65	29.85	80.81	0.0086	2.8419	24.26	
11:10:24	2.8472	1677.69	121	2174	439	13.54	15.48	13.97	46.53	81.06	0.0053	2.8472	25.75	
11:10:51	2.8547	1677.94	119	2150	432	16.46	12.79	14.04	34.04	81.31	0.0075	2.8547	32.15	
11:11:19	2.8625	1678.19	117	2038	427	18.87	10.47	13.20	32.13	81.56	0.0078	2.8625	33.63	34.65
11:11:42	2.8689	1678.44	119	2154	432	15.65	13.57	13.13	38.41	81.81	0.0064	2.8689	34.18	
11:12:10	2.8767	1678.69	121	2095	430	18.58	10.65	12.63	32.89	82.06	0.0078	2.8767	34.63	
11:12:48	2.8875	1678.95	121	1918	439	21.51	7.97	11.13	23.55	82.32	0.0108	2.8875	34.34	
11:13:27	2.8981	1679.20	119	2064	433	18.44	10.86	10.74	28.57	82.57	0.0106	2.8981	31.67	28.41
11:13:55	2.9058	1679.46	117	2108	426	17.62	11.62	10.57	33.09	82.83	0.0078	2.9058	31.49	
11:14:25	2.9144	1679.71	119	1966	434	18.69	10.63	10.39	28.96	83.08	0.0086	2.9144	31.31	
11:14:49	2.9208	1679.96	120	2128	437	16.37	12.85	10.79	40.40	83.33	0.0064	2.9208	31.84	
11:15:18	2.9289	1680.22	120	2043	436	19.34	9.85	11.19	32.02	83.58	0.0081	2.9289	30.74	33.08
11:15:47	2.9369	1680.47	118	2083	430	18.85	12.37	11.49	31.63	83.84	0.0081	2.9369	30.83	
11:16:09	2.9431	1680.73	121	2123	438	16.65	12.96	11.76	41.99	84.10	0.0061	2.9431	30.89	
11:16:45	2.9539	1680.98	118	2060	430	18.48	12.75	12.12	28.19	84.35	0.0108	2.9539	29.65	
11:17:20	2.9628	1681.23	118	2123	428	16.18	14.64	12.54	27.96	84.61	0.0089	2.9628	30.42	35.19
11:18:06	2.9756	1681.48	117	2056	424	12.62	16.44	13.53	20.03	84.86	0.0125	2.9756	29.95	
11:18:47	2.9869	1681.74	120	2030	438	11.52	17.47	14.65	22.03	85.11	0.0114	2.9869	28.11	
11:19:45	3.0031	1681.99	119	2025	431	12.74	16.21	15.98	15.78	85.36	0.0161	3.0031	25.73	
11:20:23	3.0136	1682.25	118	2080	430	11.20	17.79	16.97	23.79	85.62	0.0106	3.0136	24.68	19.87
11:21:03	3.0247	1682.50	119	1982	429	10.72	18.24	17.63	22.91	85.87	0.0111	3.0247	23.79	
11:22:03	3.0414	1682.68	116	1978	430	10.38	18.77	18.19	10.85	86.05	0.0167	3.0414	21.16	
11:22:51	3.0547	1682.93	116	1936	430	10.65	18.39	18.26	18.59	86.30	0.0133	3.0547	19.79	
11:23:35	3.0644	1683.18	118	2132	430	12.34	16.79	17.98	28.40	86.55	0.0097	3.0644	19.50	
11:24:26	3.0811	1683.29	117	1847	424	22.47	6.99	15.62	6.61	86.66	0.0167	3.0811	17.32	15.41
11:25:20	3.0961	1683.55	117	1801	425	18.37	9.49	14.07	18.68	86.92	0.0150	3.0961	17.09	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 8	Date: 12/14/95 to 12/15/95													
Starting Depth =	1595.63			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	91.81		
Hours On Bit =	4.7500			Mud Type =	Water Based						Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =	9.00						Average ROP	27.32		
Drillstring (ft) =	1631.78			Pipe (ft) =	883.16		Collar (ft) =		748.64					

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
11:26:20	3.1128	1683.84	118	1969	430	16.29	13.67	12.55	5.84	87.01	0.0167	3.1128	15.10	
11:26:59	3.1236	1683.89	119	2014	433	15.72	15.36	12.27	23.59	87.26	0.0108	3.1236	15.76	
11:27:23	3.1303	1684.14	118	2157	426	16.76	12.65	11.40	36.73	87.51	0.0067	3.1303	16.20	
11:28:17	3.1453	1684.39	121	2018	441	16.91	12.31	12.48	16.70	87.76	0.0150	3.1453	15.68	17.14
11:28:52	3.1550	1684.65	118	2112	433	16.76	12.48	13.06	28.20	88.02	0.0097	3.1550	17.34	
11:29:22	3.1633	1684.90	119	1970	433	16.36	10.90	12.71	30.19	88.27	0.0083	3.1633	18.14	
11:30:16	3.1783	1685.15	119	1900	433	15.62	13.52	12.33	16.68	88.52	0.0150	3.1783	17.30	
11:31:06	3.1950	1685.23	118	1700	430	25.77	9.80	10.60	5.08	88.60	0.0167	3.1950	17.03	
11:31:55	3.2058	1685.48	121	1844	441	19.98	9.38	10.02	22.94	88.85	0.0108	3.2058	17.56	18.00
11:32:26	3.2144	1685.74	115	2281	419	15.31	13.86	10.23	29.31	89.11	0.0086	3.2144	20.68	
11:33:26	3.2311	1685.50	118	1431	429	29.36	0.44	8.20	-14.42	88.87	0.0167	3.2311	14.88	
11:33:38	3.2344	1685.75	124	1392	460	29.17	0.61	5.62	79.04	89.12	0.0033	3.2344	15.46	
11:34:35	3.2503	1686.00	118	1785	429	21.48	7.94	6.45	15.85	89.37	0.0158	3.2503	15.33	
11:35:10	3.2600	1686.25	120	1949	435	19.87	9.48	6.47	25.83	89.62	0.0097	3.2600	15.24	
11:36:00	3.2767	1686.45	117	1887	426	16.76	12.44	9.18	11.70	89.82	0.0167	3.2767	13.68	13.89
11:36:58	3.2930	1686.70	119	1976	432	18.25	11.03	8.38	19.27	90.07	0.0163	3.2930	13.88	
11:37:33	3.3037	1686.95	116	1902	421	20.56	8.80	9.94	25.35	90.32	0.0097	3.3097	16.42	
11:38:09	3.3097	1687.20	115	1900	425	20.02	8.68	10.64	25.42	90.57	0.0100	3.3097	16.56	
11:39:00	3.3258	1687.48	115	1881	428	18.43	9.88	10.13	17.67	90.85	0.0142	3.3228	15.72	21.39
11:39:37	3.3342	1687.71	119	1898	432	20.90	8.43	9.32	24.36	91.08	0.0103	3.3342	21.44	
11:40:14	3.3444	1687.96	121	1863	441	21.83	7.58	8.63	25.07	91.33	0.0103	3.3444	21.83	
11:40:38	3.3514	1688.21	117	1898	424	21.57	7.85	8.44	35.83	91.58	0.0069	3.3514	21.86	
11:41:14	3.3611	1688.47	119	1913	434	20.65	8.74	8.50	26.87	91.84	0.0097	3.3611	21.96	27.13
11:42:01	3.3742	1688.72	118	1929	428	20.94	8.44	8.21	19.62	92.09	0.0131	3.3742	22.26	
11:42:36	3.3839	1688.97	119	1906	431	20.85	8.50	8.22	28.53	92.34	0.0097	3.3839	24.18	
11:43:08	3.3928	1689.22	118	1933	427	20.53	8.68	8.48	28.36	92.59	0.0089	3.3928	24.35	
11:44:08	3.4094	1689.35	120	1930	435	20.16	9.27	8.75	7.73	92.72	0.0167	3.4094	21.56	
11:45:08	3.4261	1689.25	115	1996	419	18.58	10.33	9.09	-9.07	92.72	0.0167	3.4261	18.49	
11:46:08	3.4428	1689.41	120	2007	435	20.08	9.25	9.24	3.74	92.76	0.0167	3.4428	15.65	
11:47:08	3.4594	1689.48	119	2004	431	21.64	7.78	8.10	2.87	92.83	0.0167	3.4594	13.04	19.07
11:48:08	3.4761	1689.33	118	1907	427	26.95	2.90	7.86	-7.75	92.78	0.0167	3.4761	8.68	
11:49:08	3.4919	1689.66	120	1881	434	25.34	4.01	5.81	17.41	92.97	0.0158	3.4919	8.64	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

Well No. 8	Date: 12/14/98 to 12/15/98														
Starting Depth =	1596.53			Bit Type =	Walker McDonald MP66H							Average ROP Excluding Hard Streak			
Ending Depth =	1694.42			Bit Size =	4.75										
Total Depth Drilled	97.79			Bit Nozzles =	8, 8, 12, 12							Depth Drilled =	91.64		
Hours On Bit =	4.7000			Mud Type =	Water Based							Hours On Bit =	3.35		
Average ROP =	20.81			Mud Weight (lbs/gal) =	9.00							Average ROP	27.32		
Drillstring (ft) =	1631.70			Pipe (ft) =	883.16		Collar (ft) =		748.54						

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
11:50:05	3.5069	1595.59	120	1991	437	20.06	5.22	5.78	-37.02	92.67	0.0169	3.5069	5.73	
11:51:05	3.5236	1689.54	118	2032	428	19.44	6.83	5.80	2.43	92.91	0.0167	3.5236	4.02	
11:52:05	3.5422	1689.54	119	2067	432	18.28	10.95	6.53	-0.16	92.91	0.0167	3.5422	2.14	
11:53:05	3.5589	1689.53	118	2028	423	19.87	9.44	7.89	0.66	92.92	0.0167	3.5589	1.34	
11:54:05	3.5756	1689.52	118	1974	438	21.16	8.26	8.74	2.56	92.58	0.0167	3.5756	1.61	
11:55:05	3.5922	1689.73	118	1962	428	22.14	7.29	9.15	8.09	93.10	0.0167	3.5922	3.14	
11:56:05	3.6089	1689.83	119	2018	433	21.39	7.99	8.76	-3.91	93.05	0.0167	3.6089	1.97	
11:57:03	3.6247	1689.93	121	1982	439	22.12	7.19	8.01	15.86	93.30	0.0158	3.6247	4.04	
11:57:22	3.6300	1690.18	124	1956	451	22.59	3.99	6.92	47.45	93.58	0.0053	3.6300	4.26	
11:58:22	3.6467	1689.71	119	1905	453	22.48	6.77	6.63	-28.32	93.08	0.0167	3.6467	1.92	
11:58:43	3.6525	1689.96	120	1945	436	20.45	-0.91	4.99	43.50	93.33	0.0058	3.6525	3.31	
11:59:43	3.6692	1689.10	119	1982	432	20.52	-0.58	3.37	-31.73	92.47	0.0167	3.6692	-1.47	
11:59:50	3.6711	1689.37	121	1965	440	20.40	-1.45	1.56	144.23	92.74	0.0019	3.6711	-1.60	
12:00:50	3.6878	1689.14	120	1975	434	20.46	-1.31	0.50	-28.22	92.51	0.0167	3.6878	-4.01	
12:01:19	3.6956	1689.40	118	1975	436	20.20	0.35	-0.78	31.68	92.77	0.0081	3.6956	-3.18	
12:01:36	3.6989	1689.65	118	1973	432	20.36	-1.04	-0.93	88.22	93.03	0.0031	3.6989	-0.33	
12:02:36	3.7156	1689.38	121	1973	438	20.25	-0.04	-0.82	-31.64	92.75	0.0167	3.7156	-6.05	
12:03:08	3.7261	1689.63	118	1972	434	20.08	0.04	-0.46	28.77	93.00	0.0106	3.7261	-5.72	
12:04:08	3.7428	1689.63	120	1953	436	20.04	3.00	0.46	0.11	93.00	0.0167	3.7428	-0.83	
12:04:53	3.7553	1689.89	118	2025	428	19.54	9.55	2.30	21.01	93.26	0.0125	3.7553	-0.66	1.45
12:05:07	3.7592	1690.46	118	2039	429	20.13	4.49	3.51	66.37	93.77	0.0039	3.7592	14.44	
12:06:07	3.7758	1689.76	121	2003	438	19.68	6.58	5.42	-41.45	93.07	0.0167	3.7758	3.16	
12:07:07	3.7925	1689.76	118	2016	432	19.91	9.44	7.18	3.23	93.13	0.0167	3.7925	5.92	
12:08:07	3.8092	1689.79	118	1991	439	20.52	8.85	8.35	2.12	93.16	0.0167	3.8092	3.44	
12:09:07	3.8256	1689.80	117	2014	434	19.76	9.60	8.36	0.51	93.17	0.0167	3.8258	1.18	
12:10:07	3.8425	1689.77	119	2035	434	20.35	8.01	9.28	-1.62	93.14	0.0167	3.8425	3.07	
12:11:07	3.8592	1689.87	120	2011	437	20.92	8.47	9.07	5.87	93.24	0.0167	3.8592	1.80	
12:12:07	3.8758	1689.86	118	2020	432	20.44	8.94	8.87	-0.57	93.23	0.0167	3.8758	1.73	
12:13:07	3.8925	1689.92	118	2018	428	20.60	8.80	8.86	3.94	93.28	0.0167	3.8925	8.22	
12:14:07	3.9092	1689.91	118	2019	428	20.55	8.88	8.82	-1.13	93.28	0.0167	3.9092	-3.27	
12:15:07	3.9258	1689.92	119	2025	432	19.36	9.96	9.01	0.78	93.29	0.0167	3.9258	1.47	
12:16:07	3.9425	1689.92	120	2030	434	19.85	9.51	9.22	0.29	93.29	0.0167	3.9425	1.07	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 1

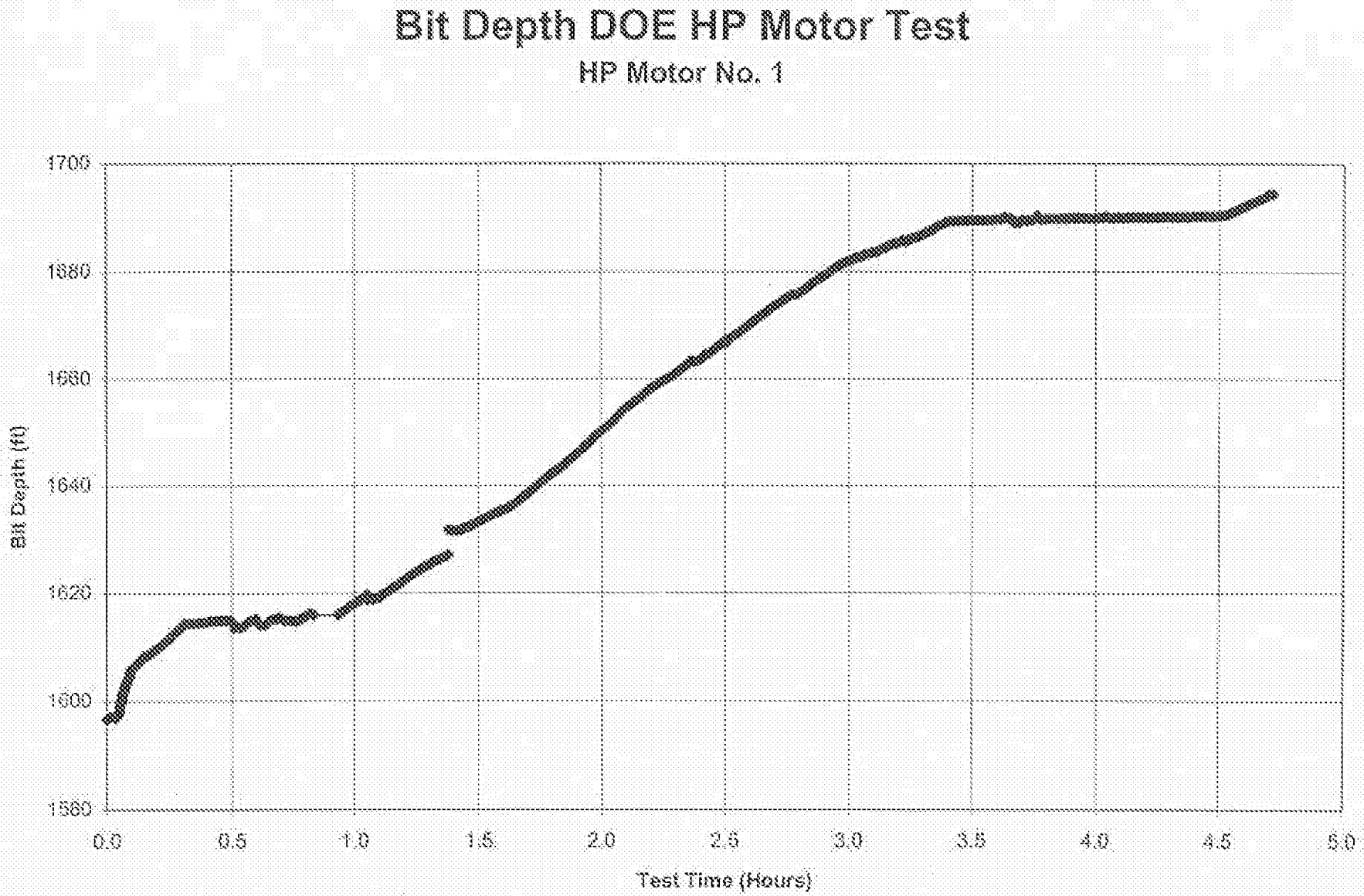
Well No. 6	Date: 12/14/98 to 12/15/98													
Starting Depth =	1588.63			Bit Type =	Walker McDonald MP50H						Average ROP Excluding Hard Streak			
Ending Depth =	1684.42			Bit Size =	4.75									
Total Depth Drilled	97.79			Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	91.84		
Hours On Bit =	4.7910			Mud Type =	Water Based						Hours On Bit =	3.36		
Average ROP =	20.81			Mud Weight (lbs/gal) =	9.00						Average ROP	27.32		
Drillstring (ft) =	1831.70			Pipe (ft) =	883.16		Collar (ft) =		748.54					

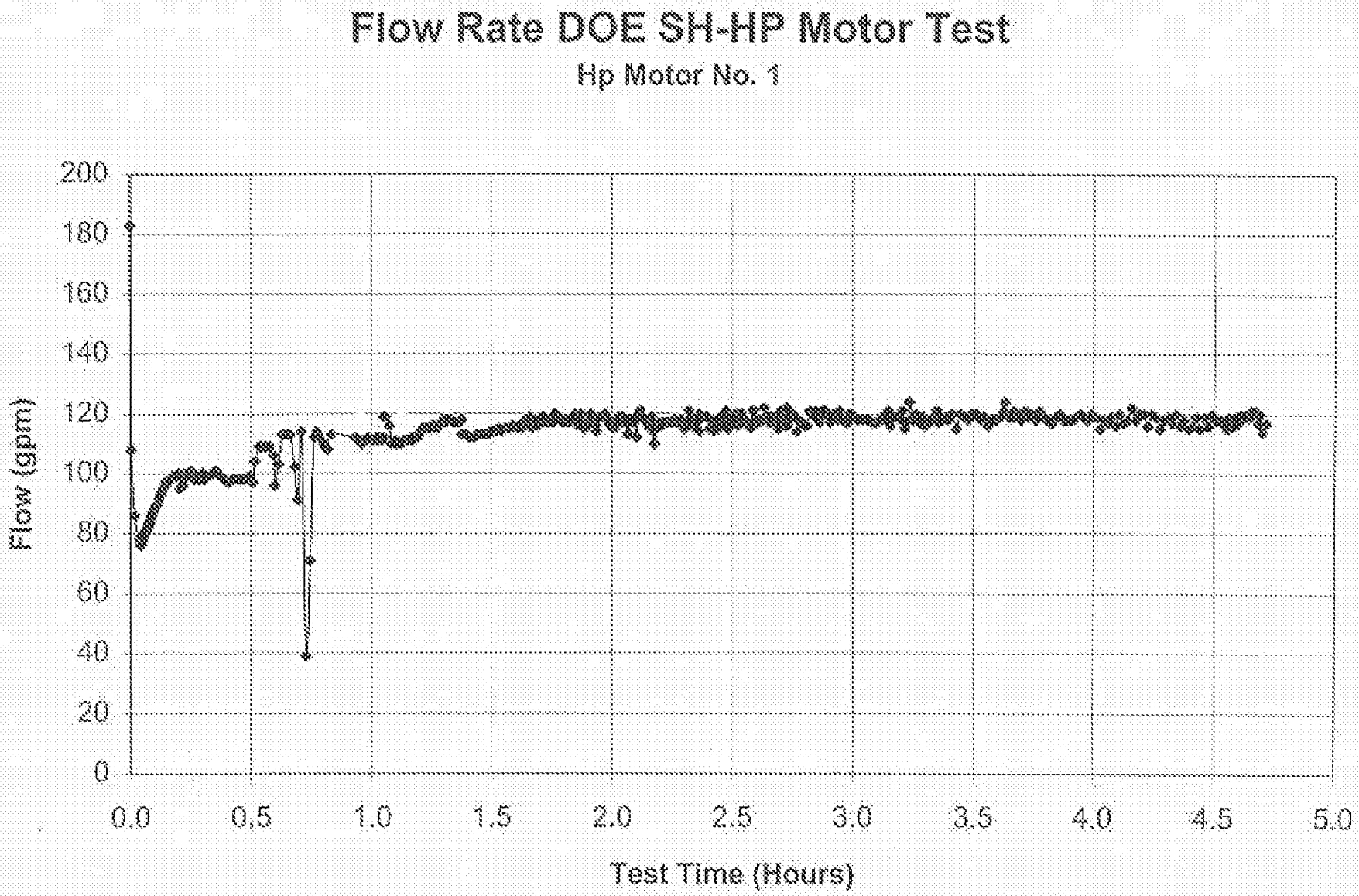
Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
12:17:07	3.9592	1689.92	119	2035	434	19.98	9.38	9.31	-0.34	93.29	0.0167	3.9592	0.87	
12:18:07	3.9758	1689.91	118	2009	429	20.26	9.10	9.32	-0.49	93.28	0.0167	3.9758	0.73	
12:19:07	3.9925	1689.87	120	2034	436	20.29	9.10	9.42	-2.47	93.24	0.0167	3.9925	0.67	
12:20:07	4.0092	1689.92	119	2019	434	20.01	8.78	9.17	3.13	93.29	0.0167	4.0092	0.33	0.12
12:21:07	4.0258	1689.98	115	2007	418	20.50	8.75	9.02	3.86	93.35	0.0167	4.0258	0.80	
12:22:01	4.0408	1690.34	116	2007	430	20.41	8.68	8.85	17.46	93.61	0.0150	4.0408	2.16	
12:23:01	4.0575	1689.94	117	2009	427	20.32	8.41	8.75	-33.71	93.31	0.0167	4.0575	0.20	
12:24:01	4.0742	1690.02	119	2004	431	19.75	9.59	8.84	4.85	93.39	0.0167	4.0742	0.67	
12:25:01	4.0908	1690.07	116	2012	423	18.32	16.86	9.28	3.08	93.44	0.0167	4.0908	1.01	
12:26:01	4.1075	1689.96	120	2006	435	18.37	10.92	9.71	-6.65	93.33	0.0167	4.1075	0.27	
12:27:01	4.1242	1690.08	117	2008	422	18.44	10.84	10.14	6.69	93.43	0.0167	4.1242	1.01	
12:28:01	4.1408	1690.08	118	2024	429	19.18	10.14	10.49	-0.24	93.43	0.0167	4.1408	1.28	
12:29:01	4.1575	1690.08	122	2014	440	19.73	9.61	10.49	1.41	93.45	0.0167	4.1575	1.08	
12:30:01	4.1742	1690.08	118	2028	428	19.46	9.89	10.26	0.24	93.45	0.0167	4.1742	0.67	
12:31:01	4.1908	1690.10	120	2029	435	19.49	9.86	10.07	3.93	93.50	0.0167	4.1908	-0.73	
12:32:01	4.2075	1690.07	120	2023	437	19.19	10.14	9.93	-3.99	93.44	0.0167	4.2075	0.67	
12:33:01	4.2242	1690.12	116	2053	421	18.89	10.35	9.97	3.24	93.49	0.0167	4.2242	0.67	
12:34:01	4.2408	1690.12	120	2053	436	17.31	11.95	10.44	-0.20	93.49	0.0167	4.2408	0.33	
12:35:01	4.2575	1690.10	119	2134	432	17.89	11.40	10.74	-1.04	93.47	0.0167	4.2575	0.53	
12:36:01	4.2742	1690.17	115	2091	419	18.52	10.78	10.82	3.93	93.54	0.0167	4.2742	0.73	
12:37:01	4.2908	1690.20	116	2053	428	18.06	11.28	10.85	2.19	93.57	0.0167	4.2908	0.93	
12:38:01	4.3075	1690.18	119	2036	432	18.49	9.84	10.85	-1.65	93.55	0.0167	4.3075	0.67	
12:39:01	4.3242	1690.15	117	2017	427	18.60	9.73	10.41	0.84	93.56	0.0167	4.3242	0.73	
12:40:01	4.3408	1690.15	120	2026	435	19.13	10.20	10.17	-2.09	93.52	0.0167	4.3408	0.13	
12:41:01	4.3575	1690.21	116	2117	422	19.41	12.81	10.57	3.20	93.58	0.0167	4.3575	0.93	
12:42:01	4.3742	1690.23	118	2208	429	14.65	14.48	11.41	1.38	93.60	0.0167	4.3742	0.73	
12:43:01	4.3908	1690.33	115	2255	420	14.45	14.06	12.38	6.85	93.71	0.0167	4.3908	1.47	
12:44:01	4.4075	1690.25	116	2302	432	14.85	14.26	13.26	-5.49	93.62	0.0167	4.4075	1.00	
12:45:01	4.4242	1690.35	119	2282	434	15.24	13.91	14.03	5.59	93.72	0.0167	4.4242	1.20	
12:46:01	4.4408	1690.33	115	2240	418	14.85	14.29	14.32	-1.36	93.70	0.0167	4.4408	0.87	
12:47:01	4.4575	1690.31	116	2268	432	13.65	15.24	14.48	-1.89	93.68	0.0167	4.4575	0.87	
12:48:01	4.4742	1690.33	116	2240	423	14.08	15.02	14.55	1.31	93.70	0.0167	4.4742	0.93	

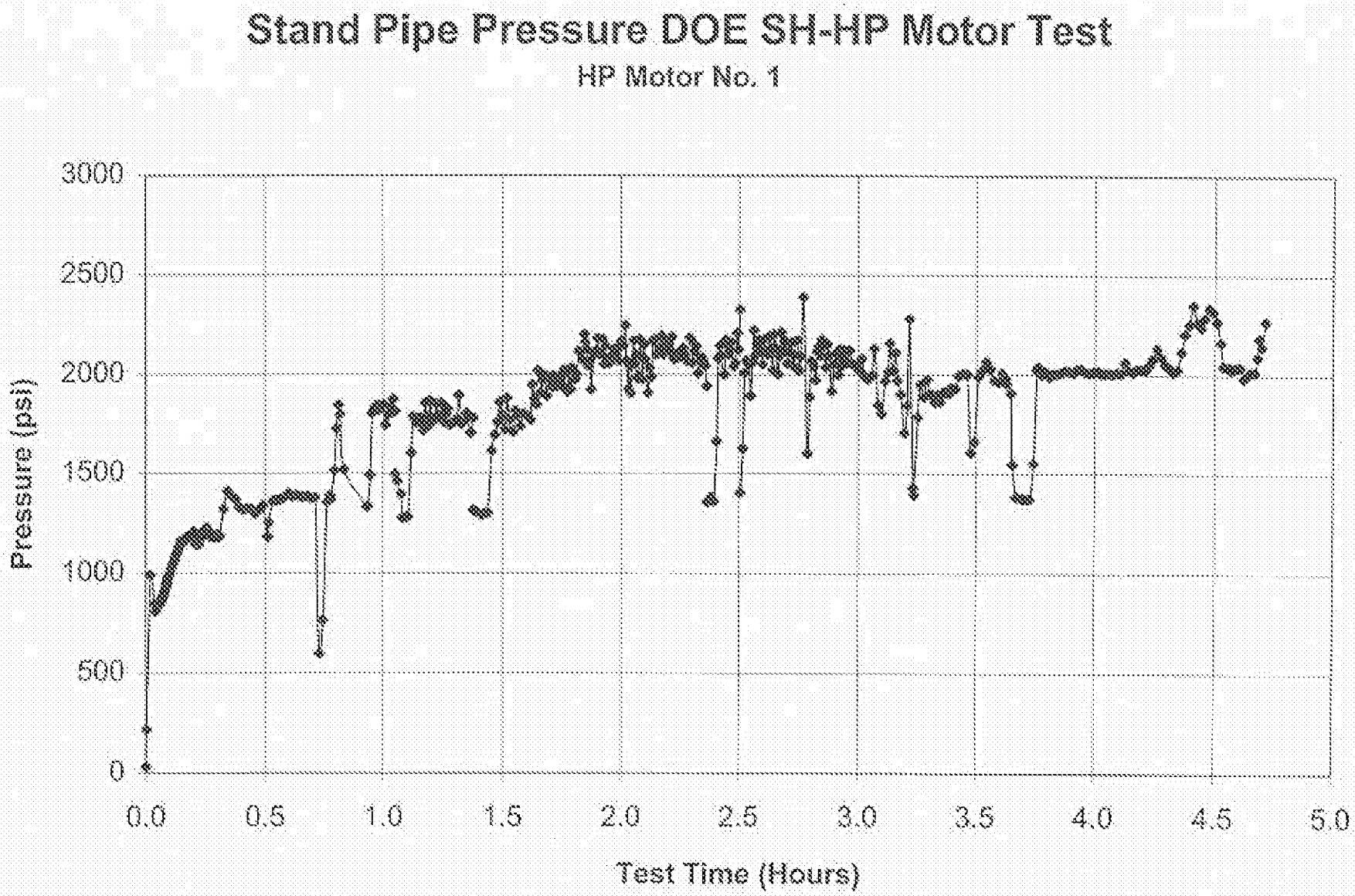
DOE high power mortor test Amaco Catoosa Test Site — DOE HP Motor No. 1

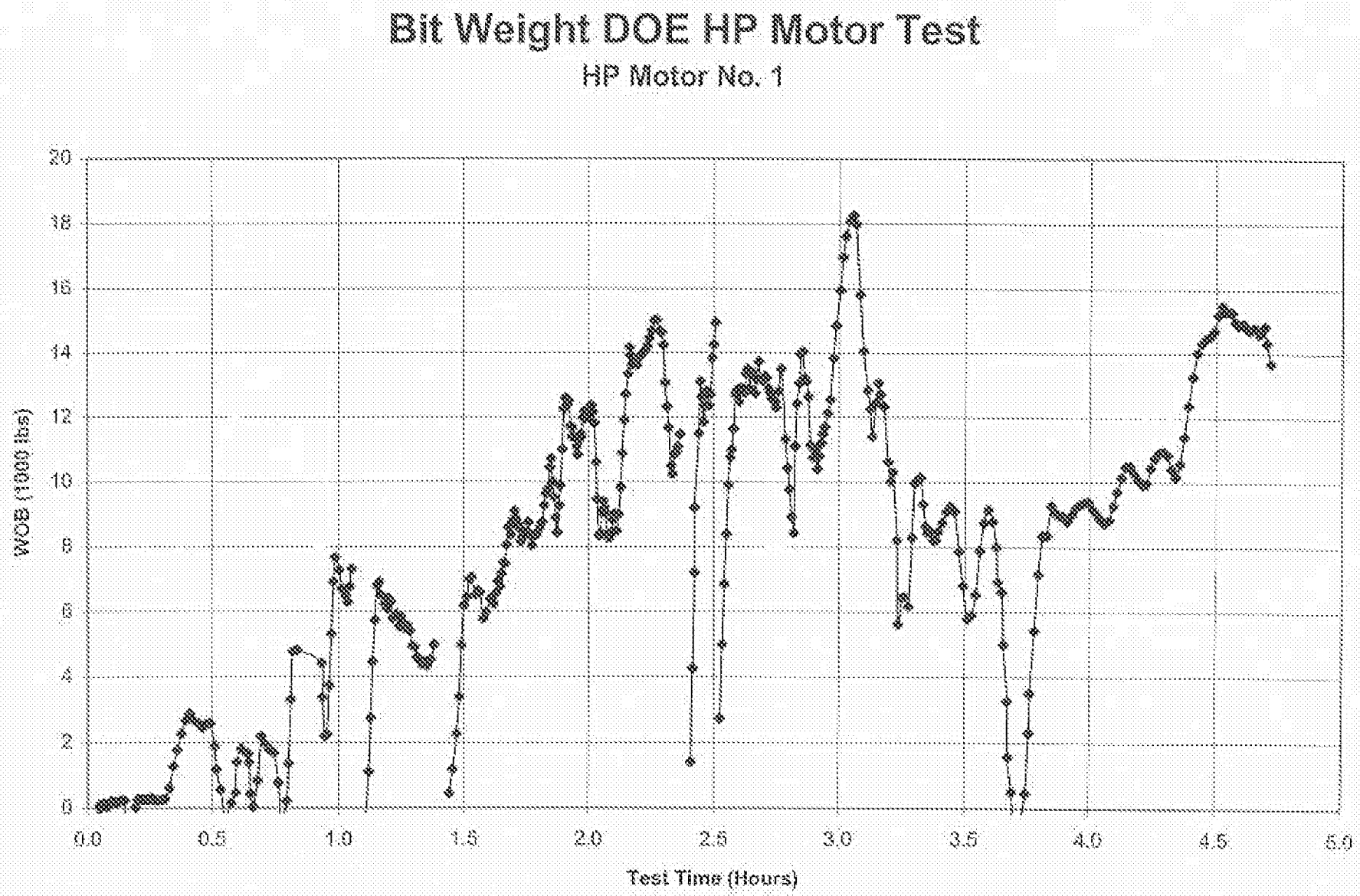
Well No. 6	Date: 12/14/98 to 12/15/98								
Starting Depth =	1606.63	Bit Type =	Walker McDonald MP66H						
Ending Depth =	1698.42	Bit Size =	4.75					Average ROP Excluding Hard Streak	
Total Depth Drilled	97.79	Bit Nozzles =	8, 9, 12, 12					Depth Drilled =	91.84
Hours On Bit =	4.7000	Mud Type =	Water Based					Hours On Bit =	3.35
Average ROP =	20.81	Mud Weight (lbs/gal) =	9.00					Average ROP	27.32
Drillstring (ft) =	1631.76	Pipe (ft) =	883.76	Collar (ft) =	748.54				

Time (HH:MM:SS)	Time From Start (Hours)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	Instant. ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	10 Point Average ROP (ft/hr)	Per Foot ROP (ft/hr)
12:49:01	4.4908	1690.37	120	2320	435	13.98	15.12	14.72	2.58	93.74	0.0167	4.4908	1.47	
12:50:01	4.5076	1690.45	118	2270	427	12.64	16.46	15.31	4.48	93.82	0.0167	4.5076	1.60	0.94
12:51:01	4.5242	1690.52	118	2165	429	13.47	16.59	15.47	4.64	93.89	0.0167	4.5242	1.63	
12:51:44	4.5361	1690.78	117	2048	434	14.58	14.51	15.33	21.34	94.15	0.0119	4.5361	3.03	
12:52:38	4.5511	1691.03	115	2039	419	14.21	14.89	15.30	16.76	94.40	0.0150	4.5511	5.43	
12:53:12	4.5606	1691.28	119	2043	433	14.06	15.02	15.28	26.35	94.65	0.0095	4.5606	6.82	
12:53:59	4.5736	1691.53	119	2027	423	14.14	14.94	14.99	19.23	94.90	0.0131	4.5736	8.04	16.34
12:54:41	4.5853	1691.78	119	2037	434	14.01	15.03	14.88	22.19	95.16	0.0117	4.5853	11.58	
12:55:21	4.5964	1692.04	117	2039	427	14.37	14.73	14.82	22.39	95.41	0.0111	4.5964	13.99	
12:56:01	4.6075	1692.29	120	2039	434	14.67	15.01	14.96	22.22	95.66	0.0111	4.6075	16.46	
12:56:47	4.6203	1692.54	119	1984	431	14.82	14.36	14.86	16.67	95.91	0.0128	4.6203	18.53	21.64
12:57:32	4.6328	1692.79	120	1995	436	14.47	14.82	14.74	20.01	96.16	0.0125	4.6328	20.90	
12:58:18	4.6456	1693.04	119	2013	433	13.71	15.38	14.80	20.12	96.41	0.0128	4.6456	20.65	
12:58:53	4.6553	1693.30	121	2015	436	14.46	14.04	14.79	25.46	96.67	0.0097	4.6553	21.79	
12:59:44	4.6694	1693.55	121	2016	439	15.02	14.20	14.62	17.80	96.92	0.0142	4.6694	20.85	20.58
13:00:29	4.6808	1693.80	117	2032	427	14.25	14.85	14.75	22.52	97.17	0.0114	4.6808	21.17	
13:00:54	4.6889	1694.05	120	2187	434	14.03	15.12	14.68	30.65	97.42	0.0081	4.6889	21.81	
13:01:27	4.6981	1694.31	114	2143	416	13.50	12.79	14.34	27.83	97.68	0.0092	4.6981	23.33	
13:02:27	4.7147	1694.42	117	2269	428	17.93	11.41	13.69	6.70	97.79	0.0167	4.7147	19.67	19.21


Bit Depth DOE HP Motor Test
HP Motor No. 1
Bit Depth (ft)
1700
1680
1660
1640
1620
1600
1580
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Test Time (Hours)

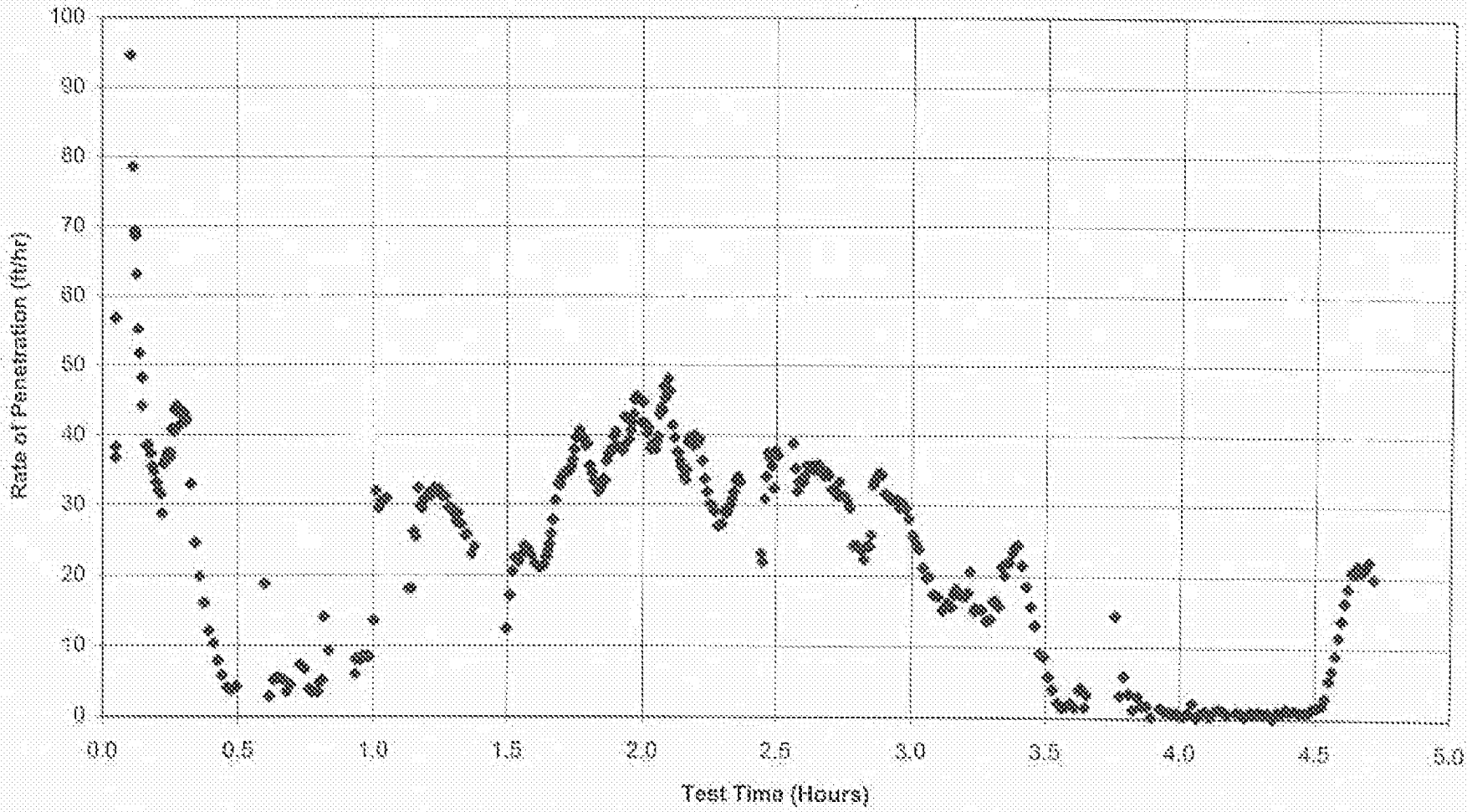

Flow Rate DOE SH-HP Motor Test
Hp Motor No. 1
Flow (gpm)
200
180
160
140
120
100
80
60
40
20
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Test Time (Hours)


Stand Pipe Pressure DOE SH-HP Motor Test
HP Motor No. 1
Pressure (psi)
3000
2500
2000
1500
1000
500
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Test Time (Hours)


Bit Weight DOE HP Motor Test
HP Motor No. 1
WOB (1000 lbs)
20
18
16
14
12
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Test Time (Hours)

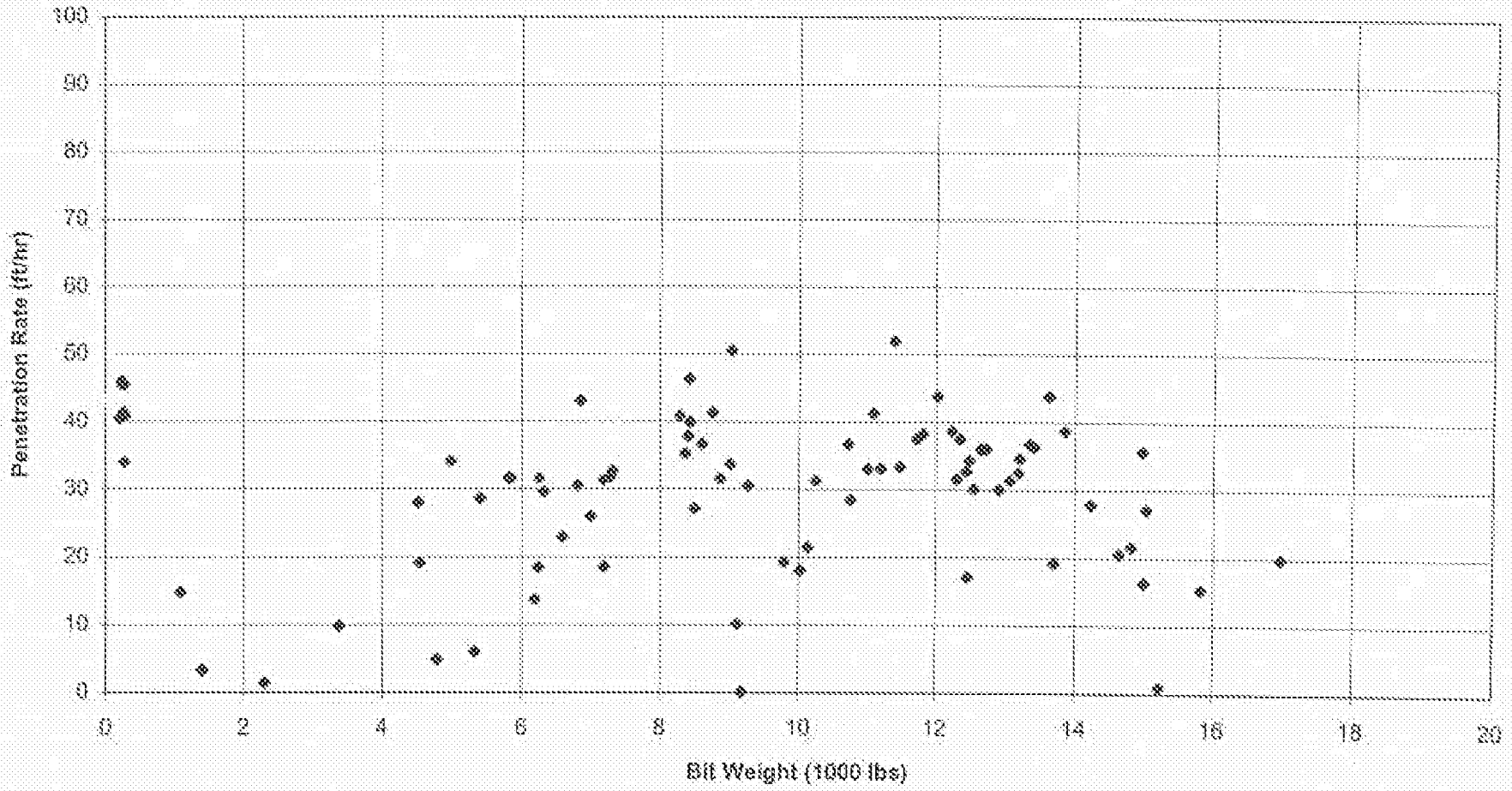
Penetration Rate DOE HP Motor Test

HP Motor No. 1



ROP As A Function Of Bit Weight

DOE HP Motor No. 1



DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1693.55			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Stops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.69			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.69		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
08:26:06	0.0000	1693.55		1137	421	29.54	0.33		13.79	0.0000	0.0000	0.0000		
08:27:01	0.0147	1693.90	116	1240	423	28.41	1.40		16.91	0.2600	0.0147	0.0147		
08:28:01	0.0314	1694.08	116	1284	423	28.01	1.75		10.88	0.4300	0.0167	0.0314		
08:28:35	0.0408	1694.33	117	1332	427	27.85	1.90		26.73	0.5600	0.0094	0.0408		
08:29:27	0.0553	1694.55	118	1381	428	27.91	1.85	1.45	17.6	0.6400	0.0144	0.0553	17.81	17.01
08:30:16	0.0687	1694.84	117	1342	427	27.76	1.98	1.78	17.3	1.1900	0.0144	0.0697	17.09	
08:31:04	0.0823	1695.09	119	1375	432	27.35	2.37	1.97	26.02	1.4400	0.0125	0.0822	19.67	
08:31:52	0.0958	1695.34	118	1378	428	27.52	2.24	2.07	19.22	1.6900	0.0133	0.0956	18.46	
08:32:40	0.1093	1695.60	118	1382	430	26.96	2.76	2.35	19.31	1.9500	0.0139	0.1095	18.84	18.64
08:33:35	0.1242	1695.85	119	1383	432	27.15	2.59	2.39	16.34	2.2000	0.0153	0.1248	18.55	18.55
08:34:35	0.1408	1696.08	119	1381	433	27.34	2.58	2.61	12.49	2.4100	0.0167	0.1408	15.05	
08:35:16	0.1522	1696.31	119	1387	431	27.3	2.84	2.52	22.36	2.6600	0.0114	0.1522	17.12	
08:35:15	0.1988	1696.58	119	1382	433	29.01	0.29	2.12	16.36	2.9300	0.0164	0.1686	16.41	16.41
08:37:15	0.1853	1696.93	119	1183	433	29.84	0.00	1.56	-39.5	2.2700	0.0167	0.1853	1.15	
08:37:36	0.1894	1696.19	116	1133	419	29.66	0.00	1.04	63.51	2.5400	0.0042	0.1894	2.67	2.67
08:37:51	0.1953	1696.44	114	1083	414	29.84	0.00	0.53	44.33	2.7900	0.0058	0.1953	3.02	
08:38:51	0.2119	1696.84	110	1029	400	29.87	0.00	0.04	-30.37	2.3900	0.0167	0.2119	-34.77	
08:39:46	0.2272	1696.19	110	1019	400	29.7	0.16	0.04	16.44	2.5400	0.0153	0.2272	6.44	
08:40:07	0.2331	1696.44	110	1022	400	29.5	0.34	0.10	41.6	2.7900	0.0058	0.2331	6.73	
08:41:02	0.2483	1696.69	109	1249	399	26.8	2.93	0.69	16.56	3.0400	0.0153	0.2483	4.71	4.71
08:41:34	0.2572	1696.94	109	1335	398	26.96	3.76	1.44	28.29	3.2900	0.0086	0.2572	22.06	
08:42:34	0.2739	1696.93	108	1230	395	28.29	1.51	1.74	-0.54	3.2800	0.0167	0.2739	15.06	
08:43:13	0.2847	1697.18	109	1135	396	28.21	1.58	2.02	23	3.5300	0.0108	0.2847	14.32	
08:44:13	0.3014	1697.30	109	1230	396	28	1.80	2.32	6.86	3.6600	0.0167	0.3014	11.50	
08:45:00	0.3144	1697.55	108	1259	395	28.07	3.01	2.31	19.42	3.9099	0.0131	0.3144	10.00	6.65
08:45:38	0.3250	1697.80	109	1256	395	28.87	3.85	2.35	23.8	4.1599	0.0106	0.3250	17.02	
08:46:30	0.3394	1698.05	109	1310	397	25.21	4.49	2.95	17.46	4.4099	0.0144	0.3394	15.90	
08:47:12	0.3511	1698.30	107	1308	391	25.12	4.56	3.54	21.45	4.6599	0.0117	0.3511	20.11	
08:47:58	0.3633	1698.56	108	1339	393	24.39	5.23	4.23	20.63	4.9199	0.0122	0.3633	20.66	20.66
08:48:34	0.3739	1698.81	109	1397	395	23.86	5.75	4.78	24.22	5.1800	0.0106	0.3739	20.86	
08:49:07	0.3831	1699.57	108	1443	397	23.4	6.13	5.23	27.97	5.4300	0.0092	0.3831	23.39	

DOE high power mortor test Amaco Caloosa Test Site — Commercial Motor

Well No. 8	Date: 12/16/98													
Starting Depth =	1693.65			Bit Type =	Walker McDonald MF66H									
Ending Depth =	1781.24			Bit Size =	4.75							Average ROP Excluding Stops		
Total Depth Drilled	87.59			Bit Nozzles =		5, 9, 13, 12						Depth Drilled	87.59	
Hours On Bit =	4.10			Mud Type =		Water Based						Hours On Bit	3.83	
Average ROP =	21.35			Mud Weight (lb/gal) =		8.70						Average ROP	22.52	
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HR:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
08:49:44	0.3933	1699.32	108	1432	395	24.38	5.22	5.39	24.18	5.6700	0.0103	0.3933	24.18	
08:50:11	0.4008	1699.57	106	1442	398	24.39	5.35	5.54	33.37	5.9200	0.0075	0.4008	36.83	28.93
08:50:45	0.4103	1699.82	109	1441	396	24.03	5.59	5.81	27	6.1700	0.0094	0.4103	27.76	
08:51:22	0.4206	1700.07	108	1438	396	24.11	5.48	5.55	24.42	6.4200	0.0103	0.4206	26.67	
08:51:52	0.4289	1700.53	108	1446	394	23.95	5.62	5.45	30.35	6.5600	0.0083	0.4289	28.41	
08:52:52	0.4456	1700.53	110	1313	396	26.47	3.22	5.05	12.17	6.6800	0.0167	0.4456	21.47	21.47
08:53:29	0.4558	1700.78	109	1370	396	24.73	4.94	4.97	24.75	7.1300	0.0103	0.4558	21.97	
08:54:09	0.4669	1701.03	108	1371	397	24.97	4.66	4.78	22.56	7.3800	0.0111	0.4669	20.69	
08:54:43	0.4764	1701.28	111	1418	403	24.71	4.91	4.87	25.35	7.6300	0.0094	0.4764	20.00	
08:55:43	0.4931	1701.42	109	1370	398	27.02	2.71	4.69	8.42	7.7700	0.0167	0.4931	16.74	18.74
08:56:33	0.5069	1701.67	110	1391	401	26.46	3.27	4.16	17.94	8.0200	0.0139	0.5069	17.41	
08:57:03	0.5153	1701.92	107	1419	382	24.97	4.68	4.04	30.92	8.2700	0.0083	0.5153	18.41	
08:58:03	0.5319	1702.03	110	1348	400	27.49	3.24	3.56	6.35	8.3600	0.0167	0.5319	13.52	
08:58:53	0.5458	1702.28	109	1361	399	25.76	3.91	3.38	17.9	8.6300	0.0139	0.5458	15.28	18.28
08:59:53	0.5625	1702.52	110	1298	400	25.96	3.79	3.56	14.22	8.8700	0.0167	0.5625	15.36	
09:00:53	0.5792	1702.78	109	1295	399	26.9	2.85	3.47	13.67	9.1500	0.0167	0.5792	12.59	
09:01:34	0.5878	1703.00	110	1364	402	24.91	4.75	3.49	25.69	9.3500	0.0086	0.5878	17.37	
09:02:21	0.6035	1703.25	108	1316	394	26.28	3.41	3.72	15.81	9.6000	0.0158	0.6035	16.79	16.79
09:03:08	0.6144	1703.50	111	1296	404	25.79	3.88	3.72	23.04	9.8500	0.0108	0.6144	18.87	
09:03:37	0.6247	1703.75	110	1336	401	25.36	4.29	3.84	34.7	10.1000	0.0103	0.6247	21.95	
09:04:24	0.6247	1704.07	110	1334	403	25.81	3.88		27.48	10.4200	0.0000	0.6247		
09:04:54	0.6331	1704.27	111	1339	403	25.74	3.93		23.29	10.6200	0.0083	0.6331		
09:05:24	0.6414	1704.42	110	1329	399	25.94	3.76		18.08	10.7700	0.0083	0.6414		
09:05:54	0.6497	1704.62	110	1330	399	25.87	3.81		24.3	10.9700	0.0083	0.6497		
09:06:24	0.6581	1704.83	110	1339	401	24.09	5.52	4.18	24.98	11.1800	0.0083	0.6581	22.81	
09:06:54	0.6664	1705.02	111	1319	405	23.98	5.60	4.62	22.63	11.3700	0.0083	0.6664	22.50	27.89
09:07:24	0.6747	1705.14	111	1306	403	26.3	4.36	4.61	14.38	11.4900	0.0083	0.6747	21.60	
09:07:54	0.6831	1705.33	111	1304	403	25.72	3.97	4.65	23.57	11.6800	0.0083	0.6831	21.30	21.30
09:08:22	0.6906	1705.56	108	1304	394	26.26	3.44	3.58	33.09	11.9300	0.0078	0.6909	22.88	
09:08:52	0.6992	1705.76	111	1314	404	26.78	2.93	4.05	20.16	12.1300	0.0083	0.6992	22.27	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98														
Starting Depth =	1693.68			Bit Type =	Walker McDonald MP88H							Average ROP Excluding Stops			
Ending Depth =	1781.26			Bit Size =	4.75										
Total Depth Drilled	87.58			Bit Nozzles =		9, 9, 12, 12						Depth Drilled	87.58		
Hours On Bit =	4.10			Mud Type =		Water Based						Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70						Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
09:09:22	0.7575	1705.94	109	1291	396	28.2	3.43	3.63	23	12.2900	0.0083	0.7575	24.41	
09:09:52	0.7158	1706.35	111	1342	403	26.77	2.62	3.34	24.84	12.5000	0.0083	0.7158	25.02	
09:10:22	0.7242	1706.34	111	1342	405	26.7	3.00	3.14	22.91	12.6900	0.0083	0.7242	22.89	24.57
09:10:52	0.7326	1706.51	109	1234	398	27.19	2.49	2.95	20.95	12.8800	0.0083	0.7326	22.80	
09:11:19	0.7400	1706.77	110	1353	401	26.73	2.97	2.96	33.71	13.1200	0.0075	0.7400	25.54	
09:11:49	0.7483	1706.65	110	1233	401	26.79	2.90	2.86	18.47	13.2000	0.0083	0.7483	21.54	
09:12:19	0.7567	1707.00	113	1336	413	24.61	4.99	3.27	17.09	13.3500	0.0083	0.7567	20.31	
09:12:49	0.7650	1707.22	112	1310	408	26.82	2.86	3.24	35.78	13.5700	0.0083	0.7650	21.85	
09:13:19	0.7733	1707.36	113	1314	409	27	2.74	3.23	19.5	13.7300	0.0083	0.7733	18.30	21.15
09:13:49	0.7817	1707.56	113	1314	411	27.07	2.65	3.23	21.82	13.9100	0.0083	0.7817	21.30	
09:14:19	0.7900	1707.71	111	1309	405	26.73	3.00	3.25	18.41	14.0600	0.0083	0.7900	21.30	
09:14:49	0.7983	1707.84	112	1308	406	26.79	2.95	2.84	15.57	14.1800	0.0083	0.7983	18.60	
09:15:19	0.8067	1708.08	112	1299	405	26.89	2.84	2.84	28.8	14.4100	0.0083	0.8067	20.40	
09:15:49	0.8150	1708.16	112	1313	406	26.83	3.23	2.93	11.94	14.5100	0.0083	0.8150	18.00	
09:16:17	0.8226	1708.31	112	1341	408	26.65	3.06	3.02	32.12	14.7000	0.0078	0.8226	21.36	20.83
09:16:47	0.8311	1708.58	112	1333	408	26.59	3.14	3.04	30.16	14.9300	0.0083	0.8311	22.58	
09:17:17	0.8394	1708.76	110	1354	408	26.3	3.42	3.14	20.77	15.1100	0.0083	0.8394	21.36	
09:17:47	0.8478	1708.95	113	1355	411	26.2	3.48	3.27	23.28	15.3000	0.0083	0.8478	24.10	
09:18:17	0.8561	1709.14	111	1331	403	25.73	3.95	3.41	22.59	15.4900	0.0083	0.8561	21.90	
09:18:47	0.8644	1709.38	113	1337	413	25	4.85	3.73	28.34	15.7300	0.0083	0.8644	34.00	23.28
09:19:17	0.8728	1709.54	111	1271	404	27.3	2.46	3.59	19.07	15.8900	0.0083	0.8728	23.40	
09:19:39	0.8789	1709.79	111	1477	405	25.85	5.80	3.57	41.9	16.1400	0.0061	0.8789	27.00	
09:20:09	0.8872	1709.83	111	1313	405	27.62	2.18	3.40	3.94	16.1800	0.0083	0.8872	22.16	
09:20:39	0.8956	1709.97	113	1263	408	27.06	2.87	3.15	16.99	16.3200	0.0083	0.8956	18.96	
09:21:07	0.9033	1710.22	112	1315	409	25.97	3.74	2.97	32.14	16.5700	0.0078	0.9033	22.25	
09:21:37	0.9117	1710.43	113	1314	412	25.69	3.59	3.19	24.77	16.7800	0.0083	0.9117	19.53	22.24
09:22:07	0.9200	1710.63	110	1384	401	25.6	4.08	3.25	23.91	16.9800	0.0083	0.9200	24.41	
09:22:37	0.9283	1710.84	111	1324	403	26.14	3.54	3.52	25.35	17.1800	0.0083	0.9283	26.54	
09:23:07	0.9367	1711.00	112	1325	407	25.9	3.78	3.75	20.02	17.3500	0.0083	0.9367	23.46	
09:23:34	0.9442	1711.26	111	1344	405	25.56	3.72	3.74	33.29	17.6100	0.0075	0.9442	25.54	
09:24:04	0.9525	1711.41	110	1386	402	25.57	4.11	3.85	18.44	17.7600	0.0083	0.9525	24.66	24.26

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98														
Starting Depth =	1693.65			Bit Type =	Walker McDonald MF68H							Average ROP Excluding Steps			
Ending Depth =	1781.24			Bit Size =	4.75										
Total Depth Drilled	87.59			Bit Nozzles =		9, 9, 12, 12						Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based						Hours On Bit	3.82		
Average ROP =	21.36			Mud Weight (lbs/gal) =		8.70						Average ROP	22.92		
Drillstring (ft) =	1715.65			Pipe (ft) =	977.74		Collar (ft)	740.31							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Rock Load (Klps)	WOB (Klps)	Average WOB (Klps)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
09:24:34	0.6608	1711.61	111	1368	403	26.95	4.14	3.66	23.57	17.9600	0.0083	0.9608	23.69	
09:25:04	0.6692	1711.73	111	1323	405	26.41	3.92	3.61	14.9	18.0800	0.0083	0.9692	22.46	
09:25:33	0.9772	1711.98	111	1375	404	25.74	3.95	3.85	32.13	18.3300	0.0381	0.9772	21.78	
09:26:03	0.9856	1712.18	112	1358	408	26.1	3.89	3.82	23.15	18.5100	0.0083	0.9856	22.69	
09:26:33	0.9939	1712.34	113	1315	410	26.1	3.89	3.72	22	18.6900	0.0083	0.9939	22.09	22.47
09:27:03	1.0022	1712.55	108	1351	398	26.24	4.43	3.78	28.62	18.8300	0.0083	1.0022	25.71	
09:27:33	1.0106	1712.75	112	1485	408	26.01	3.69	3.85	21.21	19.1300	0.0083	1.0106	23.13	
09:28:03	1.0189	1712.87	112	1169	405	26.67	1.15	3.39	14.34	19.2200	0.0083	1.0189	21.33	
09:28:33	1.0272	1713.01	110	1257	402	27.61	2.14	3.00	15.92	19.3600	0.0083	1.0272	20.15	
09:29:03	1.0356	1713.19	113	1290	413	27.3	2.46	2.77	22.09	19.5400	0.0083	1.0356	18.30	
09:29:33	1.0439	1713.42	114	1352	418	27.3	2.43	2.37	27.77	19.7700	0.0083	1.0439	20.10	21.60
09:30:03	1.0522	1713.57	111	1300	404	27.03	2.71	2.18	17.37	19.9200	0.0083	1.0522	21.00	
09:30:33	1.0606	1713.52	116	1221	420	28.84	0.98	2.15	-6.16	19.8700	0.0083	1.0606	15.30	
09:31:03	1.0689	1713.69	113	1316	412	27.51	1.99	2.11	20.73	20.0400	0.0083	1.0689	16.00	
09:31:33	1.0772	1713.83	113	1300	411	28.89	2.83	2.19	17.5	20.1800	0.0083	1.0772	12.30	
09:32:03	1.0856	1713.99	111	1322	405	26.73	3.02	2.31	16.41	20.3400	0.0083	1.0856	12.60	
09:32:33	1.0939	1714.17	111	1348	405	26.6	3.12	2.39	22.35	20.5200	0.0083	1.0939	19.50	
09:33:03	1.1022	1714.37	112	1322	408	26.83	2.91	2.77	23.8	20.7200	0.0083	1.1022	20.40	16.25
09:33:33	1.1106	1714.52	112	1328	409	27.07	2.97	2.91	17.56	20.8700	0.0083	1.1106	20.70	
09:34:03	1.1189	1714.71	111	1322	405	26.89	2.85	2.91	22.25	21.0500	0.0083	1.1189	21.60	
09:34:33	1.1272	1714.89	113	1358	415	26.57	3.16	2.94	21.65	21.2400	0.0083	1.1272	21.60	
09:35:03	1.1356	1715.04	111	1298	404	26.95	2.83	2.88	17.84	21.3900	0.0083	1.1356	20.10	
09:35:27	1.1422	1715.29	111	1343	406	25.34	4.35	3.17	36.59	21.6400	0.0067	1.1422	24.32	
09:35:57	1.1506	1715.48	113	1356	410	24.33	5.31	3.62	17.08	21.7900	0.0083	1.1506	22.74	21.93
09:36:27	1.1589	1715.65	113	1347	412	23.56	6.04	4.33	14.72	21.9000	0.0083	1.1589	20.64	
09:36:57	1.1672	1715.76	114	1336	415	23.55	6.06	4.91	25.21	22.1100	0.0083	1.1672	22.74	
09:37:27	1.1756	1715.75	113	1475	412	25.88	3.86	5.12	-0.97	22.1000	0.0083	1.1756	13.80	
09:37:57	1.1839	1715.93	112	1286	410	25.33	4.37	5.13	21.23	22.2800	0.0083	1.1839	15.00	
09:38:27	1.1922	1716.01	113	1283	410	25.86	3.87	4.84	10.12	22.3600	0.0083	1.1922	13.80	
09:38:57	1.2006	1716.22	112	1341	407	24.18	5.47	4.73	25.15	22.5700	0.0083	1.2006	12.60	
09:39:27	1.2089	1716.34	113	1313	413	24.25	5.39	4.53	14.11	22.6900	0.0083	1.2089	17.76	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/15/95													
Starting Depth =	1693.65			Bit Type =	Walker McDonald MP88H						Average ROP Excluding Steps			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.59			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.92		
Drillstrings (ft) =	1718.69			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
09:39:57	1.2172	1716.82	115	1295	429	24.61	5.06	4.83	9.02	23.7700	0.0083	1.2172	14.79	14.85
09:40:27	1.2256	1716.61	113	1312	411	25.6	4.11	4.78	22.95	22.9600	0.0083	1.2256	16.00	
09:40:57	1.2339	1716.78	109	1431	397	26.68	3.08	4.62	20.7	23.1300	0.0083	1.2339	16.88	
09:41:19	1.2400	1717.05	112	1260	408	26.56	2.81	4.09	43.51	23.4000	0.0061	1.2400	32.82	
09:41:20	1.2403	1717.32	111	1174	405	27.85	1.94	3.40	4539.95	23.8730	0.0003	1.2403	39.64	39.64
09:54:22	1.2403	1717.57	121	1120	438	29.9	0.44		448.97	33.8219	0.0000	1.2403		
09:54:23	1.2408	1717.82	115	1117	418	30.26	0.09		931.57	24.1700	0.0003	1.2408		
09:54:28	1.2419	1718.06	122	1121	441	30.06	0.27		186.24	24.4300	0.0014	1.2419		
09:54:38	1.2447	1718.33	118	1124	429	30.11	0.24		91.29	24.6800	0.0028	1.2447		
09:55:08	1.2531	1718.17	117	1134	426	30.18	0.18		-19.34	24.8200	0.0083	1.2531	98.95	
09:55:38	1.2614	1718.16	115	1122	418	30.41	0.00	0.16	-0.42	24.8100	0.0083	1.2614	16.32	
09:56:08	1.2697	1718.20	116	1128	422	30.41	0.00	0.14	4.46	24.8500	0.0083	1.2697	4.32	
09:56:38	1.2781	1718.18	117	1115	424	30.25	0.11	0.11	-2.34	24.8300	0.0083	1.2781	-4.50	
09:57:08	1.2864	1718.37	116	1103	421	30.18	0.18	0.09	22.67	24.7800	0.0083	1.2864	5.00	
09:57:38	1.2947	1718.54	105	1160	377	27.44	2.81	0.62	20.38	24.8500	0.0083	1.2947	11.40	17.82
09:58:08	1.3031	1716.80	61	907	233	28.23	1.59	0.94	-424.25	21.3589	0.0083	1.3031	-98.00	
09:58:38	1.3114	1714.92	104	978	381	30.58	0.00	0.54	-5.80	21.2700	0.0083	1.3114	-97.20	
09:59:08	1.3197	1714.62	116	1128	423	30.56	0.00	0.32	-0.61	21.2700	0.0083	1.3197	-103.69	
09:59:38	1.3247	1715.17	116	1137	423	30.4	0.00	0.18	91.39	21.5200	0.0050	1.3247	-112.33	
09:59:38	1.3247	1715.43	121	1163	440	29.8	0.52	0.42	1956.75	21.7800	0.0000	1.3247	19.85	
09:59:27	1.3250	1715.88	120	1160	436	29.83	0.55	0.21	2655.88	22.0300	0.0003	1.3250	55.84	
09:59:27	1.3250	1715.84	115	1159	417	29.92	0.38	0.29	2700.75	22.2800	0.0000	1.3250	193.26	
09:59:27	1.3250	1716.21	107	1162	391	29.55	0.78	0.45	2790.01	22.5600	0.0000	1.3250	3744.00	
09:59:28	1.3253	1716.47	106	1161	388	30.01	0.37	0.52	2951.2	22.8200	0.0003	1.3253	1872.00	
09:59:28	1.3253	1716.73	107	1166	389	30.57	0.00	0.42	2979.29	23.0800	0.0000	1.3253	3780.00	
09:59:28	1.3253	1716.99	110	1150	401	31.01	0.00	0.31	2281.69	23.3300	0.0000	1.3253	3744.00	
09:59:29	1.3256	1717.24	110	1147	421	29.92	0.00	0.23	1031.58	23.5800	0.0003	1.3256	1664.00	
09:59:30	1.3259	1717.49	110	1135	400	30.38	0.00	0.07	1535.38	23.8400	0.0003	1.3256	1696.00	
09:59:32	1.3264	1717.74	117	1161	426	30.23	0.12	0.02	381.54	24.0900	0.0006	1.3264	969.00	
09:59:37	1.3278	1717.89	124	1103	449	30.17	0.21	0.07	202.25	24.3400	0.0014	1.3278	494.01	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1693.85			Bit Type =	Walker McDonnald MP6841						Average ROP Excluding Slops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.39			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.39		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.53		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HR:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
09:59:47	1.3306	1718.25	109	1067	399	30.13	0.22	0.11	60.03	24.6000	0.0028	1.3306	202.50	
10:00:04	1.3353	1718.50	107	980	392	29.63	0.51	0.21	53.86	24.8500	0.0047	1.3353	196.94	
10:00:34	1.3436	1718.14	80	894	330	29.69	0.64	0.34	-402.25	21.4500	0.0083	1.3436	-155.97	
10:00:51	1.3483	1715.40	33	360	131	30.86	0.00	0.32	52.56	21.7500	0.0047	1.3483	-738.00	
10:01:21	1.3567	1715.36	1	97	28	30.83	0.00	0.27	-4.37	21.7100	0.0083	1.3567	-119.68	
10:01:51	1.3650	1715.38	1	86	26	30.77	0.05	0.23	2.49	21.7300	0.0083	1.3650	-104.97	
10:02:21	1.3733	1715.38	1	83	26	30.72	0.05	0.13	0	21.7300	0.0083	1.3733	8.67	
10:02:51	1.3817	1715.37	1	81	26	30.68	0.00	0.00	-1.24	21.7200	0.0083	1.3817	-0.90	
10:03:21	1.3900	1715.36	1	79	26	30.65	0.00	0.00	-0.86	21.7100	0.0083	1.3900	0.00	
10:03:51	1.3983	1715.36	1	78	26	30.62	0.00	0.00	0.59	21.7100	0.0083	1.3983	-0.60	
10:04:21	1.4067	1715.36	1	77	26	30.62	0.00	0.00	-0.85	21.7100	0.0083	1.4067	-0.60	
10:04:51	1.4150	1715.36	1	78	26	30.61	0.00	0.00	0.22	21.7100	0.0083	1.4150	-0.30	
10:05:21	1.4233	1715.35	1	76	26	30.6	0.00	0.00	-0.57	21.7000	0.0083	1.4233	-0.30	
10:05:51	1.4317	1715.38	1	75	26	30.6	0.06	0.00	2.81	21.7300	0.0083	1.4317	3.60	
10:16:53	1.6158	1715.17	117	1143	426	30.64	0.00	0.00	328.37	21.5200	0.1939	1.6158	-0.91	
10:17:23	1.6239	1715.13	119	1163	433	30.58	0.00	0.00	-5.23	21.4800	0.0083	1.6239	-1.10	
10:17:53	1.6322	1715.16	123	1171	445	30.58	0.00	0.00	3.57	21.5100	0.0083	1.6322	0.91	
10:18:23	1.6405	1715.14	120	1177	436	30.57	0.00	0.00	-2.49	21.4900	0.0083	1.6405	-1.15	
10:18:53	1.6489	1715.18	121	1173	438	30.56	0.00	0.00	4.85	21.5300	0.0083	1.6489	0.30	
10:19:51	1.6650	1715.27	120	1177	434	30.07	0.30	0.06	138.84	24.6200	0.0161	1.6650	75.38	
10:20:17	1.6722	1715.32	122	1255	443	28.67	1.64	0.39	34.45	24.8700	0.0072	1.6722	84.00	
10:20:47	1.6806	1715.69	119	1429	434	28.26	3.86	1.18	20.42	25.0400	0.0083	1.6806	88.75	
10:21:17	1.6889	1715.92	120	1451	437	27.13	3.12	1.89	27.29	25.2700	0.0083	1.6889	90.59	
10:21:47	1.6972	1716.09	121	1387	438	27.82	2.65	2.33	20.52	25.4400	0.0083	1.6972	25.45	
10:22:14	1.7047	1716.34	122	1445	442	26.49	3.73	3.09	33.71	25.6000	0.0075	1.7047	25.33	
10:22:44	1.7131	1716.46	119	1396	433	26.91	3.33	3.38	14.49	25.6180	0.0083	1.7131	22.89	2.20
10:23:14	1.7214	1716.67	119	1444	434	26.63	3.65	3.28	25.06	25.6210	0.0083	1.7214	23.08	
10:23:44	1.7297	1716.85	119	1392	433	26.94	3.36	3.32	21.61	25.6300	0.0083	1.7297	23.38	
10:24:14	1.7381	1720.04	122	1440	442	26.56	4.25	3.64	22.25	25.6900	0.0083	1.7381	21.60	
10:24:44	1.7464	1720.37	119	1398	431	26.28	3.81	3.66	15.41	25.7200	0.0083	1.7464	21.30	
10:25:14	1.7547	1720.58	121	1424	440	25.86	4.52	3.92	26.24	25.7300	0.0083	1.7547	21.30	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. &	Date: 12/16/98														
Starting Depth =	1693.65			Bit Type =	Walker McDonald MF66H						Average ROP Excluding Stops				
Ending Depth =	1781.24			Bit Size =	4.75										
Total Depth Drilled	87.59			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.59			
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82			
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.76					Average ROP	22.92			
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Klps)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:25:44	1.7531	1720.54	117	1439	427	26.5	4.68	4.13	18.53	26.8800	0.0083	1.7531	20.76	21.69
10:26:14	1.7714	1720.74	118	1481	428	25.03	5.13	4.58	21.58	27.0900	0.0083	1.7714	21.05	
10:26:44	1.7797	1720.84	118	1460	429	25.1	5.05	4.66	24.17	27.2900	0.0083	1.7797	23.10	
10:27:14	1.7881	1721.13	120	1458	437	25.31	4.56	4.79	22.62	27.4800	0.0083	1.7881	22.50	
10:27:44	1.7964	1721.37	121	1453	441	25.94	4.26	4.74	29.47	27.7200	0.0083	1.7964	24.90	
10:28:14	1.8047	1721.56	120	1421	434	25.38	4.80	4.76	22.34	27.9100	0.0083	1.8047	24.90	34.46
10:28:39	1.8117	1721.81	118	1431	428	25.51	4.67	4.67	36.44	28.1600	0.0069	1.8117	27.23	
10:29:09	1.8200	1721.96	116	1503	422	25.41	4.76	4.61	18.49	28.3100	0.0083	1.8200	25.98	
10:29:39	1.8283	1722.11	119	1333	432	27.89	3.15	4.93	17.89	28.4600	0.0083	1.8283	23.17	
10:30:09	1.8367	1722.34	120	1428	436	26.11	4.09	4.25	27.25	28.6900	0.0083	1.8367	24.42	
10:30:37	1.8444	1722.59	118	1480	429	25.66	4.53	5.24	32.5	28.9400	0.0078	1.8444	23.80	25.93
10:31:07	1.8528	1722.72	118	1470	429	25.36	4.90	4.28	15.03	29.0700	0.0083	1.8528	23.19	
10:31:35	1.8606	1722.97	121	1460	439	26.43	3.78	4.09	31.26	29.3200	0.0078	1.8606	26.69	
10:32:05	1.8689	1723.07	120	1469	435	25.47	4.71	4.40	11.84	29.4200	0.0083	1.8689	22.06	
10:32:35	1.8772	1723.29	123	1458	446	24.69	5.46	4.66	27.16	29.6400	0.0083	1.8772	21.36	
10:33:01	1.8844	1723.54	118	1489	428	25.55	4.60	4.69	34.89	29.8900	0.0072	1.8844	25.80	23.75
10:33:31	1.8928	1723.68	120	1402	436	26.11	4.08	4.52	16.91	30.0300	0.0083	1.8928	22.03	
10:33:45	1.8967	1723.98	118	1525	427	25.63	3.59	4.49	55.21	30.2900	0.0039	1.8967	31.32	
10:34:15	1.9050	1724.09	119	1423	431	26.04	4.16	4.36	7.79	30.3500	0.0083	1.9050	25.56	
10:34:26	1.9106	1724.25	118	1469	427	25.71	4.48	4.16	42.39	30.6000	0.0056	1.9106	26.91	
10:35:06	1.9192	1724.47	122	1444	444	26.93	3.39	3.92	25.62	30.8200	0.0083	1.9192	26.94	28.78
10:35:36	1.9275	1724.69	118	1455	439	26.5	3.72	3.85	26.3	31.0000	0.0083	1.9275	24.00	
10:36:06	1.9358	1724.87	124	1445	448	26.09	4.19	3.85	22.35	31.2200	0.0083	1.9358	28.22	
10:36:36	1.9442	1725.03	120	1433	437	26.6	3.62	3.84	19.76	31.3800	0.0083	1.9442	23.40	
10:37:04	1.9519	1725.29	119	1454	432	25.73	4.47	3.81	32.39	31.6400	0.0078	1.9519	26.62	
10:37:31	1.9594	1725.54	120	1522	434	26.25	3.95	3.97	34.23	31.8900	0.0075	1.9594	26.92	26.57
10:38:01	1.9678	1725.75	121	1471	440	26.04	4.16	4.06	25.06	32.1000	0.0083	1.9678	27.55	
10:38:27	1.9750	1726.00	121	1491	438	25.59	4.59	4.36	33.89	32.3500	0.0072	1.9750	31.46	
10:38:57	1.9833	1726.21	120	1527	435	26.35	3.86	4.23	25.25	32.5600	0.0083	1.9833	26.31	
10:39:27	1.9917	1726.43	117	1415	424	27.24	3.08	3.91	26.29	32.7800	0.0083	1.9917	27.62	27.62
10:39:57	2.0000	1726.68	121	1529	438	26.11	4.09	3.84	30.31	33.0300	0.0083	2.0000	28.55	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1693.55			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Slops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.69			Bit Nozzles =	9, 9, 12, 12						Depth Drilled	87.69		
Hours On Bit =	4.19			Mud Type =	Water Based						Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =	8.70						Average ROP	22.93		
Drillstring (ft) =	1718.85			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:40:27	2.0583	1726.91	119	1467	433	26.71	3.50	3.81	27.22	33.2600	0.0083	2.0083	27.30	
10:40:57	2.0167	1727.10	120	1438	435	25.29	4.87	3.66	28.19	33.4500	0.0083	2.0167	26.70	
10:41:27	2.0250	1727.28	119	1486	432	24.66	5.48	4.19	22.05	33.6300	0.0083	2.0250	25.56	
10:41:57	2.0333	1727.53	119	1501	432	25.74	4.48	4.48	30.31	33.8800	0.0083	2.0333	25.80	25.40
10:42:27	2.0417	1727.70	119	1455	431	25.56	4.61	4.53	20.7	34.0500	0.0083	2.0417	23.79	
10:42:57	2.0500	1727.90	120	1466	435	25.91	4.29	4.76	23.55	34.2500	0.0083	2.0500	24.09	
10:43:27	2.0583	1728.11	121	1412	438	26.09	4.10	4.62	24.84	34.4600	0.0083	2.0583	24.86	
10:43:57	2.0667	1728.29	118	1435	438	25.91	4.28	4.38	22.38	34.6400	0.0083	2.0667	22.66	
10:44:26	2.0747	1728.54	121	1458	438	26.15	4.05	4.31	31.41	34.8500	0.0081	2.0747	25.41	24.40
10:44:56	2.0831	1728.87	120	1393	438	26.07	4.14	4.17	14.84	35.0200	0.0083	2.0831	23.29	
10:45:25	2.0911	1728.92	118	1469	420	25.82	5.13	4.34	31.23	35.2700	0.0081	2.0911	24.71	
10:45:52	2.0986	1729.17	119	1496	418	26.21	3.99	4.32	32.23	35.5200	0.0075	2.0986	27.55	
10:46:16	2.1053	1729.42	120	1494	436	27.35	3.90	4.04	36.21	35.7750	0.0067	2.1053	28.80	28.80
10:46:46	2.1139	1729.64	120	1436	436	25.37	3.84	4.00	25.61	35.9500	0.0083	2.1136	31.75	
10:47:16	2.1219	1729.82	119	1486	431	25.64	5.12	4.20	22.24	36.1700	0.0083	2.1219	25.19	
10:47:46	2.1303	1729.99	120	1453	437	24.7	5.43	4.26	20.76	36.3400	0.0083	2.1303	25.55	
10:48:13	2.1378	1730.24	122	1467	441	24.11	6.01	4.66	34.37	36.5800	0.0075	2.1378	25.23	
10:48:43	2.1461	1730.44	119	1487	432	25.28	4.80	5.06	23.01	36.7800	0.0083	2.1461	24.62	24.98
10:49:13	2.1544	1730.65	118	1499	430	25.62	5.14	5.32	25.39	37.0000	0.0083	2.1544	25.54	
10:49:38	2.1614	1730.90	117	1485	420	26.47	3.74	5.05	35.51	37.2500	0.0069	2.1614	28.26	
10:50:08	2.1697	1730.96	122	1319	442	28.63	1.66	4.29	5.84	37.3000	0.0083	2.1697	22.23	
10:50:34	2.1769	1731.20	120	1435	436	27.33	2.92	3.67	35.11	37.5500	0.0072	2.1769	24.65	
10:51:04	2.1853	1731.37	119	1469	433	26.72	3.50	3.39	20.08	37.7200	0.0083	2.1853	23.35	
10:51:34	2.1936	1731.48	119	1328	434	27.81	2.46	2.86	13.65	37.8300	0.0083	2.1936	17.07	21.26
10:52:04	2.2019	1731.65	123	1401	447	26.13	4.68	3.92	23.61	38.0300	0.0083	2.2019	21.72	
10:52:28	2.2081	1731.90	119	1485	431	25.94	4.25	3.44	42.09	38.2500	0.0061	2.2081	23.50	
10:52:53	2.2156	1732.15	120	1545	437	25.62	4.55	3.77	33.2	38.5000	0.0075	2.2156	25.76	
10:53:15	2.2217	1732.41	116	1671	420	26.61	3.71	3.61	41.69	38.7600	0.0061	2.2217	34.23	34.23
10:53:45	2.2300	1732.63	119	1358	434	27.03	3.21	3.96	15.31	38.8500	0.0083	2.2300	31.37	
10:54:00	2.2342	1732.78	115	1549	418	25.49	4.79	4.09	59.75	39.1300	0.0042	2.2342	33.70	
10:54:30	2.2425	1732.93	120	1510	435	26.66	3.57	3.96	17.48	39.2800	0.0083	2.2425	28.96	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/99													
Starting Depth =	1693.65			Bit Type =	Walker McDonald MP08H						Average ROP Excluding Slips			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.59			Bit Nozzles =		8, 9, 12, 12					Depth Drilled	87.59		
Hours On Bit =	4.19			Mud Type =		Water Based					Hours On Bit	3.83		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.82		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:54:55	2.2494	1733.16	116	1509	430	24.51	5.54	4.15	36.1	39.5300	0.0069	2.2494	27.72	
10:55:18	2.2558	1733.43	116	1514	430	24.04	6.07	4.62	39.91	39.7800	0.0064	2.2558	34.84	29.86
10:55:47	2.2639	1733.68	118	1441	428	26.3	3.91	4.76	31.19	40.0300	0.0081	2.2639	30.28	
10:56:17	2.2722	1733.73	122	1621	442	25.1	5.06	4.83	5.96	40.0800	0.0083	2.2722	26.53	
10:56:47	2.2806	1733.87	120	1556	437	27.95	3.33	4.58	16.42	40.2200	0.0083	2.2806	22.18	
10:57:17	2.2889	1734.05	119	1522	433	24.87	5.27	4.53	31.09	40.4000	0.0083	2.2889	19.76	
10:57:31	2.2956	1734.36	119	1670	431	24.74	5.41	4.39	37.15	40.6800	0.0067	2.2956	19.58	
10:58:11	2.3039	1734.34	122	1316	442	28.03	2.25	4.06	4.87	40.6200	0.0083	2.3039	19.25	18.94
10:58:40	2.3119	1734.59	118	1481	429	25.36	4.62	4.01	31.64	40.9400	0.0081	2.3119	22.01	
10:59:10	2.3203	1734.83	119	1519	433	24.9	5.26	4.60	28.73	41.1800	0.0083	2.3203	24.65	
10:59:37	2.3278	1735.06	115	1562	429	24.92	5.22	4.59	33.05	41.4300	0.0075	2.3278	24.21	
11:00:07	2.3361	1735.23	117	1468	427	26.66	3.64	4.22	17.49	41.5800	0.0083	2.3361	27.62	
11:00:37	2.3444	1735.36	119	1436	434	27.95	2.28	4.22	15.44	41.7100	0.0083	2.3444	23.69	25.16
11:01:00	2.3508	1735.51	123	1455	446	28.62	4.55	4.17	40.48	41.9500	0.0064	2.3508	25.53	
11:01:30	2.3592	1735.82	123	1463	448	25.43	4.73	4.06	25.91	42.1700	0.0083	2.3592	23.58	
11:01:58	2.3669	1736.03	124	1550	448	24.56	5.58	4.14	32.1	42.4300	0.0078	2.3669	27.57	
11:02:28	2.3753	1736.39	122	1673	441	23.46	6.63	4.75	23.63	42.6300	0.0083	2.3753	33.64	
11:02:58	2.3836	1736.44	123	1418	439	25.36	4.81	5.26	15.35	42.7500	0.0083	2.3836	25.32	27.57
11:03:27	2.3917	1736.67	121	1462	440	25.21	4.35	5.34	31.85	43.0400	0.0081	2.3917	26.77	
11:03:50	2.3981	1736.85	117	1504	428	25.36	4.89	5.35	38.18	43.3000	0.0064	2.3981	27.88	
11:04:18	2.4053	1737.20	119	1510	431	25.16	5.00	5.24	35.35	43.5500	0.0072	2.4053	30.67	
11:04:48	2.4136	1737.40	117	1539	425	24.56	5.58	6.03	24.43	43.7800	0.0083	2.4136	32.00	32.00
11:05:13	2.4211	1737.68	118	1501	430	24.38	5.75	6.22	32.59	44.0100	0.0075	2.4211	32.94	
11:05:40	2.4286	1737.91	120	1573	437	23.67	6.42	5.51	34.2	44.2600	0.0075	2.4286	31.42	
11:06:00	2.4336	1738.16	121	1570	439	24.9	5.26	5.68	36.06	44.5100	0.0050	2.4336	31.71	
11:06:35	2.4439	1738.37	116	1403	424	27.13	3.11	5.22	25.46	44.7200	0.0083	2.4439	32.04	32.04
11:07:05	2.4522	1738.57	120	1385	437	24.73	5.40	5.18	23.62	44.9500	0.0083	2.4522	29.25	
11:07:31	2.4594	1738.82	118	1505	429	24.25	5.87	5.21	34.77	45.1700	0.0072	2.4594	29.51	
11:07:58	2.4664	1739.07	139	1547	435	24.25	5.83	5.18	35.78	45.3200	0.0069	2.4664	29.51	
11:08:21	2.4733	1739.33	128	1545	437	24.36	5.76	5.19	38.53	45.5700	0.0069	2.4733	32.26	32.26
11:08:51	2.4817	1739.51	121	1561	439	25.07	4.11	5.33	22.21	45.8600	0.0083	2.4817	31.92	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1693.65			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Stops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.59			Bit Nozzles =		8, 9, 12, 12					Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.93		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:09:23	2.4600	1739.60	119	1311	431	27.09	3.14	4.94	16.69	45.9500	0.0083	2.4830	25.53	
11:09:48	2.4975	1739.85	121	1486	439	24.86	5.47	4.86	34.09	46.2000	0.0075	2.4975	25.57	
11:10:18	2.5058	1740.09	119	1458	431	23.89	6.22	4.94	38.55	46.4400	0.0083	2.5058	23.69	
11:10:48	2.5136	1740.34	124	1513	451	24.24	5.89	4.87	31.83	46.6900	0.0078	2.5136	26.98	25.32
11:11:05	2.5189	1740.59	124	1558	448	24.99	5.17	5.18	47.16	46.8400	0.0053	2.5189	34.27	
11:11:33	2.5264	1740.84	122	1513	443	25.33	4.84	5.52	34.43	47.1600	0.0075	2.5264	34.37	
11:12:03	2.5347	1741.09	119	1491	433	25.06	5.11	5.45	19.28	47.3500	0.0083	2.5347	31.59	
11:12:29	2.5422	1741.35	121	1463	436	25.34	4.82	5.17	33.41	47.6000	0.0075	2.5422	31.81	31.81
11:12:59	2.5506	1741.41	117	1462	424	25.68	4.49	4.86	18.43	47.7600	0.0083	2.5506	25.65	
11:13:26	2.5581	1741.66	122	1535	444	25.25	4.93	4.84	33.5	48.0100	0.0075	2.5581	25.68	
11:13:56	2.5664	1741.89	121	1549	439	23.68	6.42	5.15	27.44	48.2400	0.0083	2.5664	28.11	
11:14:16	2.5719	1742.14	117	1637	427	23.11	6.96	5.52	43.94	48.4900	0.0056	2.5719	29.94	
11:14:46	2.5803	1742.29	115	1478	418	24.39	5.72	5.70	18.47	48.6400	0.0083	2.5803	29.61	27.33
11:15:13	2.5878	1742.54	118	1598	427	23.23	6.76	5.16	33.51	48.8900	0.0075	2.5878	29.61	
11:15:40	2.5953	1742.80	117	1633	426	23.3	6.77	5.53	33.5	49.1500	0.0075	2.5953	31.50	
11:16:07	2.6028	1743.05	124	1605	449	23.67	6.42	5.53	33.14	49.4000	0.0075	2.6028	29.51	
11:16:36	2.6108	1743.30	139	1697	435	24.26	5.85	6.31	31.89	49.6500	0.0081	2.6108	33.05	33.05
11:17:00	2.6175	1743.55	117	1605	426	24.53	5.60	6.28	37.84	49.8600	0.0067	2.6175	33.98	
11:17:30	2.6258	1743.87	119	1598	433	24.8	5.34	6.00	14.77	50.1200	0.0083	2.6258	28.47	
11:17:51	2.6317	1743.92	118	1580	429	24.8	5.35	5.72	32.66	50.2700	0.0056	2.6317	30.12	
11:18:15	2.6383	1744.17	116	1606	427	24.5	5.63	5.58	37.8	50.5200	0.0067	2.6383	31.64	
11:18:45	2.6467	1744.36	122	1542	442	24.71	5.43	5.47	21.87	50.7100	0.0083	2.6467	27.77	29.58
11:19:09	2.6533	1744.61	119	1529	433	24.02	6.09	5.57	36.85	50.9600	0.0067	2.6533	34.18	
11:19:39	2.6617	1744.68	117	1595	426	25.7	4.47	5.39	8.58	51.0400	0.0083	2.6617	25.67	
11:20:00	2.6675	1744.80	117	1504	425	24.16	5.86	5.52	13.36	51.1600	0.0083	2.6700	19.89	
11:20:30	2.6758	1745.05	123	1621	444	24.61	5.71	5.63	44.7	51.4000	0.0058	2.6758	28.66	
11:21:00	2.6842	1745.22	120	1550	435	24.79	5.35	5.52	19.79	51.5700	0.0083	2.6842	19.78	
11:21:18	2.6892	1745.47	116	1556	423	24.73	5.42	5.38	48.25	51.8200	0.0050	2.6892	29.86	26.12
11:21:48	2.6975	1745.68	118	1512	429	25	5.16	5.52	25.42	52.0300	0.0083	2.6975	32.01	
11:22:14	2.7047	1745.94	116	1527	420	25.25	4.92	5.31	36.24	52.2900	0.0072	2.7047	30.81	
11:22:44	2.7131	1746.11	117	1621	427	24.45	5.68	5.31	20.54	52.4600	0.0083	2.7131	30.81	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/15/99														
Starting Depth =	1693.65			Bit Type =	Walker McDonald MP58H							Average ROP Excluding Slips			
Ending Depth =	1781.24			Bit Size =	4.75										
Total Depth Drilled	87.59			Bit Nozzles =		9, 9, 12, 12						Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based						Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70						Average ROP	22.92		
Drillstring (ft) =	1719.05			Pipe (ft) =	977.74		Collar (ft)	740.31							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:23:38	2.7197	1746.36	120	1588	435	23.83	6.28	5.49	37.75	52.7100	0.0067	2.7197	29.13	
11:23:38	2.7281	1746.51	119	1608	434	24.33	5.79	5.57	17.84	52.8600	0.0083	2.7281	27.16	28.74
11:24:06	2.7356	1746.78	120	1584	435	24.11	6.00	5.73	32.82	53.1100	0.0078	2.7356	30.38	
11:24:32	2.7431	1747.02	116	1589	423	24.21	5.91	5.83	34.85	53.3700	0.0072	2.7431	30.33	
11:24:58	2.7503	1747.27	120	1480	436	24.55	6.58	5.91	34.85	53.6200	0.0072	2.7503	29.78	
11:25:26	2.7586	1747.46	119	1523	432	24.83	5.33	5.72	23.65	53.8100	0.0083	2.7586	31.09	31.09
11:25:48	2.7642	1747.72	120	1555	437	24.71	5.43	5.65	46.43	54.0700	0.0056	2.7642	33.88	
11:26:18	2.7725	1747.93	121	1522	439	25.37	4.85	5.41	24.99	54.2800	0.0083	2.7725	30.91	
11:26:31	2.7789	1748.18	120	1571	435	24.59	5.55	5.34	49.47	54.5300	0.0064	2.7789	31.81	
11:27:11	2.7872	1748.36	120	1703	436	25.55	4.63	5.15	20.49	54.7000	0.0083	2.7872	31.11	
11:27:41	2.7956	1748.47	122	1596	443	26.39	3.83	4.85	14.16	54.8200	0.0083	2.7956	23.69	27.34
11:28:03	2.8017	1748.72	118	1511	430	25.13	5.03	4.77	49.84	55.0700	0.0061	2.8017	27.09	
11:28:33	2.8100	1748.88	119	1662	432	24.23	5.89	4.99	19.83	55.2300	0.0083	2.8100	32.56	
11:28:58	2.8169	1749.13	122	1504	444	24.7	5.44	5.48	35.63	55.4800	0.0069	2.8169	28.34	
11:29:28	2.8253	1749.29	120	1474	436	25.14	5.01	5.64	18.68	55.6400	0.0083	2.8253	27.59	
11:29:51	2.8317	1749.54	118	1698	429	23.59	6.46	5.57	38.59	55.8900	0.0064	2.8317	27.33	29.63
													19.65	
11:40:34	2.8317	1749.79	120	1187	437	30.53	0.10		-20.68	56.1400	0.0000	2.8317	44.82	
11:41:04	2.8400	1749.78	119	1376	431	30.75	0.00		-1.73	56.1300	0.0083	2.8400	33.28	
11:41:34	2.8483	1749.74	120	1178	436	30.73	0.00		-4.01	56.0900	0.0083	2.8483	12.66	
11:42:04	2.8567	1749.71	118	1173	429	30.72	0.00		-3.72	56.0600	0.0083	2.8567	19.62	
11:42:34	2.8650	1749.75	117	1373	427	30.69	0.00		4.38	56.1000	0.0083	2.8650	-1.20	
11:43:02	2.8728	1750.00	123	1174	443	30.51	0.12	0.03	32.07	56.3500	0.0078	2.8728	8.71	
11:43:32	2.8811	1750.09	117	1208	427	29.71	0.87	0.28	11	56.4400	0.0083	2.8811	10.66	
11:44:02	2.8894	1750.18	119	1347	431	27.29	3.23	0.84	10.83	56.5300	0.0083	2.8894	14.34	
11:44:32	2.8978	1750.19	116	1284	428	28.38	2.15	1.27	1.39	56.5400	0.0083	2.8978	13.42	
11:45:02	2.9061	1750.42	116	1362	426	26.69	3.76	2.03	27.35	56.7700	0.0083	2.9061	12.60	
11:45:32	2.9144	1750.56	117	1495	426	25.34	5.08	3.02	16.43	56.9300	0.0083	2.9144	14.76	
11:45:43	2.9175	1750.83	117	1636	425	26.59	3.89	3.62	82.13	57.1800	0.0031	2.9175	20.17	12.13
11:46:13	2.9258	1750.86	116	1483	422	25.63	4.80	3.94	14.5	57.3000	0.0083	2.9258	27.06	
11:46:43	2.9342	1751.18	122	1483	443	25.36	5.01	4.52	26.02	57.6100	0.0083	2.9342	28.38	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1693.65			Bit Type =	Walker McDonald MP88H						Average ROP Excluding Stops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.59			Bit Nozzles =		8, 8, 12, 12					Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70					Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:47:06	2.9406	1751.41	121	1528	440	25.11	5.30	4.82	49.46	57.7600	0.0064	2.9406	31.79	
11:47:36	2.9489	1751.67	120	1486	435	24.76	5.02	4.93	30.61	58.0300	0.0083	2.9489	28.76	
11:48:01	2.9558	1751.92	117	1579	424	23.38	6.96	5.54	34.97	58.2700	0.0069	2.9558	32.33	28.83
11:48:27	2.9631	1752.17	118	1615	427	24.28	8.05	5.79	35.73	58.5200	0.0072	2.9631	34.96	
11:48:57	2.9714	1752.33	120	1601	436	25.1	5.26	5.84	19.06	58.6800	0.0083	2.9714	29.84	
11:49:17	2.9769	1752.58	116	1548	423	24.92	5.43	5.86	44.79	58.8400	0.0056	2.9769	32.44	
11:49:47	2.9853	1752.73	121	1738	439	24.17	5.16	5.57	18.34	58.9800	0.0083	2.9853	27.51	
11:50:17	2.9936	1752.84	120	1525	435	27.37	3.08	5.20	13.39	59.1900	0.0083	2.9936	21.83	
11:50:47	3.0019	1753.02	120	1377	437	27.21	3.24	4.63	20.64	59.3700	0.0083	3.0019	22.56	23.86
11:51:14	3.0094	1753.27	120	1504	435	26.17	4.23	4.43	33.43	59.6200	0.0075	3.0094	21.23	
11:51:44	3.0178	1753.39	120	1542	437	25.85	4.72	4.29	14.12	59.7400	0.0083	3.0178	20.31	
11:52:08	3.0236	1753.64	118	1461	428	24.51	5.82	4.22	43.14	59.9900	0.0058	3.0236	26.67	
11:52:35	3.0319	1753.71	119	1735	433	26.19	4.22	4.45	8.85	60.0600	0.0083	3.0319	23.01	
11:53:05	3.0403	1753.80	117	1341	424	26.76	3.65	4.52	10.81	60.1500	0.0083	3.0403	17.19	
11:53:35	3.0486	1753.98	122	1443	442	25.04	5.31	4.74	21.17	60.3300	0.0083	3.0486	19.14	25.57
11:54:05	3.0569	1754.21	115	1402	420	25.46	4.90	4.78	27.52	60.5600	0.0083	3.0569	17.10	
11:54:35	3.0653	1754.39	122	1397	443	25.44	4.53	4.60	16.81	60.6500	0.0083	3.0653	17.76	
11:55:05	3.0736	1754.47	120	1413	434	25.42	4.90	4.73	20.61	60.8200	0.0083	3.0736	20.16	
11:55:35	3.0819	1754.66	118	1405	428	25.29	5.11	5.03	22.31	61.0100	0.0083	3.0819	20.40	
11:56:05	3.0903	1754.91	121	1532	438	24.67	5.69	5.10	30.54	61.2600	0.0083	3.0903	21.00	22.92
11:56:28	3.0967	1755.16	118	1527	428	24.41	5.92	5.31	29.26	61.5100	0.0064	3.0967	27.40	
11:56:58	3.1050	1755.30	118	1485	429	25.7	4.67	5.26	16.27	61.6500	0.0083	3.1050	26.44	
11:57:28	3.1128	1755.55	123	1485	447	25.86	4.89	5.24	32.8	61.9000	0.0078	3.1128	28.80	
11:57:56	3.1211	1755.73	120	1454	437	24.35	5.97	5.41	21.47	62.0800	0.0083	3.1211	26.69	
11:58:20	3.1278	1755.88	120	1548	434	23.82	6.40	5.55	37.73	62.3300	0.0067	3.1278	26.36	28.53
11:58:50	3.1361	1755.19	119	1455	433	23.36	6.36	5.64	16.32	62.4700	0.0083	3.1361	26.36	
11:59:16	3.1433	1756.37	123	1652	447	24.33	6.00	5.81	34.18	62.7200	0.0072	3.1433	26.84	
11:59:41	3.1503	1756.62	120	1652	437	24.9	5.45	6.04	36.15	62.9700	0.0069	3.1503	30.51	
12:00:11	3.1586	1756.83	119	1548	433	25.37	5.09	5.84	24.87	63.1800	0.0083	3.1586	27.57	
12:00:41	3.1669	1757.01	119	1513	431	25.46	4.99	5.54	21.74	63.3600	0.0083	3.1669	28.88	28.39
12:01:09	3.1747	1757.26	122	1585	441	25.13	5.23	5.32	32.38	63.6100	0.0078	3.1747	28.35	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 8	Date: 12/16/98													
Starting Depth =	1693.68			Bit Type =	Walker McDonald MP6SH						Average ROP Excluding Stops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.56			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.56		
Hours On Bit =	4.36			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.36			Mud Weight (lbs/gal) =		8.70					Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
12:01:36	3.1822	1757.81	122	1611	444	25.23	5.12	5.14	34.88	63.8600	0.0375	3.1822	27.86	
12:02:06	3.1906	1757.89	119	1669	433	26.05	4.35	4.82	21.96	64.0400	0.0083	3.1906	28.02	
12:02:36	3.1989	1757.89	118	1546	421	25.28	5.10	4.94	24.52	64.2400	0.0083	3.1989	27.95	
12:03:06	3.2072	1758.06	119	1514	434	26.39	4.96	4.96	20.82	64.4100	0.0083	3.2072	24.63	26.07
12:03:29	3.2136	1758.32	122	1625	441	25.38	4.59	4.91	39.43	64.5700	0.0064	3.2136	25.81	
12:03:59	3.2219	1758.49	123	1431	447	25.45	4.82	4.87	20.85	64.8400	0.0083	3.2219	25.49	
12:04:39	3.2275	1758.74	133	1564	448	24.77	5.58	5.11	45.42	65.0900	0.0056	3.2275	29.71	
12:04:49	3.2358	1758.94	119	1512	432	24.81	5.83	5.26	23.44	65.2900	0.0083	3.2358	30.76	
12:05:10	3.2417	1759.19	122	1563	443	25	5.36	5.33	43.12	65.5400	0.0056	3.2417	31.01	32.81
12:05:40	3.2500	1759.36	118	1435	428	25.24	5.12	5.36	20.35	65.7100	0.0083	3.2500	31.01	
12:05:55	3.2542	1759.62	118	1525	426	24.12	5.21	5.62	62.05	65.9700	0.0042	3.2542	33.69	
12:06:16	3.2600	1759.87	117	1602	427	24.14	5.16	5.74	42.37	66.2200	0.0058	3.2600	30.46	
12:06:46	3.2683	1759.97	121	1465	440	24.94	5.41	5.65	12.69	66.3900	0.0083	3.2683	29.25	
12:07:03	3.2731	1760.22	121	1554	438	24.86	5.42	5.65	52.57	66.5700	0.0047	3.2731	37.30	32.81
12:07:33	3.2814	1760.45	121	1452	438	25.06	4.44	5.53	27.83	66.8300	0.0083	3.2814	30.49	
12:08:02	3.2894	1760.79	121	1504	439	24.6	5.74	5.48	31.58	67.0800	0.0081	3.2894	28.19	
12:08:21	3.2947	1760.96	120	1578	437	23.73	6.59	5.61	67.73	67.2600	0.0053	3.2947	37.14	
12:08:51	3.3031	1761.08	119	1479	433	25.07	5.28	5.49	17.15	67.4400	0.0083	3.3031	29.06	
12:09:14	3.3094	1761.34	118	1629	423	24.73	5.61	5.53	39	67.6900	0.0061	3.3094	31.72	30.78
12:09:44	3.3178	1761.55	119	1609	433	24.64	5.69	5.78	24.46	67.9300	0.0083	3.3178	30.00	
12:10:03	3.3231	1761.89	121	1557	436	24.63	5.79	5.79	68.08	68.1300	0.0053	3.3231	31.69	
12:10:33	3.3314	1762.03	117	1552	426	23.98	6.32	5.74	26.28	68.3700	0.0083	3.3314	32.82	
12:11:03	3.3397	1762.18	117	1729	427	24.26	6.05	5.89	19.36	68.5300	0.0083	3.3397	27.74	
12:11:33	3.3481	1762.27	121	1604	438	27.45	3.00	5.37	10.46	68.6200	0.0083	3.3481	23.76	34.69
12:12:03	3.3564	1762.48	119	1421	433	26.32	4.08	5.05	26.04	68.8300	0.0083	3.3564	20.49	
12:12:33	3.3647	1762.69	121	1529	441	25.61	4.57	4.80	24.46	69.0400	0.0083	3.3647	20.15	
12:12:59	3.3719	1762.94	118	1482	431	26.48	3.94	4.33	34.53	69.2900	0.0072	3.3719	23.89	
12:13:29	3.3803	1763.05	120	1521	435	23.83	5.72	4.26	13.34	69.3900	0.0083	3.3803	24.21	
12:13:44	3.3844	1763.30	118	1573	430	23.41	6.08	5.04	59.11	69.5500	0.0042	3.3844	29.23	28.31
12:14:13	3.3925	1763.56	116	1515	422	24.44	5.89	5.40	32.09	69.9100	0.0081	3.3925	31.32	
12:14:40	3.4006	1763.81	116	1539	422	24.75	5.69	5.80	33.59	70.1600	0.0075	3.4006	31.01	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

Well No. 6	Date: 12/16/98													
Starting Depth =	1683.85			Bit Type =	Walker McDonald MF58H						Average ROP Excluding Stops			
Ending Depth =	1761.24			Bit Size =	4.75									
Total Depth Drilled	87.52			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.52		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.79					Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
12:15:06	3.4972	1764.07	119	1545	431	24.56	5.77	5.97	35.5	70.4200	0.0072	3.4972	37.86	
12:15:36	3.4156	1764.11	126	1973	436	27.62	2.84	5.39	5.54	70.4600	0.0083	3.4156	26.04	
12:16:06	3.4239	1764.29	119	1440	434	26.38	3.66	4.83	21.49	70.6400	0.0083	3.4239	23.26	35.10
12:16:36	3.4319	1764.55	120	1456	434	26.2	4.21	4.49	32.23	70.9000	0.0081	3.4319	23.17	
12:17:03	3.4397	1764.80	118	1554	432	25.56	4.83	4.34	31.31	71.1500	0.0078	3.4397	22.48	
12:17:33	3.4481	1764.97	122	1496	443	25.35	4.44	4.07	20.3	71.3200	0.0083	3.4481	26.45	
12:18:00	3.4556	1765.22	115	1508	423	24.41	5.22	4.59	33.42	71.5700	0.0075	3.4556	29.97	28.37
12:18:30	3.4639	1765.36	121	1659	430	26.42	4.39	4.68	18.62	71.7100	0.0083	3.4639	25.36	
12:19:00	3.4722	1765.39	118	1305	427	27.42	3.03	4.44	3.39	71.7400	0.0083	3.4722	18.15	
12:19:30	3.4806	1765.54	120	1356	437	25.58	4.80	4.44	18.34	71.8900	0.0083	3.4806	17.53	
12:20:00	3.4889	1765.78	120	1606	437	23.2	7.08	4.97	28.51	72.1100	0.0083	3.4889	18.29	
12:20:32	3.4950	1766.02	119	1676	431	24.56	5.77	4.84	82.8	72.3700	0.0061	3.4950	21.21	
12:20:52	3.5033	1766.15	120	1572	437	24.6	5.55	5.25	16	72.5000	0.0083	3.5033	24.43	19.47
12:21:14	3.5094	1766.40	119	1495	434	23.61	4.76	5.59	41.09	72.7500	0.0061	3.5094	29.77	
12:21:44	3.5178	1766.51	118	1538	429	24.36	5.97	5.83	13.64	72.8600	0.0083	3.5178	28.96	
12:21:56	3.5217	1766.76	119	1496	434	24.43	5.89	5.59	66.05	73.1100	0.0039	3.5217	27.75	
12:22:26	3.5300	1766.88	119	1571	431	24.33	6.00	5.83	15.06	73.2300	0.0083	3.5300	27.36	
12:22:49	3.5358	1767.14	119	1535	431	24.63	5.71	5.67	43.22	73.4900	0.0058	3.5358	26.84	30.86
12:23:19	3.5442	1767.36	122	1565	442	24.99	5.35	5.78	26.36	73.7100	0.0083	3.5442	32.21	
12:23:43	3.5508	1767.61	122	1594	443	25.37	4.99	5.59	36.87	73.9600	0.0067	3.5508	29.14	
12:24:13	3.5592	1767.86	119	1533	431	25.57	4.52	5.31	30.94	74.2100	0.0083	3.5592	30.60	
12:24:43	3.5675	1767.97	115	1654	417	26.32	4.09	4.93	13.01	74.3200	0.0083	3.5675	26.21	
12:25:13	3.5758	1768.16	120	1350	435	27.39	3.08	4.80	23.44	74.5100	0.0083	3.5758	25.26	25.59
12:25:41	3.5836	1768.41	118	1515	429	26.23	4.16	4.17	31.41	74.7600	0.0078	3.5836	24.41	
12:26:11	3.5919	1768.59	119	1610	431	26.49	3.92	3.96	21.2	74.9400	0.0083	3.5919	22.27	
12:26:41	3.6003	1768.80	121	1371	440	29.46	1.08	3.27	6.59	74.9500	0.0083	3.6003	18.22	
12:27:09	3.6081	1768.85	119	1383	434	27.88	2.76	3.01	32.72	75.2000	0.0078	3.6081	21.43	
12:27:39	3.6164	1769.00	120	1625	436	27.22	3.22	3.04	18.78	75.3500	0.0083	3.6164	18.00	
12:28:09	3.6247	1769.09	121	1326	438	28.08	2.40	2.68	10.78	75.4400	0.0083	3.6247	15.25	19.62
12:28:39	3.6331	1769.23	120	1362	436	27.1	3.34	2.56	16.89	75.5805	0.0083	3.6331	18.33	
12:29:07	3.6408	1769.48	115	1352	419	26.49	3.82	3.13	32.5	75.8300	0.0078	3.6408	19.22	

DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

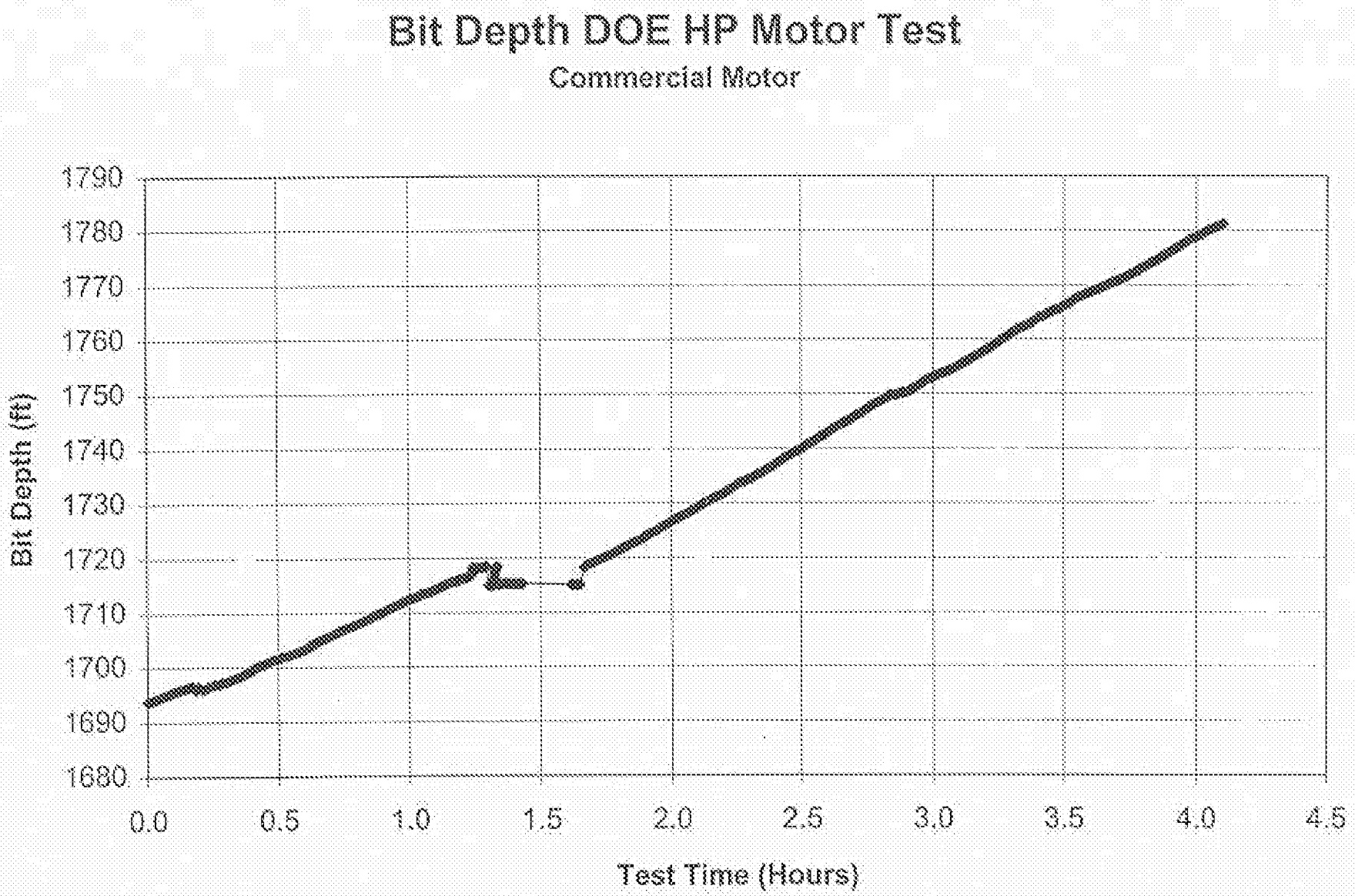
Well No. 6	Date: 12/16/98													
Starting Depth =	1693.65			Bit Type =	Walker McDonnald MF68H						Average ROP Excluding Stops			
Ending Depth =	1781.24			Bit Size =	4.75									
Total Depth Drilled	87.59			Bit Nozzles =		9, 9, 12, 12					Depth Drilled	87.59		
Hours On Bit =	4.10			Mud Type =		Water Based					Hours On Bit	3.82		
Average ROP =	21.36			Mud Weight (lbs/gal) =		8.70					Average ROP	22.92		
Drillstring (ft) =	1718.05			Pipe (ft) =	977.74		Collar (ft)	740.31						

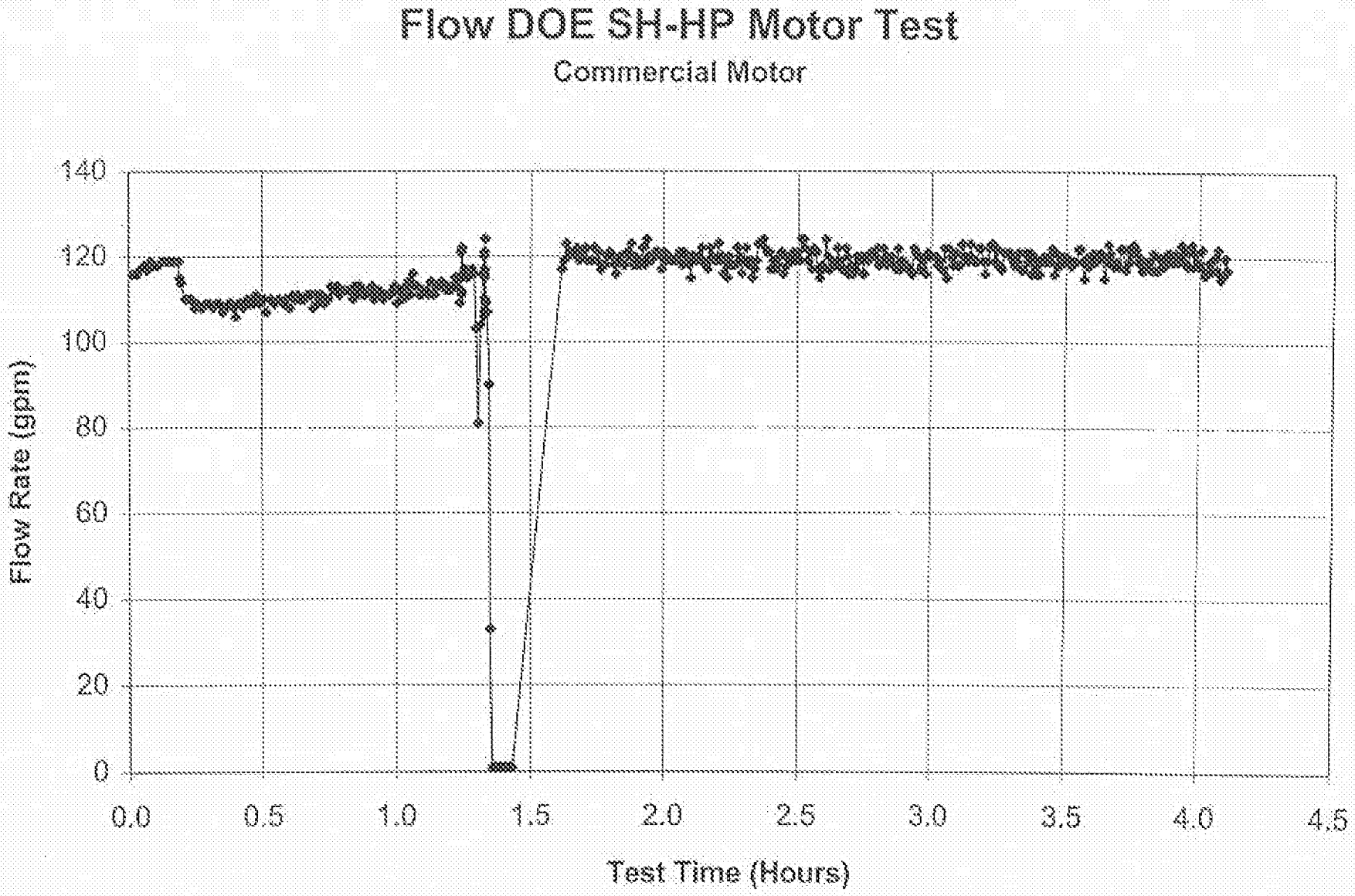
Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
12:29:37	3.6493	1766.53	119	1447	431	28.31	4.10	3.40	5.87	75.8800	0.0083	3.6482	16.17	
12:29:57	3.6547	1769.79	123	1472	445	25.65	4.83	3.72	45.19	76.1400	0.0056	3.6547	23.33	
12:30:27	3.6631	1769.86	121	1421	439	25.98	4.79	4.38	8.33	76.2100	0.0083	3.6631	21.00	
12:30:47	3.6686	1770.11	119	1442	434	24.7	5.64	4.88	45.32	76.4600	0.0056	3.6686	22.68	23.24
12:31:07	3.6789	1770.28	116	1487	427	24.77	5.57	5.09	18.31	76.5100	0.0083	3.6769	20.28	
12:31:47	3.6853	1770.48	119	1459	434	24.44	5.69	5.34	25.33	76.6300	0.0083	3.6853	23.56	
12:32:17	3.6936	1770.68	116	1508	428	25.57	4.82	5.34	24.14	77.0300	0.0083	3.6936	26.84	
12:32:47	3.7019	1770.72	122	1476	442	26.74	1.77	4.74	4.86	77.0700	0.0083	3.7019	15.39	
12:33:17	3.7103	1770.87	122	1375	441	26.63	3.79	4.37	18.06	77.2200	0.0083	3.7103	15.39	
12:33:47	3.7186	1771.10	117	1482	436	26.81	4.56	4.17	27.86	77.4500	0.0083	3.7186	16.69	19.80
12:34:17	3.7269	1771.32	122	1454	444	26.11	4.26	3.85	26.77	77.6700	0.0083	3.7269	19.20	
12:34:47	3.7353	1771.55	119	1456	432	26.49	3.93	3.67	27.89	77.9000	0.0083	3.7353	24.96	
12:35:17	3.7436	1771.67	121	1443	440	26.36	4.05	4.13	14.43	78.0200	0.0083	3.7436	24.00	
12:35:39	3.7497	1771.92	123	1479	447	25.93	4.47	4.29	40.95	78.2700	0.0061	3.7497	26.36	
12:36:09	3.7581	1772.09	122	1423	444	26.5	3.92	4.13	19.53	78.4400	0.0083	3.7581	24.75	25.10
12:36:39	3.7664	1772.31	118	1435	434	25.17	4.23	4.12	26.46	78.6600	0.0083	3.7664	24.43	
12:37:00	3.7739	1772.56	120	1476	437	25.54	4.84	4.30	34.81	78.9100	0.0075	3.7739	28.39	
12:37:36	3.7822	1772.64	117	1491	436	25.38	4.43	4.38	9.96	78.9900	0.0083	3.7822	22.15	
12:37:52	3.7867	1772.93	117	1546	427	25.42	4.96	4.48	55.1	79.2500	0.0044	3.7867	28.31	
12:38:22	3.7950	1773.12	119	1483	432	25.61	4.39	4.61	27.2	79.4700	0.0083	3.7950	28.31	27.88
12:38:52	3.8033	1773.28	119	1477	432	25.37	4.99	4.76	16.05	79.6100	0.0083	3.8033	23.77	
12:39:36	3.8072	1773.51	119	1504	431	25.53	4.65	4.76	67.95	79.8400	0.0039	3.8072	34.80	
12:39:36	3.8156	1773.64	117	1477	427	25.58	4.80	4.84	15.41	79.9600	0.0083	3.8156	25.62	
12:40:03	3.8231	1773.89	121	1497	438	26.1	5.26	4.80	33.44	80.2400	0.0075	3.8231	27.48	
12:40:33	3.8314	1774.07	117	1486	427	24.81	5.82	5.14	22.08	80.4200	0.0083	3.8314	38.87	26.11
12:41:03	3.8397	1774.25	117	1469	426	24.77	5.57	5.26	22.97	80.6100	0.0083	3.8397	25.08	
12:41:33	3.8481	1774.47	120	1481	437	23.78	6.58	5.60	24.35	80.8200	0.0083	3.8481	25.54	
12:41:58	3.8550	1774.72	118	1516	429	23.52	6.77	5.99	36.03	81.0700	0.0069	3.8550	25.38	
12:42:26	3.8633	1774.91	118	1471	428	23.79	6.51	6.24	22.24	81.2600	0.0083	3.8633	26.35	
12:42:49	3.8692	1775.16	120	1514	436	23.57	6.71	6.42	44.06	81.5100	0.0058	3.8692	30.67	28.85
12:43:19	3.8775	1775.33	121	1504	438	23.27	7.02	6.71	20.48	81.6800	0.0083	3.8775	29.21	

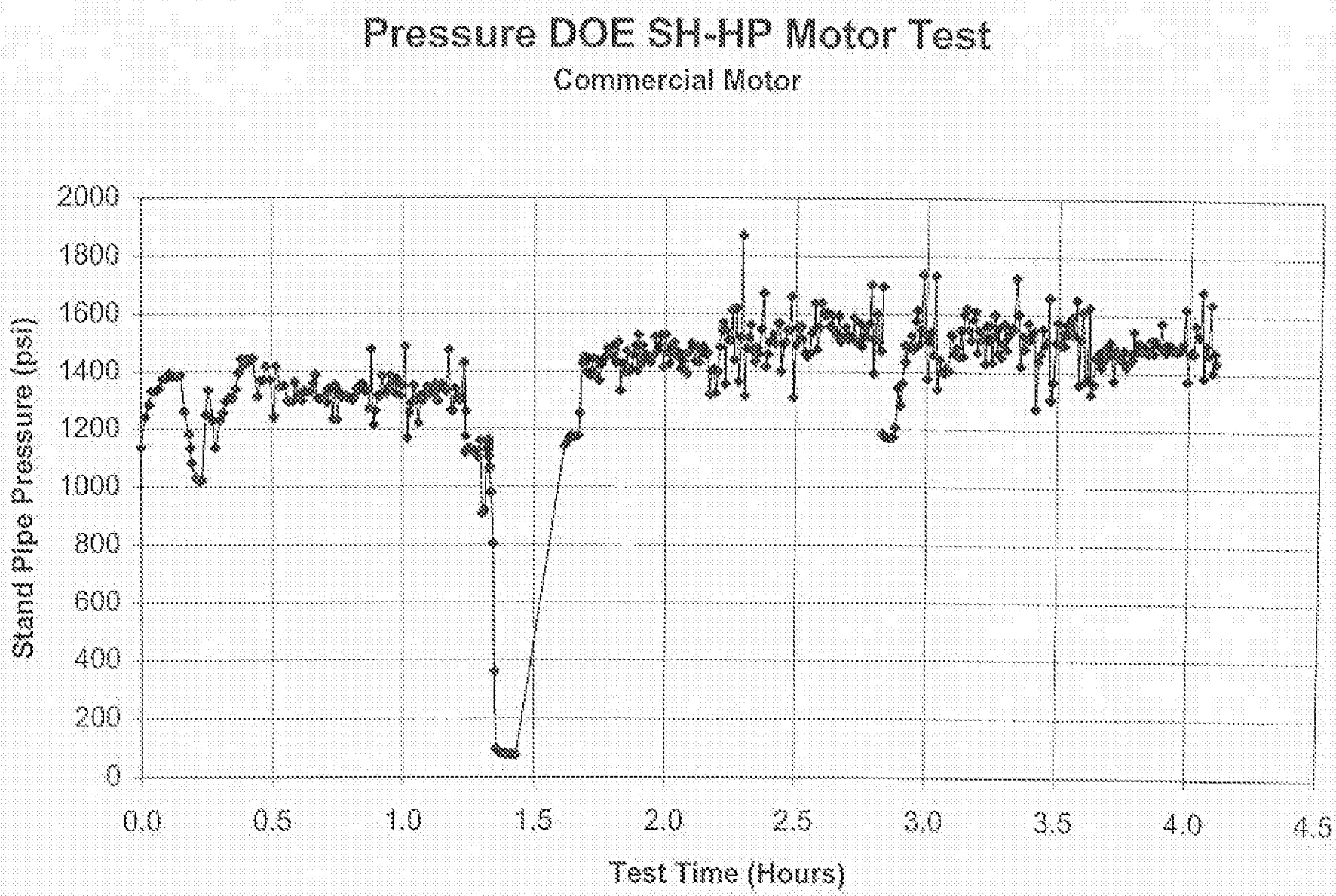
DOE high power mortor test Amaco Catoosa Test Site — Commercial Motor

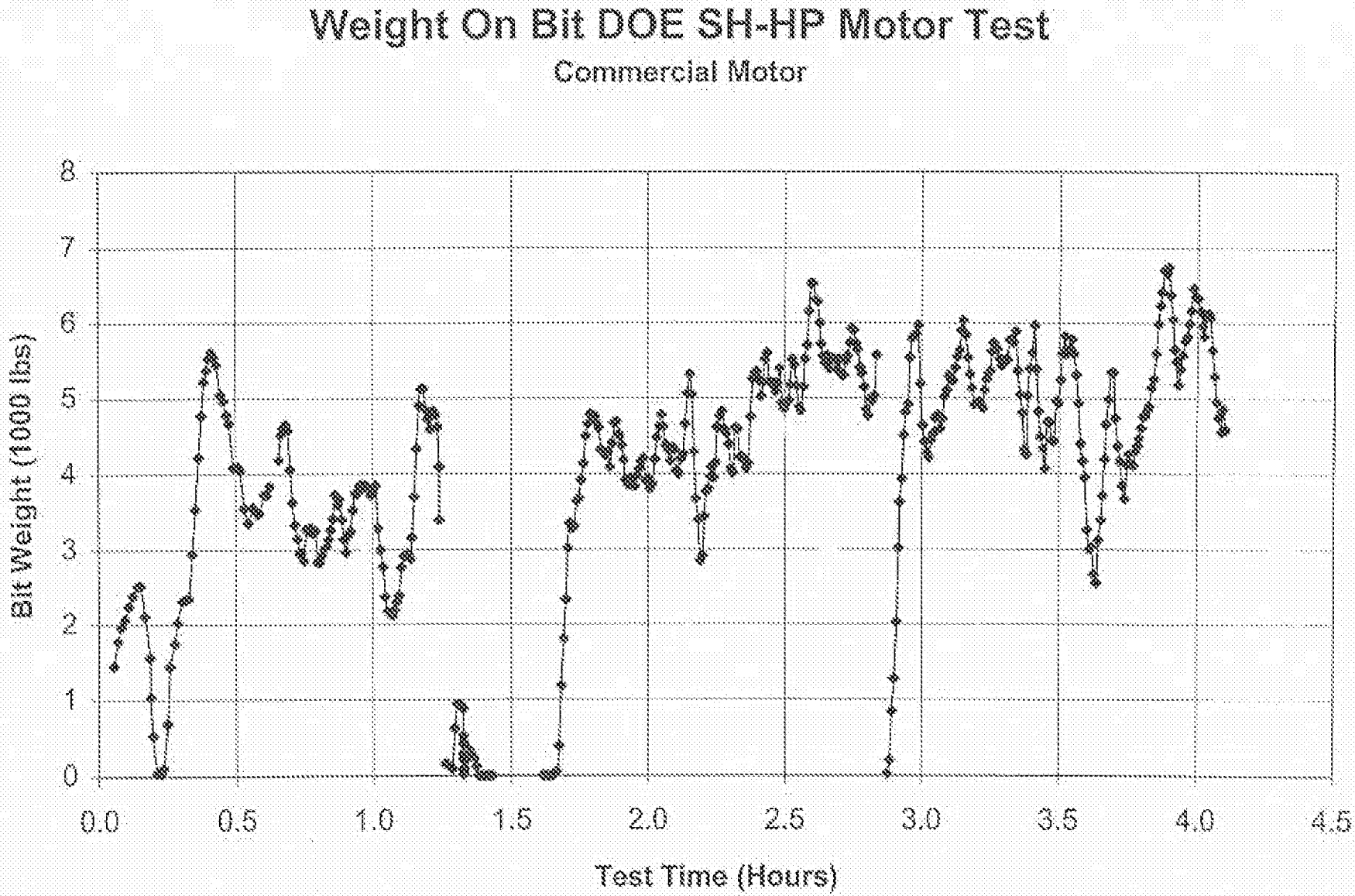
Well No: 6	Date: 12/16/98														
Starting Depth =	1693.55			Bit Type =	Walker McDonald MP66H							Average ROP Excluding Stops			
Ending Depth =	1761.24			Bit Size =	4.75										
Total Depth Drilled	67.69			Bit Nozzles =		9, 9, 12, 12						Depth Drilled	67.69		
Hours On Bit =	3.10			Mud Type =		Water Based						Hours On Bit	3.62		
Average ROP =	21.35			Mud Weight (lbs/gal) =		8.70						Average ROP	22.02		
Drillstring (ft) =	1710.95			Pipe (ft) =	977.74		Collar (ft)	740.31							

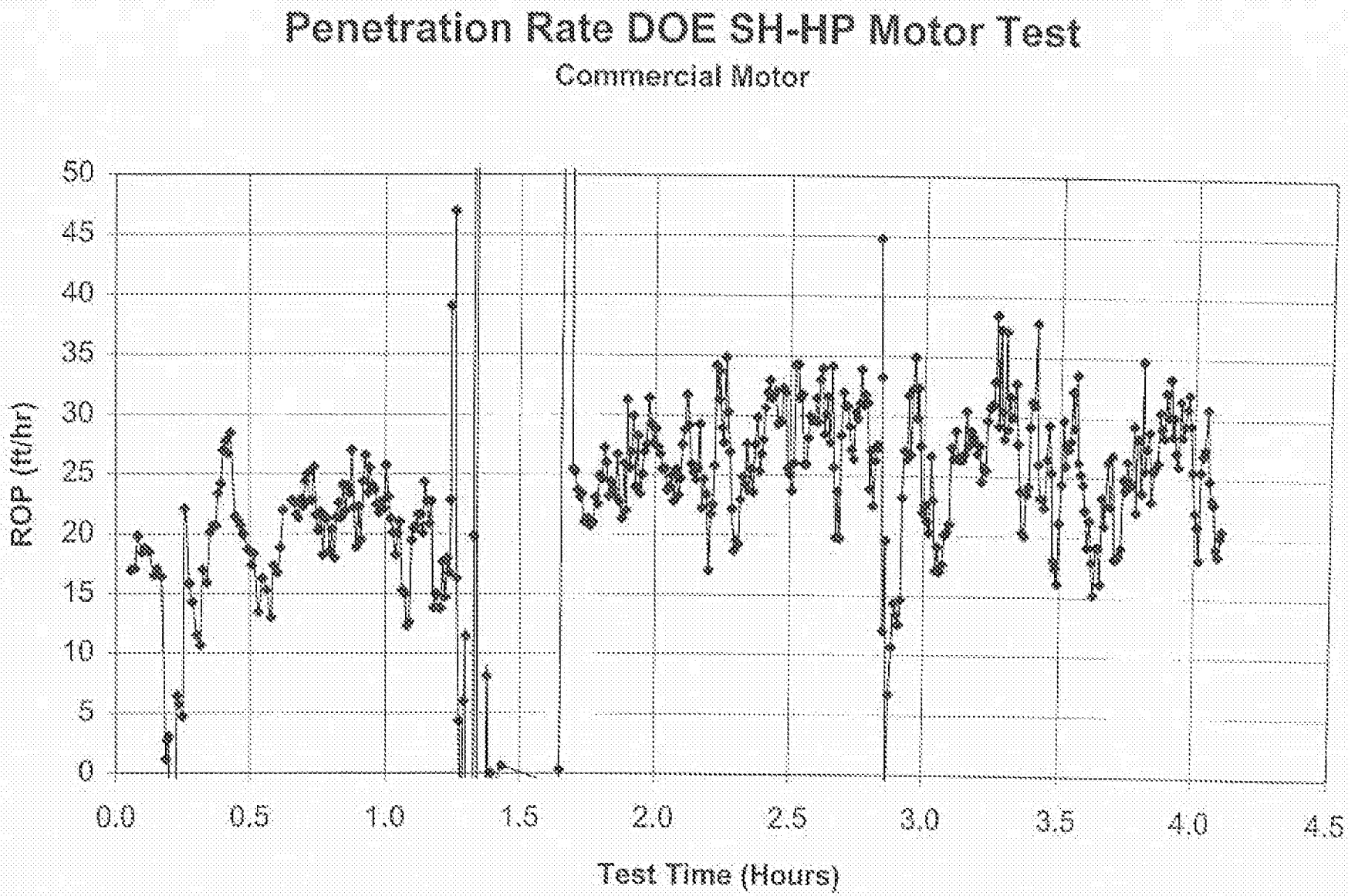
Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
12:43:47	3.8853	1775.58	121	1498	439	23.97	6.34	6.67	31.44	81.9300	0.0078	3.8853	26.46	
12:44:12	3.8922	1775.84	119	1576	431	25.12	7.16	6.75	37.32	82.1900	0.0069	3.8922	32.19	
12:44:30	3.9000	1776.09	119	1487	433	25.73	4.65	6.36	32.13	82.4493	0.0078	3.9000	30.16	30.16
12:45:08	3.9078	1776.34	121	1475	441	25.27	5.10	6.06	32.13	82.6900	0.0078	3.9078	30.30	
12:45:38	3.9161	1776.46	119	1501	433	25.37	5.01	5.68	14.11	82.8100	0.0083	3.9161	28.54	
12:45:59	3.9211	1776.71	120	1497	436	24.77	5.57	5.50	61.12	83.0600	0.0050	3.9211	30.12	
12:46:23	3.9294	1776.83	123	1497	446	24.74	5.69	5.18	21.78	83.2400	0.0083	3.9294	27.17	
12:46:55	3.9378	1777.12	121	1478	438	24.66	5.67	5.39	26.63	83.4700	0.0083	3.9378	28.08	27.26
12:47:32	3.9459	1777.37	119	1486	431	24.27	6.06	5.89	24.87	83.7200	0.0072	3.9459	31.50	
12:47:51	3.9531	1777.62	118	1478	430	24.41	5.92	5.76	38.76	83.9738	0.0081	3.9531	28.49	
12:48:21	3.9614	1777.83	122	1483	444	24.47	5.86	5.82	25.96	84.1900	0.0083	3.9614	29.43	
12:48:49	3.9692	1778.09	123	1487	445	23.83	6.17	6.09	32.65	84.4400	0.0078	3.9692	30.90	30.90
12:49:11	3.9753	1778.34	118	1508	430	23.75	6.58	6.17	41.86	84.6300	0.0061	3.9753	32.04	
12:49:41	3.9836	1778.52	121	1503	440	23.71	7.55	6.47	21.18	84.8700	0.0083	3.9836	29.45	
12:50:11	3.9918	1778.61	119	1375	434	25.64	5.32	6.35	11.84	84.9600	0.0083	3.9918	28.53	
12:50:41	4.0003	1778.78	118	1472	427	24.67	5.75	6.33	19.84	85.1300	0.0085	4.0003	23.18	
12:51:09	4.0081	1779.03	122	1477	442	24.67	5.67	6.17	32.62	85.3800	0.0078	4.0081	21.06	24.17
12:51:39	4.0164	1779.12	116	1469	421	24.61	5.51	5.97	11.18	85.4700	0.0083	4.0164	18.31	
12:51:58	4.0217	1779.37	116	1509	423	23.47	5.83	5.82	47.4	85.7200	0.0053	4.0217	25.57	
12:52:28	4.0300	1779.58	117	1524	427	23.08	5.81	6.08	25.06	85.9300	0.0083	4.0300	26.62	
12:52:54	4.0372	1779.83	119	1527	431	24.29	6.03	6.14	34.16	86.1800	0.0072	4.0372	27.43	
12:53:24	4.0456	1780.02	117	1484	425	24.98	5.37	6.08	23.2	86.3700	0.0083	4.0456	30.85	26.40
12:53:54	4.0539	1780.17	120	1386	437	27.86	3.39	5.65	17.2	86.5200	0.0083	4.0539	24.63	
12:54:24	4.0622	1780.33	117	1500	425	25.28	5.08	5.30	19.87	86.6800	0.0083	4.0622	23.38	
12:54:52	4.0700	1780.58	122	1484	443	25.5	4.65	4.95	32.63	86.9300	0.0078	4.0700	22.88	
12:55:22	4.0783	1780.68	119	1639	418	25.36	5.02	4.75	8.69	87.0330	0.0083	4.0783	19.32	
12:55:52	4.0867	1780.78	116	1406	421	26.01	4.93	4.56	15.68	87.1300	0.0083	4.0867	19.61	
12:56:22	4.0950	1780.99	120	1474	436	25.45	4.93	4.86	25.31	87.3400	0.0083	4.0950	30.14	
12:56:47	4.1019	1781.24	117	1458	426	26.74	3.68	4.58	36.71	87.5880	0.0069	4.1019	29.65	21.64


Bit Depth DOE HP Motor Test
Commercial Motor
Bit Depth (ft)
1790
1780
1770
1760
1750
1740
1730
1720
1710
1700
1690
1680
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Test Time (Hours)


Flow DOE SH-HP Motor Test
Commercial Motor
Flow Rate (gpm)
140
120
100
80
60
40
20
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Test Time (Hours)

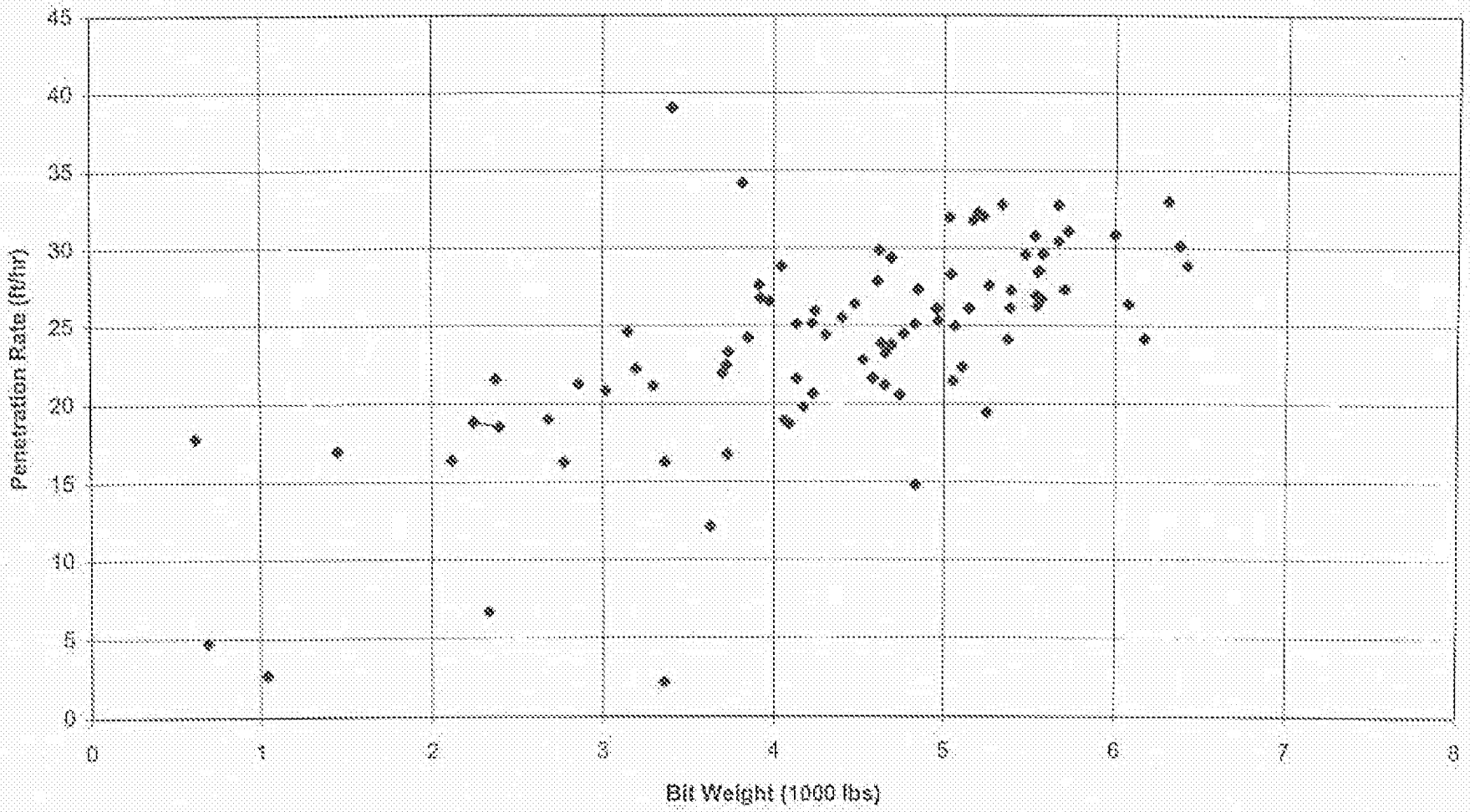

Pressure DOE SH-HP Motor Test
Commercial Motor
Stand Pipe Pressure (psi)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Test Time (Hours)


Weight On Bit DOE SH-HP Motor Test
Commercial Motor
Bit Weight (1000 lbs)
0
1
2
3
4
5
6
7
8
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Test Time (Hours)


Penetration Rate DOE SH-HP Motor Test
Commercial Motor
ROP (ft/hr)
50
45
40
35
30
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Test Time (Hours)

ROP As Function Of Bit Weight DOE HP Motor Test

Commercial Motor



DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 8	Date: 12/17/99														
Starting Depth =	1781			Bit Type =	Walker McDearmid MP68H							Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75										
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based						Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70						Average ROP	48.34		
Drillstring (ft) =	1789.68			Pipe (ft) =	1041.05		Collar (ft)	748.63							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
8:06:26	0.0000	1780.54	116	1362	418	29.63	0.78		8.16	88.85	0.0000	0.0000		
8:06:56	0.0083	1780.65	116	1526	421	27.40	3.09		13.33	88.85	0.0083	0.0083	0.00	
8:07:26	0.0167	1780.84	117	1536	424	26.15	4.30		22.41	88.65	0.0053	0.0167	0.00	
8:07:55	0.0253	1780.99	118	1560	423	26.44	4.91		17.84	88.65	0.0083	0.0250	0.00	
8:08:25	0.0333	1781.13	117	1532	425	28.76	3.72	3.18	17.01	88.65	0.0083	0.0333	0.00	
8:08:55	0.0417	1781.30	117	1585	424	28.75	3.72	3.77	20.35	88.65	0.0083	0.0417	0.00	
8:09:25	0.0500	1781.40	117	1573	425	26.61	3.86	3.92	12.95	88.7	0.0083	0.0500	0.00	
8:09:55	0.0583	1781.52	118	1587	426	26.96	3.50	3.76	14.05	88.87	0.0083	0.0583	20.40	
8:10:25	0.0667	1781.75	118	1635	429	26.17	4.26	3.82	27.47	97.04	0.0083	0.0667	20.40	
8:10:51	0.0739	1782.00	116	1559	428	25.95	4.87	4.05	35.55	87.27	0.0072	0.0739	31.85	19.76
8:11:21	0.0822	1782.21	118	1587	426	25.38	5.04	4.31	24.93	87.62	0.0083	0.0822	30.60	21.11
8:11:38	0.0869	1782.46	117	1626	427	22.43	7.66	5.11	50.77	87.72	0.0047	0.0869	42.35	23.05
8:11:50	0.0903	1782.71	117	2089	424	21.75	8.49	6.11	77.33	87.87	0.0033	0.0903	75.00	26.35
8:12:04	0.0942	1782.98	118	2501	420	21.38	8.69	7.03	66.14	88.34	0.0039	0.0942	65.14	30.08
8:12:34	0.1025	1783.02	118	1642	428	27.42	3.08	6.68	6.53	88.34	0.0083	0.1025	0.00	28.27
8:12:59	0.1094	1783.27	118	1791	431	22.86	7.44	7.16	35.29	88.6	0.0069	0.1094	37.44	31.85
8:13:14	0.1136	1783.52	120	1826	428	21.51	8.78	7.33	61.34	88.85	0.0042	0.1136	62.69	36.19
8:13:44	0.1219	1783.71	118	1820	427	27.51	2.91	6.22	22.69	89.01	0.0083	0.1219	22.83	35.46
8:14:14	0.1303	1783.91	118	1645	431	23.97	6.39	5.72	24.66	89.15	0.0083	0.1303	28.40	33.87
8:14:34	0.1358	1784.17	118	1825	430	22.50	7.80	6.66	44.75	89.45	0.0056	0.1358	55.40	36.56
8:14:47	0.1394	1784.42	118	2067	428	20.49	9.73	7.12	69.94	89.72	0.0036	0.1394	72.00	37.33
8:15:02	0.1436	1784.67	118	1924	430	21.76	8.51	7.07	61.51	89.94	0.0042	0.1435	52.50	38.76
8:15:17	0.1464	1784.93	117	2089	428	22.23	8.06	8.10	95.30	90.2	0.0028	0.1464	93.60	37.63
8:15:22	0.1492	1785.17	118	2052	430	22.37	7.93	8.61	84.87	90.52	0.0028	0.1492	116.20	36.87
8:15:33	0.1522	1785.43	117	2047	425	21.69	8.57	8.58	82.50	90.7	0.0031	0.1522	58.91	36.49
8:15:46	0.1558	1785.68	118	1883	429	23.15	7.18	8.05	73.88	90.84	0.0036	0.1558	86.46	51.16
8:15:58	0.1586	1785.94	118	2126	428	21.58	8.71	8.09	85.77	91.18	0.0028	0.1586	90.00	60.82
8:16:05	0.1611	1786.19	118	2109	428	22.47	7.83	8.04	110.47	91.48	0.0025	0.1611	120.00	73.95
8:16:22	0.1658	1786.44	118	1935	431	20.30	9.92	8.44	53.00	91.78	0.0047	0.1658	61.41	76.87
8:16:32	0.1686	1786.69	117	2558	425	17.79	12.32	9.19	84.63	91.95	0.0028	0.1686	91.20	77.83

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Slips			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.75					Average ROP	48.34		
Drillstring (ft) =	1788.66			Pipe (ft) =	1041.85		Collar (ft)	746.81						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Klps)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
8:17:02	0.1769	1786.70	120	1627	437	28.74	1.78	8.11	1.36	92.62	0.0083	0.1769	8.40	60.90
8:17:28	0.1836	1786.95	118	1698	433	24.75	5.61	7.49	37.98	92.21	0.0067	0.1836	28.50	54.64
8:17:42	0.1881	1787.20	119	1872	434	24.19	6.14	7.15	58.12	92.5	0.0044	0.1881	66.25	52.20
8:17:54	0.1914	1787.45	119	1953	433	22.31	7.97	6.78	73.36	92.72	0.0033	0.1914	88.65	51.57
8:18:09	0.1958	1787.70	118	1923	430	23.81	6.82	6.80	66.97	93.02	0.0042	0.1956	72.00	50.85
8:18:29	0.2011	1787.85	117	1842	427	22.87	7.42	6.73	43.88	93.23	0.0056	0.2011	37.80	47.53
8:18:48	0.2058	1788.21	120	1903	435	21.53	8.71	7.35	53.20	93.53	0.0047	0.2058	63.53	46.17
8:19:05	0.2111	1788.46	118	1869	427	21.61	8.63	7.85	49.29	93.73	0.0053	0.2111	37.80	44.81
8:39:22	0.2111	1788.83	116	1355	423	30.78	0.47		147.34	93.97	0.0003	0.2111	0.00	
8:39:29	0.2131	1788.78	118	1364	422	30.81	0.36		131.73	94.14	0.0019	0.2131	57.43	
8:39:57	0.2206	1789.04	117	1507	426	27.82	4.00		33.00	94.3	0.0078	0.2209	28.57	
8:40:23	0.2281	1789.29	116	1566	421	23.82	7.06		34.75	94.6	0.0072	0.2281	41.54	
8:40:53	0.2364	1789.45	117	1557	426	26.86	1.27	2.64	16.17	94.76	0.0083	0.2364	19.20	
8:41:22	0.2444	1789.70	116	1591	420	27.86	3.17	3.16	31.33	94.97	0.0081	0.2444	26.07	
8:41:43	0.2503	1789.95	115	1718	418	25.05	5.90	4.28	41.42	95.26	0.0058	0.2503	49.71	
8:41:53	0.2539	1790.20	119	1978	431	22.64	8.22	5.13	76.68	95.48	0.0036	0.2539	55.38	
8:42:10	0.2578	1790.45	118	1894	428	24.66	6.27	4.37	65.67	95.75	0.0039	0.2578	74.57	
8:42:24	0.2617	1790.71	117	1912	426	23.41	7.47	6.21	62.76	95	0.0039	0.2617	64.28	43.13
8:42:35	0.2650	1790.96	118	2011	428	22.90	7.98	7.17	77.68	96.24	0.0033	0.2650	72.00	41.79
8:42:50	0.2689	1791.21	119	1921	433	24.01	6.80	7.37	66.83	96.48	0.0039	0.2689	61.71	46.36
8:43:09	0.2717	1791.46	118	2131	430	22.60	8.25	7.37	87.86	96.77	0.0028	0.2717	104.40	49.76
8:43:13	0.2753	1791.71	117	1898	424	25.04	5.92	7.30	76.63	96.97	0.0036	0.2753	65.38	58.11
8:43:27	0.2792	1791.96	118	1929	428	23.86	7.06	7.22	81.13	97.38	0.0039	0.2792	79.71	65.09
8:43:45	0.2828	1792.21	119	1991	432	23.58	7.31	7.69	72.67	97.51	0.0036	0.2828	68.89	68.54
8:43:61	0.2858	1792.46	118	2016	429	23.58	7.31	7.17	80.38	97.73	0.0031	0.2858	72.00	70.75
8:44:05	0.2897	1792.72	117	1962	424	24.43	6.51	6.82	63.00	98.04	0.0039	0.2897	79.71	70.75
8:44:23	0.2947	1792.97	118	1943	430	21.96	8.86	7.41	93.26	98.33	0.0050	0.2947	36.00	68.57
8:44:32	0.2972	1793.22	116	2156	418	21.02	9.75	7.95	94.03	98.58	0.0026	0.2972	140.00	70.14
8:44:50	0.3022	1793.47	118	1963	428	23.54	8.31	8.15	51.00	98.74	0.0050	0.3022	32.00	67.62

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/66													
Starting Depth =	1781			Bit Type =	Walker McDonanald MP68H						Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1788.66			Pipe (ft) =	1043.05		Collar (ft)	740.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
8:45:02	0.3056	1793.72	116	2052	423	22.26	8.58	8.41	77.63	85.02	0.0033	0.3056	84.00	66.69
8:45:14	0.3089	1793.98	118	2023	430	22.77	8.03	8.73	79.87	85.28	0.0033	0.3089	78.90	67.54
8:45:26	0.3123	1794.23	117	1969	427	23.11	7.77	8.51	84.77	85.54	0.0033	0.3123	88.85	67.54
8:45:40	0.3161	1794.48	117	2064	426	23.02	7.86	8.12	76.93	85.78	0.0033	0.3161	72.53	66.10
8:45:54	0.3200	1794.73	119	2083	431	22.42	8.02	8.22	66.85	100.01	0.0039	0.3200	58.14	66.44
8:46:05	0.3233	1794.98	118	2015	426	22.80	8.86	8.28	73.31	100.28	0.0033	0.3233	81.03	67.24
8:46:16	0.3267	1795.23	118	2164	429	22.81	8.84	8.43	76.97	100.51	0.0033	0.3267	69.00	79.75
8:46:30	0.3300	1795.49	119	1962	434	23.91	7.52	8.38	74.77	100.76	0.0033	0.3300	75.00	69.25
8:46:43	0.3336	1795.74	119	1981	433	24.07	7.39	8.29	69.60	101.05	0.0036	0.3336	80.31	72.32
8:46:52	0.3361	1795.99	119	2082	432	24.75	6.73	7.87	101.04	101.32	0.0025	0.3361	108.00	74.29
8:47:04	0.3394	1796.24	117	2063	425	25.06	6.45	7.38	74.07	101.61	0.0033	0.3394	67.00	73.56
8:47:34	0.3480	1796.49	118	1793	428	25.68	4.90	6.60	46.34	101.85	0.0086	0.3480	61.26	70.14
8:47:40	0.3494	1796.74	117	1922	424	24.71	5.76	6.48	59.36	102	0.0044	0.3494	31.75	67.80
8:47:53	0.3522	1797.00	117	2152	425	22.40	8.96	8.76	87.64	102.28	0.0028	0.3522	100.80	70.45
8:48:01	0.3553	1797.25	117	2156	424	22.54	8.85	7.19	78.65	102.54	0.0031	0.3553	85.09	71.06
8:48:11	0.3581	1797.50	120	2134	435	23.35	8.11	7.52	96.44	102.8	0.0028	0.3581	93.00	72.32
8:48:22	0.3611	1797.75	118	2126	429	23.24	8.20	8.18	85.04	103.05	0.0031	0.3611	81.82	72.64
8:48:35	0.3650	1798.00	118	2044	430	23.20	8.25	8.47	84.59	103.32	0.0039	0.3650	69.43	72.06
8:49:01	0.3719	1798.26	117	2227	424	22.37	8.98	8.48	36.73	103.63	0.0069	0.3719	30.24	63.35
8:49:13	0.3753	1798.51	119	2027	431	22.19	9.19	8.53	76.85	103.84	0.0033	0.3753	93.00	63.35
8:49:25	0.3786	1798.76	118	2050	430	24.01	7.44	8.41	82.42	104.11	0.0033	0.3786	81.00	67.54
8:49:40	0.3828	1799.01	118	1998	428	24.13	7.31	8.23	59.19	104.29	0.0042	0.3828	43.20	56.10
8:49:52	0.3861	1799.26	121	2058	439	23.03	8.44	8.27	72.02	104.54	0.0033	0.3861	75.00	66.69
8:50:07	0.3903	1799.52	119	1961	433	23.98	7.59	7.89	61.68	104.76	0.0042	0.3903	57.60	64.86
8:50:19	0.3936	1799.77	118	2046	429	23.81	7.99	7.47	77.46	105.05	0.0033	0.3936	81.00	63.54
8:50:29	0.3964	1800.02	120	2081	435	24.68	6.27	7.24	86.36	105.27	0.0028	0.3964	79.20	64.35
8:50:42	0.4000	1800.27	118	2016	430	24.58	6.36	7.05	71.11	105.56	0.0036	0.4000	85.31	64.85
8:50:58	0.4044	1800.52	120	1934	435	24.46	6.47	6.66	95.79	105.8	0.0044	0.4044	54.00	68.54
8:51:14	0.4089	1800.77	121	1998	439	22.62	8.23	6.88	56.15	106.08	0.0044	0.4089	58.50	67.24
8:51:25	0.4114	1801.02	118	2024	431	24.72	6.22	6.71	102.49	106.31	0.0025	0.4114	108.00	68.35

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/28												
Starting Depth =	1781		Bit Type =	Walker McDonald MP68H						Average ROP Excluding Steps			
Ending Depth =	1916		Bit Size =	4.75									
Total Depth Drilled	135		Bit Nozzles =	9, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80		Mud Type =	Water Based						Hours On Bit =	2.80		
Average ROP =	48.34		Mud Weight (lbs/gal) =	8.70						Average ROP	48.33		
Drillstring (ft) =	1769.66		Pipe (ft) =	1041.05		Collar (ft)	740.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
8:50:41	0.4164	1801.26	116	1902	423	23.56	8.29	7.11	48.37	106.53	0.0050	0.4164	43.00	67.84
8:51:51	0.4192	1801.53	117	2174	426	20.82	9.96	7.83	92.56	106.81	0.0028	0.4192	100.80	68.57
8:52:06	0.4233	1801.78	119	2038	432	21.68	9.13	8.37	61.37	107.07	0.0042	0.4233	62.40	68.37
8:52:14	0.4256	1802.03	118	2158	428	19.10	11.01	9.84	104.17	107.33	0.0022	0.4256	117.00	70.75
8:52:28	0.4289	1802.28	119	2065	432	20.00	10.74	9.95	75.58	107.62	0.0033	0.4289	87.00	69.64
8:52:37	0.4319	1802.53	118	2024	429	23.64	7.25	9.74	84.09	107.81	0.0031	0.4319	82.18	70.75
8:52:50	0.4356	1802.78	119	2040	433	23.63	7.27	9.20	72.83	108.06	0.0036	0.4356	88.23	72.64
8:53:04	0.4394	1803.03	120	1976	436	22.58	8.28	9.03	64.45	108.32	0.0039	0.4394	66.85	72.96
8:53:14	0.4422	1803.28	117	2221	426	20.70	10.06	8.72	89.44	108.55	0.0028	0.4422	82.80	73.52
8:53:25	0.4453	1803.54	118	2151	429	22.70	8.17	8.21	83.72	108.8	0.0031	0.4453	81.62	73.23
8:53:38	0.4491	1803.78	116	2058	428	24.21	6.75	8.10	61.40	108.07	0.0031	0.4453	59.38	72.49
8:53:49	0.4519	1804.04	119	2049	434	22.60	8.36	8.30	72.17	109.32	0.0036	0.4519	69.23	72.96
8:53:58	0.4544	1804.29	117	2178	426	23.77	8.09	8.26	95.24	109.6	0.0025	0.4544	112.00	73.23
8:54:13	0.4586	1804.54	119	2003	434	21.37	9.43	8.13	80.95	109.61	0.0042	0.4586	50.40	76.04
8:54:27	0.4625	1804.79	119	2110	431	18.13	12.54	9.65	64.86	110.06	0.0039	0.4625	84.29	73.96
8:54:42	0.4667	1805.05	118	2112	428	18.83	11.67	10.64	61.89	110.33	0.0042	0.4667	64.80	72.96
8:54:50	0.4689	1805.30	119	2136	434	19.11	11.60	10.71	107.12	110.61	0.0022	0.4689	126.00	77.03
8:55:03	0.4722	1805.55	118	2105	428	22.01	8.83	10.85	77.03	110.88	0.0033	0.4722	90.00	76.33
8:55:15	0.4758	1805.80	118	2045	430	23.01	7.85	10.64	70.68	111.08	0.0036	0.4758	77.54	75.96
8:55:28	0.4794	1806.05	118	2092	428	22.97	7.90	9.81	69.53	111.35	0.0036	0.4794	74.79	75.64
8:55:38	0.4822	1806.30	118	2189	427	21.93	8.93	9.02	89.61	111.59	0.0028	0.4822	82.80	74.84
8:55:50	0.4856	1806.56	118	2052	423	23.61	7.10	8.12	73.35	111.86	0.0033	0.4856	81.00	72.96
8:56:07	0.4903	1806.81	120	1980	435	22.62	8.23	8.00	54.41	112.1	0.0047	0.4903	50.62	71.68
8:56:32	0.4972	1807.06	119	2145	428	23.26	7.62	7.98	35.82	112.33	0.0069	0.4972	33.12	65.36
8:56:46	0.5017	1807.31	121	1920	438	24.02	6.89	7.75	58.62	112.6	0.0044	0.5017	60.75	64.97
8:57:02	0.5056	1807.56	119	2036	432	23.61	8.35	7.64	53.36	112.84	0.0039	0.5056	61.71	61.64
8:57:16	0.5078	1807.81	118	2141	428	20.42	10.35	8.29	109.89	113.09	0.0022	0.5078	112.50	63.56
8:57:23	0.5114	1808.06	119	2144	433	20.73	10.35	8.65	68.34	113.35	0.0036	0.5114	72.00	63.68
8:57:36	0.5150	1808.32	119	2202	433	21.30	9.50	9.03	72.97	113.59	0.0036	0.5150	99.46	63.84
8:57:46	0.5178	1808.57	123	2155	445	21.56	9.28	9.50	85.45	113.87	0.0028	0.5178	120.80	63.64

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98														
Starting Depth =	1781			Bit Type =	Walker McOsonait MP28H							Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75										
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based						Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70						Average ROP	48.34		
Drillstring (ft) =	1789.66			Pipe (ft) =	1041.05		Collar (ft)	748.61							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
8:58:00	0.5217	1808.82	122	2034	442	21.69	9.23	9.67	85.56	114.1	0.0038	0.5217	59.14	82.56
8:58:10	0.5244	1809.07	118	2235	429	20.97	10.40	9.68	94.88	114.35	0.0028	0.5244	99.00	66.16
8:58:21	0.5275	1809.32	118	2098	430	20.84	9.93	9.88	76.69	114.59	0.0031	0.5275	78.55	74.64
8:58:36	0.5317	1809.67	119	2094	431	21.23	9.60	9.68	80.18	114.82	0.0042	0.5317	68.29	75.33
8:58:47	0.5347	1809.83	119	2312	433	20.81	10.16	9.88	88.14	115.08	0.0031	0.5347	85.06	77.49
8:58:57	0.5375	1810.07	119	2144	432	21.07	8.86	9.79	86.92	115.36	0.0028	0.5375	100.80	78.04
8:59:12	0.5417	1810.32	119	2268	431	19.99	10.75	9.86	60.62	115.59	0.0042	0.5417	55.20	74.64
8:59:38	0.5483	1810.57	119	1689	434	22.61	7.96	9.47	38.55	115.85	0.0067	0.5483	38.00	67.50
8:59:48	0.5511	1810.82	120	2074	435	22.43	8.42	9.23	83.50	116.11	0.0028	0.5511	93.60	67.50
8:59:58	0.5544	1811.08	119	2101	431	21.80	9.01	9.00	76.86	116.35	0.0033	0.5544	72.00	68.35
9:00:07	0.5569	1811.33	119	2161	432	22.26	8.88	9.00	151.81	116.63	0.0025	0.5569	113.00	69.54
9:00:21	0.5608	1811.58	118	2036	430	23.04	8.32	8.52	65.98	116.85	0.0039	0.5608	58.57	67.80
9:00:32	0.5639	1811.83	120	2168	436	22.28	8.87	8.70	82.69	117.12	0.0031	0.5639	88.18	70.14
9:00:46	0.5681	1812.08	118	2176	427	22.52	7.96	8.81	134.75	117.35	0.0022	0.5681	102.50	72.60
9:01:00	0.5717	1812.33	118	1914	427	23.54	7.36	8.28	44.04	117.58	0.0036	0.5717	41.40	68.15
9:01:12	0.5750	1812.58	118	2268	430	21.12	9.87	9.44	76.19	117.88	0.0033	0.5750	90.00	67.80
9:01:23	0.5781	1812.93	115	1998	420	23.40	7.35	8.31	81.29	118.17	0.0031	0.5781	84.91	76.04
9:01:40	0.5828	1813.08	120	2056	437	21.80	8.37	8.41	51.69	118.38	0.0047	0.5828	46.24	71.37
9:01:50	0.5856	1813.33	118	2032	430	23.44	7.87	8.39	97.25	118.65	0.0028	0.5856	115.20	72.32
9:02:01	0.5886	1813.59	119	2143	433	23.14	8.18	8.58	78.28	118.9	0.0031	0.5886	73.00	71.37
9:02:14	0.5922	1813.84	120	2032	436	24.66	6.77	7.98	72.94	119.1	0.0036	0.5922	60.38	72.00
9:02:21	0.5942	1814.09	118	2177	428	24.23	7.14	7.87	139.61	119.33	0.0019	0.5942	144.00	74.64
9:02:36	0.5983	1814.34	117	1981	426	22.84	8.40	7.87	62.11	119.6	0.0042	0.5983	52.89	70.14
9:02:43	0.6003	1814.59	117	2385	426	21.41	9.73	8.04	118.11	119.89	0.0019	0.6003	149.14	76.99
9:02:55	0.6036	1814.84	118	2136	434	22.29	8.74	8.16	81.60	120.15	0.0033	0.6036	78.00	78.35
9:03:08	0.6072	1815.09	117	2096	428	23.84	7.25	8.25	55.73	120.37	0.0036	0.6072	60.92	77.49
9:03:16	0.6094	1815.34	118	2143	428	21.17	9.83	8.75	113.86	120.62	0.0022	0.6094	112.50	84.75
9:03:27	0.6125	1815.60	118	2293	429	21.28	9.53	8.98	81.79	120.91	0.0031	0.6125	84.91	84.26
9:03:49	0.6186	1815.85	119	1837	433	24.05	6.85	8.40	41.74	121.13	0.0061	0.6186	35.00	75.03
9:03:59	0.6214	1816.10	117	2353	427	20.17	10.69	8.77	92.31	121.38	0.0028	0.6214	90.00	77.49

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 5	Date: 12/17/86													
Starting Depth =	1781			Bit Type =	Walker McDonald MPSBH						Average ROP Excluding Slips			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1789.68			Pipe (ft) =	1041.85		Collar (ft)	748.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Klps)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
9:04:11	0.6247	1818.38	120	2148	436	21.95	8.69	9.10	73.05	121.83	0.0033	0.6247	75.00	73.96
9:04:23	0.6281	1818.60	121	2187	441	19.91	10.65	9.34	74.23	121.9	0.0033	0.6281	83.00	76.04
9:04:36	0.6314	1818.85	120	2166	437	20.03	9.89	9.42	78.28	122.12	0.0033	0.6314	66.00	72.64
9:04:48	0.6342	1817.10	119	2179	433	23.71	7.26	9.49	80.47	122.37	0.0028	0.6342	90.00	73.96
9:05:01	0.6386	1817.36	118	1977	428	23.11	7.78	8.92	59.38	122.65	0.0044	0.6386	53.00	72.68
9:05:12	0.6417	1817.61	117	2267	427	20.72	10.07	9.19	84.81	122.97	0.0031	0.6417	104.73	70.45
9:05:23	0.6447	1817.86	118	2140	428	22.40	8.45	8.68	78.32	123.13	0.0031	0.6447	49.09	70.14
9:05:36	0.6469	1818.11	113	2770	413	20.37	10.41	8.78	62.63	123.41	0.0042	0.6469	69.60	74.84
9:05:58	0.6572	1818.28	118	1815	430	25.41	4.61	8.26	20.46	123.65	0.0083	0.6572	25.80	60.64
9:06:23	0.6614	1818.53	120	1957	437	22.62	6.24	8.36	60.86	123.85	0.0042	0.6614	48.00	59.45
9:06:35	0.6647	1818.78	118	2130	428	19.34	11.36	8.62	72.57	124.05	0.0033	0.6647	69.00	59.45
9:06:46	0.6678	1819.03	116	2176	424	18.29	11.44	9.22	80.64	124.29	0.0031	0.6678	78.55	58.91
9:07:00	0.6717	1819.28	118	2028	429	21.33	9.48	9.03	65.17	124.56	0.0039	0.6717	66.86	58.13
9:07:13	0.6753	1819.54	120	2082	437	21.88	9.13	9.63	71.36	124.83	0.0036	0.6753	105.23	59.73
9:07:26	0.6786	1819.79	121	1997	433	22.39	8.47	8.88	77.05	125.07	0.0033	0.6786	42.00	59.51
9:07:46	0.6844	1820.04	119	1903	432	22.15	8.76	9.44	42.98	125.31	0.0058	0.6844	41.14	54.89
9:07:55	0.6869	1820.31	116	1813	424	23.14	6.84	8.33	103.19	125.41	0.0025	0.6869	440.00	57.81
9:19:13	0.6869	1820.87	109	1259	396	31.43	0.10		7.83	126.49	0.0000	0.6869	0.00	
9:19:22	0.6894	1821.12	110	1275	399	31.03	0.46		105.68	126.49	0.0025	0.6894	0.00	
9:19:32	0.6922	1821.37	111	1272	403	31.09	0.40		91.85	126.63	0.0028	0.6922	50.40	
9:19:43	0.6953	1821.62	114	1255	413	31.17	0.34		79.39	126.89	0.0031	0.6953	85.09	
9:20:13	0.7036	1821.79	111	1467	405	27.32	4.04	1.57	19.91	127.05	0.0083	0.7036	19.20	
9:20:37	0.7103	1822.04	110	1762	402	22.20	6.96	3.84	37.59	127.37	0.0067	0.7103	48.00	
9:20:53	0.7147	1822.39	109	1826	399	22.03	9.11	4.57	68.68	127.56	0.0044	0.7147	42.75	
9:21:06	0.7181	1822.54	112	1963	419	22.24	8.91	6.27	78.55	127.8	0.0033	0.7181	72.00	
9:21:15	0.7208	1822.78	111	2013	404	21.81	9.32	6.07	86.58	128.13	0.0028	0.7208	116.80	
9:21:29	0.7247	1823.04	111	1837	405	23.62	7.59	6.78	63.81	128.33	0.0039	0.7247	51.43	57.44
9:21:42	0.7283	1823.29	111	1941	404	23.29	7.80	6.57	70.35	128.58	0.0036	0.7283	69.33	56.80
9:21:53	0.7314	1823.55	109	1915	398	23.46	7.75	6.23	84.46	128.83	0.0031	0.7314	81.82	55.66

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonald MP5B1									
Ending Depth =	1918			Bit Size =	8.75							Average ROP Excluding Stops		
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12								
Hours On Bit =	2.80			Mud Type =		Water Based						Depth Drilled =	135.33	
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70						Hours On Bit =	2.80	
Drillstring (ft) =	1759.66			Pipe (ft) =	1041.05		Collar (ft)	740.61				Average ROP	48.34	

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
9:22:12	0.7367	1823.80	103	1730	397	23.84	7.67	8.05	47.68	129.06	0.0053	0.7367	43.68	52.87
9:22:22	0.7394	1824.07	113	1850	411	22.31	8.16	7.82	52.91	129.93	0.0028	0.7394	318.26	69.63
9:22:53	0.7481	1824.86	113	1867	411	22.22	7.68	7.64	-6.12	129.98	0.0086	0.7481	5.01	66.44
9:23:04	0.7511	1824.80	113	1812	410	26.93	5.37	7.33	82.90	130.07	0.0031	0.7511	28.46	66.96
9:23:20	0.7556	1825.05	111	1885	406	23.39	8.69	7.40	59.07	130.33	0.0044	0.7556	68.50	67.20
9:23:33	0.7597	1825.31	110	1858	402	23.91	7.31	7.38	58.57	130.58	0.0042	0.7597	62.40	64.80
9:23:52	0.7644	1825.55	110	1910	403	24.06	7.16	7.12	55.37	130.83	0.0047	0.7644	56.82	63.44
9:24:05	0.7681	1825.81	112	1772	408	26.13	5.18	6.62	66.71	131.08	0.0036	0.7681	69.23	63.44
9:24:20	0.7722	1826.07	110	1818	403	24.50	6.37	6.82	59.04	131.34	0.0042	0.7722	62.40	61.71
9:24:38	0.7772	1826.32	114	1814	416	25.11	6.16	6.44	49.86	131.58	0.0050	0.7772	48.00	62.14
9:24:50	0.7806	1826.57	111	1968	403	24.19	7.06	6.39	75.14	131.84	0.0033	0.7806	78.00	60.81
9:25:07	0.7853	1826.82	111	1848	404	24.07	7.16	6.36	54.39	132.11	0.0047	0.7853	57.18	60.98
9:25:26	0.7906	1827.07	113	1859	411	20.85	10.43	7.44	46.49	132.36	0.0053	0.7906	47.37	57.55
9:25:38	0.7939	1827.32	113	2436	410	19.57	11.48	8.46	76.48	132.6	0.0033	0.7939	72.00	58.86
9:26:06	0.8022	1827.42	114	1567	414	26.76	4.58	8.14	11.21	132.76	0.0083	0.8022	21.60	48.65
9:26:25	0.8069	1827.67	111	1782	406	21.82	9.31	8.59	56.90	132.94	0.0047	0.8069	53.88	49.66
9:26:40	0.8111	1827.92	111	1937	403	22.00	9.15	8.89	57.26	133.2	0.0042	0.8111	62.40	49.91
9:26:54	0.8150	1828.17	112	1902	408	23.25	7.94	8.45	64.68	133.45	0.0039	0.8150	64.29	49.09
9:27:11	0.8197	1828.43	111	1829	404	23.13	8.08	7.91	54.80	133.71	0.0047	0.8197	55.16	48.85
9:27:24	0.8233	1828.68	113	2017	410	21.21	9.90	8.87	69.12	133.95	0.0036	0.8233	66.46	49.32
9:27:41	0.8281	1828.93	114	1849	416	23.60	7.32	8.47	58.35	134.19	0.0047	0.8281	60.82	49.32
9:27:55	0.8319	1829.18	112	1821	406	23.47	7.72	8.19	61.94	134.5	0.0039	0.8319	78.71	49.66
9:28:14	0.8372	1829.43	111	1928	405	21.26	9.83	8.57	47.60	134.7	0.0053	0.8372	37.80	48.69
9:28:31	0.8419	1829.68	111	1716	406	23.87	7.36	8.42	52.88	134.93	0.0047	0.8419	48.71	48.90
9:28:50	0.8472	1829.93	113	1852	410	23.15	8.05	8.05	46.80	135.21	0.0053	0.8472	53.05	48.71
9:29:06	0.8517	1830.18	112	1904	408	22.99	8.21	8.23	60.00	135.46	0.0044	0.8517	54.00	48.73
9:29:22	0.8561	1830.44	113	1961	410	22.74	8.43	8.37	64.96	135.74	0.0044	0.8561	65.25	48.92
9:29:40	0.8611	1830.69	113	1849	410	23.35	7.84	7.98	49.98	136.02	0.0050	0.8611	56.00	48.90
9:29:58	0.8655	1830.94	115	1949	417	23.18	8.01	8.11	59.30	136.22	0.0044	0.8655	45.00	48.83
9:30:12	0.8700	1831.19	112	1908	408	23.49	7.72	8.04	58.33	136.49	0.0044	0.8700	60.75	48.88

DOE high power mortor test Amaco Catoosa Test Sits

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonnald MP68K						Average ROP Excluding Slips			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1780.86			Pipe (ft) =	1041.05		Collar (ft)	745.81						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	RQP (ft/hr)
9:30:30	0.8750	1831.44	114	1827	414	24.16	7.08	7.82	50.63	138.77	0.0050	0.8750	56.00	52.49
9:30:50	0.8806	1831.69	113	1899	412	23.90	7.34	7.88	44.54	138.97	0.0056	0.8806	86.00	52.15
9:31:05	0.8847	1831.95	115	1742	418	26.34	4.41	6.61	61.88	137.21	0.0042	0.8847	57.60	53.06
9:31:25	0.8903	1832.20	115	1764	417	25.50	5.80	6.47	48.22	137.39	0.0056	0.8903	32.40	52.72
9:31:43	0.8953	1832.45	112	1831	408	24.74	6.52	6.23	52.45	137.72	0.0050	0.8953	56.00	52.66
9:31:57	0.8992	1832.70	113	1913	414	24.46	6.85	6.18	69.22	137.96	0.0039	0.8992	61.71	52.49
9:32:16	0.9044	1832.95	113	1831	412	24.96	6.32	5.89	47.45	138.24	0.0053	0.9044	53.05	52.15
9:32:31	0.9086	1833.20	112	1932	409	22.87	6.51	6.80	58.91	138.46	0.0042	0.9086	52.80	52.46
9:32:48	0.9133	1833.45	113	1867	410	24.52	7.21	7.08	53.49	138.78	0.0047	0.9133	67.76	52.15
9:33:06	0.9183	1833.70	114	1888	415	23.61	7.61	7.50	50.60	139.01	0.0050	0.9183	46.00	52.15
9:33:27	0.9242	1833.95	116	1852	422	22.24	8.01	7.71	43.20	139.25	0.0058	0.9242	41.14	51.82
9:33:45	0.9293	1834.21	116	1804	423	20.99	10.11	8.47	49.78	139.52	0.0050	0.9293	54.00	50.85
9:34:06	0.9350	1834.46	116	1918	423	20.26	10.80	8.93	44.17	139.84	0.0058	0.9350	54.86	50.33
9:34:20	0.9389	1834.71	116	1876	421	22.15	9.01	9.29	61.33	140.07	0.0039	0.9389	59.14	51.82
9:34:41	0.9447	1834.96	113	1874	411	22.49	8.67	9.50	44.32	140.23	0.0058	0.9447	27.43	49.61
9:34:58	0.9486	1835.21	112	1810	409	23.85	7.37	9.19	85.39	140.54	0.0039	0.9486	79.71	51.17
9:35:17	0.9547	1835.46	115	1869	417	20.40	10.68	9.31	40.14	140.73	0.0061	0.9547	31.69	49.01
9:35:37	0.9603	1835.71	117	1878	427	20.39	10.69	9.28	44.60	140.96	0.0056	0.9603	45.00	48.14
9:35:53	0.9647	1835.97	115	1954	417	20.17	10.90	9.66	58.74	141.22	0.0044	0.9647	54.69	48.53
9:36:10	0.9694	1836.22	117	1887	425	22.16	9.09	9.73	51.87	141.48	0.0047	0.9694	55.06	48.13
9:36:30	0.9750	1836.47	116	1862	422	22.76	8.41	9.84	46.05	141.76	0.0056	0.9750	48.86	49.31
9:36:56	0.9822	1836.72	112	1872	407	20.92	10.19	9.64	34.08	141.98	0.0072	0.9822	31.85	47.86
9:37:14	0.9872	1836.98	118	2025	420	21.00	10.12	9.72	52.87	142.26	0.0050	0.9872	56.00	48.97
9:37:33	0.9925	1837.23	113	1784	412	25.12	6.17	8.78	47.40	142.52	0.0053	0.9925	49.26	47.51
9:37:51	0.9975	1837.48	113	1873	410	22.18	9.00	8.76	49.10	142.77	0.0050	0.9975	50.00	46.43
9:38:09	1.0025	1837.73	115	1887	417	22.75	8.43	8.78	51.30	143.03	0.0050	1.0025	52.00	47.51
9:38:33	1.0092	1837.98	115	1873	420	21.90	9.25	8.59	37.48	143.28	0.0067	1.0092	37.50	46.43
9:38:53	1.0175	1838.14	116	1879	421	25.36	5.45	7.85	19.90	143.44	0.0083	1.0175	19.20	44.12
9:39:25	1.0286	1838.39	115	1840	418	21.84	9.31	8.27	42.84	143.68	0.0111	1.0286	39.27	46.56
9:39:43	1.0286	1838.64	117	1814	425	23.65	7.58	7.96	49.06	143.91	0.0053	1.0286	46.50	46.48

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonald MP58H						Average ROP Excluding Slips			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.89			Mud Type =		Water Based					Hours On Bit =	2.89		
Average ROP =	46.34			Mud Weight (lbs/gal) =		8.70					Average ROP	46.34		
Drillstring (ft) =	1789.66			Pipe (ft) =	1041.05		Collar (ft)	740.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
9:40:02	1.0339	1838.83	116	1850	428	23.74	7.48	7.79	47.57	144.15	0.0053	1.0339	45.47	42.03
9:40:15	1.0375	1839.15	116	1858	429	23.75	7.47	7.44	71.55	144.48	0.0036	1.0375	91.36	43.16
9:40:43	1.0453	1839.40	117	1857	424	25.22	6.97	7.56	32.37	144.88	0.0078	1.0453	25.71	41.12
9:41:02	1.0506	1839.86	114	1870	415	23.19	8.08	7.33	46.89	144.95	0.0053	1.0506	51.16	40.50
9:41:24	1.0567	1839.90	115	1869	416	24.01	7.24	7.35	41.56	145.18	0.0061	1.0567	37.64	40.06
9:41:38	1.0606	1840.15	117	1864	426	23.62	7.60	7.29	66.08	145.47	0.0039	1.0606	74.67	42.23
9:41:54	1.0650	1840.41	114	1858	416	24.61	6.75	7.14	58.34	145.67	0.0044	1.0650	35.09	42.79
9:42:15	1.0708	1840.69	116	1864	421	22.68	8.52	7.83	42.39	146.06	0.0058	1.0708	49.71	43.07
9:42:32	1.0756	1840.91	115	1866	419	20.88	10.23	8.07	55.18	146.19	0.0047	1.0756	46.59	43.36
9:42:51	1.0808	1841.16	117	1867	425	22.77	8.41	8.30	46.31	146.44	0.0053	1.0808	49.26	43.36
9:43:11	1.0864	1841.41	117	1814	423	25.06	6.20	8.02	46.81	146.68	0.0056	1.0864	43.20	43.20
9:43:27	1.0908	1841.66	118	1900	429	22.41	8.76	8.42	56.35	146.96	0.0044	1.0908	63.00	43.61
9:43:48	1.0967	1841.91	114	1869	415	23.50	7.73	8.27	43.33	147.2	0.0058	1.0967	41.14	43.61
9:44:18	1.1050	1842.11	116	1865	423	25.05	6.22	7.46	24.29	147.42	0.0083	1.1050	26.40	43.72
9:44:42	1.1117	1842.36	118	1824	427	21.61	9.52	7.69	37.39	147.64	0.0067	1.1117	33.00	43.24
9:44:59	1.1164	1842.62	116	1902	420	20.31	10.76	8.60	53.38	147.85	0.0047	1.1164	50.82	43.61
9:45:17	1.1214	1842.87	115	1904	419	22.42	8.75	8.80	50.18	148.14	0.0050	1.1214	52.80	43.71
9:45:36	1.1267	1843.12	118	1976	429	21.44	9.76	8.99	46.55	148.46	0.0053	1.1267	50.63	43.84
9:45:51	1.1306	1843.37	116	1967	421	22.69	8.59	9.45	61.69	148.63	0.0042	1.1306	40.60	44.20
9:46:10	1.1361	1843.62	117	1935	426	22.55	8.63	9.27	47.67	148.86	0.0053	1.1361	47.37	44.46
9:46:33	1.1397	1843.87	116	2017	421	24.21	7.04	8.52	69.72	149.14	0.0036	1.1397	72.00	45.26
9:46:42	1.1450	1844.12	117	1977	423	23.82	7.32	8.24	47.82	149.38	0.0053	1.1450	45.47	45.79
9:46:55	1.1486	1844.38	118	1999	428	23.73	7.50	7.80	57.57	149.75	0.0036	1.1486	102.46	52.05
9:47:15	1.1542	1844.63	117	1983	425	23.44	7.79	7.65	45.50	149.89	0.0058	1.1542	25.20	53.41
9:47:36	1.1600	1844.86	115	1875	418	22.78	8.40	7.61	44.57	150.19	0.0058	1.1600	51.43	51.82
9:47:54	1.1650	1845.13	118	1931	430	23.56	7.64	7.73	49.59	150.46	0.0050	1.1650	54.00	51.82
9:48:10	1.1694	1845.38	117	1944	425	22.56	8.62	7.89	55.25	150.67	0.0044	1.1694	47.25	52.83
9:48:31	1.1753	1845.63	120	1907	437	23.17	8.03	8.09	43.96	150.9	0.0058	1.1753	39.43	52.65
9:48:49	1.1803	1845.89	122	1968	438	23.24	7.99	8.13	49.61	151.19	0.0050	1.1803	58.09	51.40
9:49:01	1.1836	1846.14	116	1974	431	23.33	7.88	8.03	74.78	151.48	0.0033	1.1836	87.66	51.72

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/96								
Starting Depth =	1781	Bit Type =	Walker McDonald MP58H						
Ending Depth =	1916	Bit Size =	4.75					Average ROP Excluding Slags	
Total Depth Drilled	135	Bit Nozzles =	9, 9, 12, 12					Depth Drilled =	135.33
Hours On Bit =	2.80	Mud Type =	Water Based					Hours On Bit =	2.80
Average ROP =	48.34	Mud Weight (lbs/gal) =	8.70					Average ROP	48.34
Drillstring (ft) =	1789.66	Pipe (ft) =	1041.05	Collar (ft)	748.61				

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
9:48:30	1.1917	1845.39	118	1773	430	25.04	6.25	7.75	31.34	151.66	0.0081	1.1917	22.34	48.04
9:49:46	1.1961	1846.64	117	1929	425	23.61	8.19	7.58	56.82	151.93	0.0044	1.1961	60.75	47.68
9:50:06	1.2017	1846.82	119	1833	431	25.38	7.83	7.82	45.05	152.17	0.0056	1.2017	49.20	47.58
9:50:33	1.2092	1847.14	118	1849	432	30.76	10.33	8.10	32.53	152.43	0.0075	1.2092	34.67	45.97
9:51:03	1.2175	1847.30	116	1879	423	26.97	4.39	7.40	18.98	152.64	0.0083	1.2175	25.20	41.33
9:51:21	1.2225	1847.55	117	1853	425	25.31	7.50	7.73	49.91	152.91	0.0050	1.2225	64.06	45.99
9:51:40	1.2278	1847.80	116	1923	422	23.42	7.50	7.65	49.30	153.08	0.0053	1.2278	62.21	41.33
9:52:03	1.2339	1848.05	120	1962	436	21.66	9.48	7.98	40.90	153.36	0.0061	1.2339	45.82	40.29
9:52:19	1.2388	1848.31	119	1845	431	24.19	7.06	7.55	51.96	153.59	0.0047	1.2388	48.71	39.45
9:52:36	1.2451	1848.56	120	1903	437	22.98	8.59	8.09	33.78	153.92	0.0075	1.2451	30.07	39.86
9:53:05	1.2514	1848.81	117	1901	425	22.81	6.35	8.18	47.83	154.09	0.0053	1.2514	51.15	38.26
9:53:29	1.2581	1849.06	119	1872	434	21.23	9.86	8.56	38.43	154.32	0.0067	1.2581	34.50	38.48
9:53:46	1.2628	1849.31	119	1984	434	22.08	9.07	8.51	55.02	154.63	0.0047	1.2628	65.65	40.48
9:53:59	1.2664	1849.57	118	2014	429	23.29	7.91	8.38	66.54	154.9	0.0036	1.2664	74.77	40.43
9:54:13	1.2703	1849.82	114	1908	416	24.85	6.80	8.36	64.17	155.09	0.0039	1.2703	48.86	47.51
9:54:34	1.2733	1850.07	117	2004	428	23.26	7.23	8.28	85.09	155.33	0.0031	1.2733	78.55	49.83
9:54:46	1.2794	1850.32	116	1917	424	24.49	8.76	7.65	41.28	155.63	0.0061	1.2794	49.09	49.83
9:55:02	1.2839	1850.57	118	1871	428	24.91	6.36	7.11	54.87	155.84	0.0044	1.2839	47.25	48.91
9:55:16	1.2878	1850.82	119	1958	417	24.00	7.22	6.97	64.27	156.1	0.0039	1.2878	66.86	54.24
9:55:33	1.2925	1851.08	117	1952	426	23.88	7.35	7.13	55.24	156.34	0.0047	1.2925	50.82	55.22
9:55:48	1.2967	1851.33	121	1946	439	24.38	8.87	8.91	58.78	156.62	0.0042	1.2967	57.20	58.79
9:56:17	1.3047	1851.58	116	2058	424	25.80	5.78	6.72	31.92	156.88	0.0081	1.3047	29.75	54.12
9:56:36	1.3100	1851.83	119	1967	433	24.74	6.53	6.79	47.15	157.11	0.0053	1.3100	47.37	51.62
9:56:54	1.3150	1852.08	119	1948	431	25.32	5.98	6.60	50.61	157.38	0.0050	1.3150	51.00	55.53
9:57:07	1.3186	1852.33	116	2073	422	24.04	7.20	6.47	57.91	157.61	0.0036	1.3186	63.69	49.91
9:57:23	1.3231	1852.58	115	1883	418	25.17	6.12	6.32	96.83	157.86	0.0044	1.3231	60.75	51.82
9:57:37	1.3269	1852.83	114	1833	415	25.48	5.92	6.33	85.23	158.21	0.0039	1.3269	64.86	52.48
10:08:28	1.3269	1853.03	110	1299	400	31.64	5.16		85.05	158.75	0.0069	1.3269	0.00	
10:08:46	1.3319	1853.28	113	1410	412	28.51	2.74		52.98	158.75	0.0053	1.3319	0.00	

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/89													
Starting Depth =	1781		Bit Type =	Walker McDonald MF58H										
Ending Depth =	1916		Bit Size =	4.75							Average ROP Excluding Stops			
Total Depth Drilled:	135		Bit Nozzles =		9, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80		Mud Type =		Water Based						Hours On Bit =	2.80		
Average ROP =	48.34		Mud Weight (lbs/gal) =		8.70						Average ROP	48.34		
Drillstring (ft) =	1789.68		Pipe (ft) =	1041.05		Collar (ft)	748.61							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:09:00	1.3358	1853.53	110	1824	401	25.08	6.70		64.72	156.82	0.0039	1.3358	18.00	
10:09:20	1.3413	1853.78	112	1819	409	25.26	6.44		45.19	156.96	0.0056	1.3414	43.20	
10:09:33	1.3450	1854.04	113	1803	413	25.17	6.53	6.51	65.67	159.32	0.0036	1.3450	72.00	
10:09:47	1.3489	1854.29	110	1855	401	24.69	7.08	6.90	65.15	159.58	0.0039	1.3489	61.71	
10:09:58	1.3519	1854.54	111	1854	404	25.90	5.71	6.49	81.44	159.81	0.0031	1.3519	81.82	
10:10:13	1.3561	1854.79	109	1795	395	25.32	6.42	6.44	59.42	160.05	0.0042	1.3561	57.60	
10:10:27	1.3600	1855.04	110	1881	400	24.24	7.45	6.84	68.28	160.32	0.0039	1.3600	69.43	
10:10:44	1.3647	1855.29	111	1836	405	24.18	7.59	6.83	51.69	160.6	0.0047	1.3647	59.29	59.82
10:11:14	1.3731	1855.43	113	1705	410	24.24	7.47	6.91	16.71	160.8	0.0083	1.3731	24.58	52.30
10:11:31	1.3778	1855.68	111	1699	405	24.44	7.39	7.23	53.23	160.96	0.0047	1.3778	33.88	51.26
10:12:01	1.3861	1855.93	112	1693	406	24.42	7.35	7.31	30.73	161.22	0.0083	1.3861	31.20	47.85
10:12:21	1.3917	1856.18	113	1792	409	24.84	6.84	7.29	44.93	161.46	0.0056	1.3917	43.20	45.86
10:12:32	1.3947	1856.44	112	1873	408	25.41	6.33	7.06	78.02	161.69	0.0031	1.3947	75.27	46.91
10:12:56	1.4014	1856.68	113	1713	418	24.75	7.02	6.97	37.94	161.99	0.0067	1.4014	45.05	43.48
10:13:19	1.4067	1856.94	112	1760	407	25.39	6.51	6.81	49.64	162.24	0.0053	1.4067	47.37	42.53
10:13:35	1.4122	1857.19	113	1759	408	25.05	6.75	6.69	44.86	162.46	0.0056	1.4122	39.60	41.17
10:13:54	1.4175	1857.45	115	1817	420	24.33	7.43	6.81	47.95	162.71	0.0053	1.4176	47.37	40.93
10:14:06	1.4208	1857.70	111	1743	405	25.00	6.77	6.90	75.74	163.02	0.0033	1.4209	99.00	42.81
10:14:33	1.4281	1857.95	113	1810	413	24.10	7.65	7.02	34.64	163.21	0.0072	1.4281	26.31	45.15
10:14:47	1.4322	1858.20	109	1847	393	24.56	7.23	7.16	56.91	163.47	0.0042	1.4322	62.40	45.23
10:15:07	1.4378	1858.45	115	1785	419	25.49	6.22	7.69	47.18	163.79	0.0056	1.4378	57.60	45.23
10:15:27	1.4461	1858.69	114	1852	415	25.17	6.52	6.89	28.45	163.98	0.0083	1.4461	22.50	43.78
10:16:05	1.4539	1858.94	114	1751	416	23.04	8.66	7.45	32.27	164.23	0.0078	1.4539	32.14	42.86
10:16:24	1.4592	1859.19	113	1774	416	23.17	8.58	7.64	47.20	164.48	0.0053	1.4592	47.37	42.86
10:16:42	1.4642	1859.44	112	1871	408	22.34	9.44	8.08	50.48	164.71	0.0050	1.4642	46.00	43.02
10:17:01	1.4694	1859.69	110	1910	400	23.07	8.73	8.59	46.11	164.96	0.0053	1.4694	47.37	43.12
10:17:18	1.4742	1859.94	114	1846	415	24.57	7.28	8.73	59.52	165.23	0.0047	1.4742	57.18	42.98
10:17:39	1.4800	1860.20	112	1792	408	25.33	6.51	8.10	43.37	165.54	0.0058	1.4800	50.14	43.02
10:18:01	1.4861	1860.45	114	1766	415	25.71	6.16	7.62	41.40	165.71	0.0061	1.4861	27.82	41.75
10:18:17	1.4906	1860.70	113	1737	412	25.21	6.66	7.06	66.25	166.03	0.0044	1.4905	72.00	42.63

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781		Bit Type =	Weiker McDonnald MP66H							Average ROP Excluding Stops			
Ending Depth =	1916		Bit Size =	4.75										
Total Depth Drilled	135		Bit Nozzles =		9, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80		Mud Type =		Water Based						Hours On Bit =	2.80		
Average ROP =	48.34		Mud Weight (lbs/gal) =		8.70						Average ROP	48.34		
Drillstring (ft) =	1789.66		Pipe (ft) =	1041.05		Collar (ft)	748.61							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:18:42	1.4975	1860.85	114	1781	414	25.51	6.31	6.58	36.71	166.26	0.0069	1.4975	38.12	43.98
10:19:56	1.5014	1861.21	112	1881	409	24.35	7.39	6.81	66.63	166.47	0.0039	1.5014	54.00	47.76
10:19:10	1.5053	1861.46	114	1809	414	25.70	6.15	6.54	53.75	166.72	0.0039	1.5053	64.29	49.23
10:19:54	1.5119	1861.71	114	1793	413	25.92	5.99	6.50	37.42	166.97	0.0067	1.5119	37.50	47.51
10:19:46	1.5153	1861.96	116	1849	421	24.92	6.51	6.55	78.84	167.25	0.0033	1.5153	84.00	48.63
10:20:08	1.5192	1862.21	116	1833	421	25.80	6.05	6.49	68.55	167.5	0.0039	1.5192	64.29	50.44
10:20:30	1.5275	1862.46	113	1755	410	26.17	5.69	6.15	30.14	167.75	0.0083	1.5275	30.00	47.36
10:20:47	1.5322	1862.71	114	1824	414	25.34	6.48	6.32	51.27	168.01	0.0047	1.5322	85.05	49.05
10:21:06	1.5376	1862.97	113	1841	413	25.04	6.77	6.38	49.82	168.22	0.0053	1.5376	39.75	48.36
10:21:22	1.5419	1863.22	113	1788	411	26.01	5.83	6.16	58.11	168.48	0.0044	1.5419	68.75	51.87
10:21:42	1.5475	1863.48	115	1866	416	25.64	6.39	6.23	46.46	168.73	0.0056	1.5475	41.20	49.23
10:22:01	1.5528	1863.73	116	1855	420	25.70	6.14	6.32	46.85	168.99	0.0053	1.5528	49.26	47.79
10:22:22	1.5586	1863.98	117	1764	426	26.40	5.46	6.12	44.30	169.29	0.0058	1.5586	51.43	48.64
10:22:47	1.5658	1864.27	117	1736	426	26.17	5.66	5.90	41.45	169.5	0.0069	1.5658	30.24	45.94
10:23:17	1.5739	1864.49	119	1753	431	24.85	6.81	6.10	15.83	169.74	0.0053	1.5739	28.80	46.02
10:23:33	1.5783	1864.65	115	1878	418	23.85	8.73	6.58	55.96	169.95	0.0044	1.5783	47.25	43.08
10:23:49	1.5828	1864.81	113	1947	410	22.43	9.14	7.18	57.96	170.23	0.0044	1.5828	63.00	43.52
10:24:14	1.5897	1865.15	117	1820	426	24.74	8.04	7.47	35.27	170.43	0.0069	1.5897	27.36	41.64
10:24:36	1.5964	1865.41	116	1774	424	24.84	6.74	7.88	38.93	170.67	0.0067	1.5964	37.50	40.22
10:24:55	1.6011	1865.66	118	1915	425	23.43	8.14	7.85	52.44	170.92	0.0047	1.6011	52.94	40.86
10:25:17	1.6072	1865.91	117	1788	427	25.29	6.44	7.48	39.93	171.22	0.0061	1.6072	49.09	40.64
10:25:47	1.6156	1866.11	116	1769	428	25.08	6.42	6.94	24.40	171.42	0.0083	1.6156	24.51	37.40
10:26:05	1.6208	1866.37	116	1869	420	20.98	10.65	7.69	47.92	171.68	0.0053	1.6208	49.26	37.96
10:26:28	1.6269	1866.62	118	1805	430	24.53	7.20	7.77	42.58	171.88	0.0061	1.6269	32.73	41.64
10:26:57	1.6350	1866.87	116	1753	421	24.91	6.89	7.52	31.08	172.16	0.0081	1.6350	34.70	39.18
10:27:22	1.6419	1867.12	118	1824	423	20.73	10.84	8.40	36.97	172.38	0.0069	1.6419	31.68	37.35
10:27:45	1.6483	1867.38	117	1789	427	24.56	7.09	8.53	39.03	172.66	0.0064	1.6483	43.83	37.88
10:28:09	1.6550	1867.63	118	1812	429	24.04	7.64	7.83	38.68	173.02	0.0067	1.6550	54.06	37.88
10:28:34	1.6619	1867.88	116	1803	423	22.28	9.42	8.39	36.06	173.14	0.0069	1.6619	17.28	38.49
10:29:00	1.6692	1868.13	119	1841	431	22.67	9.60	8.91	34.80	173.41	0.0073	1.6692	37.38	38.64

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/96						
Starting Depth =	1781	Bit Type =	Walker McDonnald MF65H				
Ending Depth =	1916	Bit Size =	4.75			Average ROP Excluding Slops	
Total Depth Drilled	135	Bit Nozzles =	9, 9, 12, 12				
Hours On Bit =	2.80	Mud Type =	Water Based			Depth Drilled =	135.33
Average ROP =	48.34	Mud Weight (lbs/gal) =	8.70			Hours On Bit =	2.80
Drillstring (ft) =	1769.66	Pipe (ft) =	1041.85	Collar (ft)	746.61	Average ROP	48.34

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:28:17	1.4739	1868.38	118	1834	418	23.65	5.07	8.36	52.84	173.55	0.0047	1.6739	59.29	36.91
10:29:35	1.6500	1868.53	115	1841	419	22.65	5.01	8.74	41.23	173.92	0.0061	1.6866	57.64	38.20
10:30:09	1.6883	1868.77	120	1748	426	23.67	8.09	8.83	16.86	174.14	0.0083	1.6883	26.40	35.03
10:30:22	1.6919	1868.92	117	1993	427	21.50	10.23	8.59	68.74	174.32	0.0036	1.6919	48.85	37.76
10:30:48	1.6992	1869.27	119	1822	433	23.26	8.44	8.75	34.59	174.65	0.0072	1.6992	31.85	37.57
10:31:10	1.7053	1869.53	118	1786	430	25.83	5.53	8.34	41.09	174.79	0.0061	1.7053	39.27	37.76
10:31:40	1.7136	1869.73	120	1655	437	26.38	5.48	7.83	24.99	175.03	0.0083	1.7136	26.80	35.83
10:32:10	1.7219	1869.97	119	1720	433	24.57	7.21	7.45	28.26	175.23	0.0083	1.7219	24.00	34.83
10:32:35	1.7289	1870.22	122	1753	442	25.56	6.21	6.65	36.66	175.5	0.0069	1.7289	36.88	35.05
10:32:57	1.7350	1870.47	120	1906	437	22.43	9.25	6.83	40.05	175.79	0.0061	1.7350	47.45	34.29
10:33:12	1.7392	1870.73	114	1894	414	22.58	8.98	7.43	60.50	176.06	0.0042	1.7392	64.80	35.49
10:33:42	1.7475	1870.92	120	1738	435	23.79	6.94	7.72	23.70	176.25	0.0083	1.7475	22.80	35.34
10:34:09	1.7550	1871.15	117	1848	424	23.53	7.78	7.83	39.66	176.5	0.0075	1.7550	33.33	34.29
10:34:33	1.7617	1871.43	116	1847	430	24.23	7.48	8.09	36.41	176.75	0.0067	1.7617	37.50	34.55
10:35:03	1.7700	1871.61	117	1726	425	25.85	5.91	7.42	21.58	176.92	0.0083	1.7700	28.49	33.14
10:35:24	1.7756	1871.86	116	1844	421	22.50	9.13	7.45	43.46	177.22	0.0058	1.7758	51.43	34.23
10:35:47	1.7822	1872.11	116	1872	433	22.20	9.59	7.92	49.30	177.37	0.0064	1.7822	53.48	35.80
10:36:09	1.7883	1872.36	120	1751	437	24.52	7.16	7.80	39.40	177.58	0.0061	1.7883	50.73	36.00
10:36:37	1.7961	1872.61	118	1979	430	21.26	10.34	8.37	33.02	177.88	0.0078	1.7961	38.71	35.02
10:36:53	1.8006	1872.86	117	1881	427	22.54	9.11	9.01	54.94	178.13	0.0044	1.8006	58.26	34.79
10:37:23	1.8089	1872.97	116	1703	423	24.34	7.83	8.65	12.54	178.31	0.0083	1.8089	21.60	33.99
10:37:42	1.8142	1873.22	119	1870	432	23.27	8.39	8.46	48.83	178.51	0.0053	1.8142	37.89	34.46
10:37:59	1.8189	1873.47	120	1779	436	24.76	6.98	8.42	54.66	178.76	0.0047	1.8189	52.94	35.66
10:38:29	1.8264	1873.72	118	1741	427	25.31	6.40	7.63	33.32	178.98	0.0075	1.8264	29.33	37.42
10:38:58	1.8342	1873.98	120	1778	438	25.59	6.16	7.04	33.47	179.29	0.0078	1.8342	30.86	36.74
10:39:19	1.8411	1874.23	117	1688	425	27.52	4.46	5.46	37.09	179.52	0.0069	1.8411	33.12	36.00
10:39:49	1.8498	1874.42	117	1695	426	26.52	5.19	5.82	22.86	179.72	0.0083	1.8494	24.00	33.71
10:40:09	1.8550	1874.67	119	1794	432	25.19	6.62	5.75	43.41	179.93	0.0058	1.8550	37.80	34.98
10:40:28	1.8608	1874.92	117	1823	425	26.29	6.51	6.77	46.69	180.31	0.0056	1.8608	58.45	34.33
10:40:55	1.8678	1875.17	119	1728	433	26.82	4.96	5.83	35.00	180.55	0.0072	1.8678	34.62	37.38

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			BR Type =	Walker McDonald MP68H						Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1789.66			Pipe (ft) =	1041.05		Collar (ft)	740.61						

Time (HR:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:41:17	1.8738	1875.42	118	1760	428	26.18	5.71	5.76	40.80	180.72	0.0061	1.8739	38.18	36.84
10:41:37	1.8794	1875.86	117	1775	424	25.85	6.21	6.06	45.71	180.99	0.0056	1.8794	48.60	36.58
10:42:06	1.8875	1876.53	118	1747	426	25.53	6.28	5.93	36.99	181.21	0.0081	1.8875	27.31	36.16
10:42:26	1.8931	1876.18	118	1801	430	26.05	5.73	5.78	46.76	181.45	0.0056	1.8931	43.20	37.36
10:42:50	1.8997	1876.43	116	1785	430	25.25	6.52	6.09	37.36	181.69	0.0067	1.8997	36.00	37.54
10:43:15	1.9067	1876.66	119	1787	431	24.60	7.20	6.39	30.47	181.97	0.0069	1.9067	40.32	38.50
10:43:31	1.9111	1876.93	115	1838	420	22.78	8.81	8.91	96.57	182.2	0.0044	1.9111	51.75	40.28
10:43:56	1.9181	1877.19	116	1836	427	22.85	8.81	7.37	36.75	182.49	0.0069	1.9181	41.76	39.48
10:44:26	1.9264	1877.38	117	1716	426	25.19	6.38	7.50	22.65	182.74	0.0083	1.9264	30.00	37.71
10:44:39	1.9300	1877.53	118	1911	428	24.65	6.86	7.51	72.92	182.9	0.0036	1.9300	44.31	39.39
10:45:00	1.9358	1877.85	121	1791	435	25.73	5.82	7.24	42.77	183.15	0.0058	1.9358	42.86	39.19
10:45:30	1.9442	1878.06	119	1809	433	25.23	6.26	6.73	26.10	183.38	0.0083	1.9442	27.60	37.59
10:45:44	1.9481	1878.31	120	1834	435	23.09	8.33	6.87	62.76	183.59	0.0039	1.9481	54.00	38.73
10:46:00	1.9525	1878.56	120	1825	435	25.01	6.66	6.71	59.18	183.82	0.0044	1.9525	74.25	40.36
10:46:30	1.9608	1878.79	120	1779	437	25.36	6.18	6.63	28.37	184.18	0.0083	1.9608	28.80	38.99
10:46:44	1.9647	1879.05	118	1870	428	22.89	8.56	7.19	63.37	184.33	0.0039	1.9647	43.71	39.64
10:46:58	1.9686	1879.30	116	1823	424	24.76	6.77	7.29	66.58	184.5	0.0039	1.9686	68.43	41.74
10:47:28	1.9764	1879.56	119	1797	432	25.15	5.38	6.50	38.01	184.84	0.0078	1.9764	30.86	43.60
10:47:44	1.9814	1879.81	117	1901	427	22.81	8.95	7.37	49.50	185.08	0.0050	1.9814	48.00	42.42
10:48:09	1.9883	1880.06	117	1798	427	23.99	7.50	7.64	36.20	185.33	0.0069	1.9883	36.00	41.33
10:48:30	1.9937	1880.11	121	1672	438	26.52	5.09	6.94	9.23	185.85	0.0083	1.9937	26.40	39.65
10:48:49	1.9994	1880.78	122	3362	441	22.80	5.68	7.32	93.44	185.8	0.0078	1.9994	66.00	39.89
10:49:07	2.0044	1880.81	118	1759	429	24.81	6.72	7.39	46.77	186.04	0.0050	2.0044	48.00	39.47
10:49:37	2.0128	1880.81	120	1685	435	25.89	5.86	6.78	23.42	186.11	0.0083	2.0128	8.40	38.89
10:49:55	2.0178	1881.06	114	2148	416	20.44	10.91	7.46	50.05	186.51	0.0050	2.0178	80.00	37.86
10:50:22	2.0253	1881.31	117	1827	427	22.79	8.75	8.13	33.74	186.62	0.0075	2.0253	14.67	36.47
10:50:35	2.0317	1881.56	120	1776	434	24.35	6.96	7.85	39.93	186.83	0.0064	2.0317	32.67	36.18
10:51:13	2.0394	1881.81	115	1775	416	24.00	7.23	7.95	32.63	187.07	0.0078	2.0394	30.86	34.45
10:51:43	2.0478	1882.00	121	1757	438	24.68	6.87	8.10	22.63	187.35	0.0083	2.0478	33.69	32.84
10:52:05	2.0539	1882.25	118	1737	429	24.43	6.83	7.29	41.26	187.66	0.0061	2.0539	56.73	37.40

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonald MP68H						Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1788.66			Pipe (ft) =	1041.05		Collar (ft)	740.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
10:52:07	2.0800	1882.50	118	1862	430	21.78	9.36	7.41	32.70	187.78	0.0361	2.0800	19.64	35.34
10:52:56	2.0981	1882.75	120	1752	435	23.89	7.33	7.48	31.51	188.03	0.0081	2.0881	31.03	33.64
10:53:21	2.0750	1883.00	117	1751	427	24.38	6.69	7.36	36.83	188.34	0.0069	2.0750	44.64	35.20
10:53:43	2.0811	1883.26	117	1955	425	24.28	8.96	7.43	41.23	188.53	0.0061	2.0811	31.09	34.74
10:54:10	2.0886	1883.51	121	1821	436	25.57	8.72	7.21	34.43	188.78	0.0075	2.0886	30.87	34.74
10:54:40	2.0969	1883.62	123	1619	446	27.24	4.12	6.16	13.78	188.94	0.0083	2.0969	21.80	31.56
10:55:08	2.1047	1883.85	116	1740	423	24.97	6.31	5.95	32.47	189.22	0.0078	2.1047	36.09	33.71
10:55:32	2.1114	1884.13	116	1821	420	23.95	7.28	6.08	36.94	189.44	0.0067	2.1114	33.00	33.48
10:55:53	2.1172	1884.36	117	1851	424	23.73	7.51	6.19	42.48	189.69	0.0058	2.1172	42.86	33.63
11:05:53	2.1172	1884.48	111	1257	404	31.68	0.33		115.36	189.86	0.0000	2.1172	0.00	
11:05:59	2.1194	1884.73	110	1258	416	31.82	0.67		169.78	190.01	0.0022	2.1194	58.50	
11:06:29	2.1278	1884.96	108	1488	396	29.68	4.76		27.26	190.26	0.0083	2.1278	28.80	
11:06:42	2.1314	1885.21	104	2303	380	21.56	9.81		76.92	190.49	0.0036	2.1314	66.46	
11:07:12	2.1397	1885.33	106	1457	388	27.65	4.85	3.93	14.34	190.59	0.0083	2.1397	24.00	
11:07:36	2.1469	1885.56	106	1575	388	25.87	5.79	5.04	34.99	191	0.0072	2.1469	42.92	
11:07:57	2.1522	1885.83	109	1763	397	23.67	7.90	6.81	48.25	191.08	0.0053	2.1522	17.05	
11:08:13	2.1567	1886.09	107	1818	390	23.32	8.35	7.30	84.83	191.35	0.0044	2.1567	58.50	
11:08:33	2.1622	1886.34	105	1812	382	23.30	8.29	6.97	46.59	191.66	0.0056	2.1622	65.80	
11:08:47	2.1661	1886.55	105	1862	383	23.12	8.43	7.72	64.29	191.85	0.0039	2.1661	48.86	43.16
11:09:02	2.1703	1886.84	106	1919	388	22.76	8.76	8.32	59.38	192.29	0.0042	2.1703	105.60	41.51
11:09:17	2.1744	1887.10	109	1841	396	23.74	7.83	8.30	63.28	192.44	0.0042	2.1744	35.00	45.86
11:09:31	2.1783	1887.36	107	1898	389	23.26	8.38	8.31	83.58	192.63	0.0039	2.1783	46.88	46.59
11:09:47	2.1828	1887.59	109	1904	398	23.48	8.07	8.27	55.68	192.94	0.0044	2.1828	69.75	52.72
11:10:04	2.1875	1887.85	106	1815	393	23.35	8.20	8.23	54.21	193.13	0.0047	2.1875	46.28	55.97
11:10:19	2.1917	1888.10	107	1888	391	23.76	8.76	8.23	58.87	193.4	0.0042	2.1917	64.80	57.55
11:10:33	2.1956	1888.35	106	1904	386	22.71	8.81	8.42	66.57	193.68	0.0039	2.1956	72.00	58.87
11:10:52	2.2008	1888.61	102	1830	373	23.31	8.24	8.42	46.89	193.92	0.0053	2.2008	48.47	58.79
11:11:06	2.2047	1888.88	103	1935	376	22.42	9.09	8.62	66.73	194.12	0.0039	2.2047	51.43	58.79
11:11:22	2.2092	1889.11	106	1880	387	23.25	8.31	8.64	54.14	194.43	0.0044	2.2092	69.75	58.37

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98														
Starting Depth =	1781			Bit Type =	Walker McDonald MF68H							Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75										
Total Depth Drilled	135			Bit Nozzles =		8, 9, 12, 12						Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based						Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70						Average ROP	48.34		
Drillstring (ft) =	1789.86			Pipe (ft) =	1041.05		Collar (ft)	748.81							

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Klps)	WOB (Klps)	Average WOB (Klps)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:11:38	2.2136	1888.87	105	1832	384	22.96	8.57	8.60	57.88	194.82	0.0044	2.2136	42.76	57.96
11:11:57	2.2189	1889.82	108	1840	384	21.88	9.83	8.81	47.62	194.94	0.0053	2.2189	60.63	56.07
11:12:23	2.2258	1889.87	105	1726	382	21.75	9.75	9.10	37.12	195.37	0.0066	2.2258	47.52	52.72
11:12:41	2.2311	1890.32	106	1772	386	22.66	9.82	9.07	47.89	195.4	0.0053	2.2311	34.63	52.06
11:13:05	2.2378	1890.38	108	1769	388	20.53	10.00	9.59	37.63	195.71	0.0067	2.2378	46.50	49.45
11:13:16	2.2408	1890.53	105	1973	382	25.48	8.11	9.50	81.72	195.9	0.0031	2.2408	62.18	50.13
11:13:40	2.2475	1890.86	107	1891	391	25.44	8.21	8.77	39.67	196.15	0.0067	2.2475	37.50	48.64
11:13:55	2.2511	1891.14	104	1817	379	24.83	6.68	8.16	69.25	196.4	0.0036	2.2511	69.23	49.15
11:14:10	2.2558	1891.38	105	1861	384	24.28	7.30	7.84	54.85	196.65	0.0047	2.2558	52.94	48.86
11:14:26	2.2603	1891.64	106	1792	385	25.03	6.58	6.96	55.47	196.96	0.0044	2.2603	69.75	48.64
11:14:40	2.2642	1891.85	104	1835	380	25.15	6.47	6.65	54.47	197.15	0.0039	2.2642	58.67	48.13
11:14:54	2.2681	1892.14	111	1849	405	25.41	6.23	6.66	68.44	197.49	0.0039	2.2681	78.71	48.76
11:15:13	2.2733	1892.46	108	1718	396	25.34	6.29	6.67	46.23	197.67	0.0053	2.2733	34.11	48.60
11:15:38	2.2803	1892.85	107	1816	392	21.30	10.16	7.16	37.38	197.93	0.0069	2.2803	37.44	48.21
11:16:00	2.2864	1892.91	108	1820	394	21.25	10.20	7.87	42.85	198.2	0.0061	2.2864	44.18	48.86
11:16:17	2.2911	1893.17	109	1778	396	20.22	11.16	9.81	54.12	198.3	0.0047	2.2911	63.53	49.51
11:16:32	2.2953	1893.42	105	1944	382	21.18	10.28	9.82	61.51	198.51	0.0042	2.2953	86.40	49.69
11:16:41	2.2978	1893.56	106	1821	386	25.82	5.72	9.51	98.05	198.68	0.0025	2.2978	28.00	49.60
11:16:55	2.3017	1893.93	107	1763	391	25.36	6.25	8.73	67.92	199.22	0.0039	2.3017	61.71	49.33
11:17:16	2.3075	1894.18	109	1898	398	25.21	8.42	7.87	42.09	199.47	0.0058	2.3075	42.86	49.69
11:17:34	2.3125	1894.43	105	1755	385	23.23	8.30	7.39	50.47	199.7	0.0050	2.3125	46.00	49.52
11:17:56	2.3186	1894.69	110	1791	400	23.36	8.19	8.98	41.36	199.94	0.0061	2.3186	39.27	49.58
11:18:15	2.3239	1894.94	103	1815	376	21.16	10.30	7.89	46.16	200.24	0.0053	2.3239	56.84	49.61
11:18:31	2.3283	1895.19	106	1771	386	23.34	8.23	8.23	56.68	200.45	0.0044	2.3283	47.25	49.36
11:18:52	2.3342	1895.44	111	1769	404	22.34	9.17	8.89	44.19	200.77	0.0058	2.3342	54.86	49.72
11:19:07	2.3383	1895.69	106	1958	386	19.72	11.67	9.51	58.99	201	0.0042	2.3383	55.20	49.72
11:19:33	2.3456	1895.94	110	1802	399	19.97	11.44	10.16	34.78	201.22	0.0072	2.3456	30.46	47.39
11:19:51	2.3506	1896.20	108	1791	395	19.70	11.69	10.44	49.78	201.48	0.0050	2.3506	52.00	48.48
11:20:13	2.3567	1896.45	110	1866	400	19.54	11.75	11.34	41.64	201.73	0.0061	2.3567	49.91	48.17
11:20:31	2.3617	1896.70	112	1865	408	22.00	9.48	11.21	51.69	202.04	0.0050	2.3617	62.00	48.17

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98													
Starting Depth =	1781			Bit Type =	Walker McDonnald MP66H						Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1789.68			Pipe (ft) =	1041.05		Collar (ft)	740.61						

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Rock Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:20:51	2.3672	1896.95	105	1864	368	21.20	10.26	10.82	45.37	202.32	0.0056	2.3672	50.40	46.49
11:21:13	2.3733	1897.23	113	1858	402	19.95	11.46	10.83	39.92	202.54	0.0061	2.3733	36.80	45.91
11:21:28	2.3775	1897.46	108	1850	384	22.02	9.47	10.48	68.12	202.62	0.0042	2.3775	67.20	46.17
11:21:50	2.3836	1897.71	104	1773	380	22.10	9.38	10.01	40.75	202.98	0.0061	2.3836	36.18	45.91
11:22:10	2.3892	1897.96	103	1876	376	19.49	11.89	10.49	44.69	203.25	0.0056	2.3892	50.40	44.66
11:22:30	2.3975	1898.10	106	1807	385	27.31	4.41	9.32	16.22	203.4	0.0083	2.3975	16.80	41.68
11:23:10	2.4058	1898.32	110	1720	401	22.67	8.86	8.80	27.41	203.65	0.0083	2.4058	30.00	38.35
11:23:24	2.4097	1898.58	111	1957	403	19.81	11.59	9.32	68.56	203.86	0.0039	2.4097	54.00	40.15
11:23:46	2.4158	1898.83	111	1814	403	21.24	10.23	9.39	41.09	204.11	0.0061	2.4158	40.91	39.32
11:24:03	2.4206	1899.08	109	1879	398	21.29	10.18	9.85	53.95	204.34	0.0047	2.4206	48.71	39.94
11:24:18	2.4247	1899.34	107	1859	389	19.71	11.68	10.51	68.27	204.67	0.0042	2.4247	78.26	41.85
11:24:33	2.4289	1899.55	111	1832	403	22.59	8.82	10.52	58.18	204.9	0.0042	2.4289	55.36	41.85
11:25:01	2.4367	1899.84	110	1788	399	22.20	9.36	10.06	32.83	205.12	0.0078	2.4367	26.29	40.75
11:25:20	2.4419	1900.08	156	1879	394	22.01	8.49	9.91	47.01	205.47	0.0053	2.4419	66.32	40.36
11:25:43	2.4483	1900.34	110	1902	402	21.87	9.80	9.80	39.21	205.61	0.0064	2.4483	21.81	44.67
11:25:57	2.4522	1900.58	108	1925	395	19.37	11.93	9.85	68.32	205.98	0.0039	2.4522	95.14	49.15
11:26:26	2.4603	1900.86	107	1814	389	20.93	10.52	10.19	31.63	206.23	0.0081	2.4603	39.52	46.10
11:26:49	2.4667	1901.11	110	1745	400	21.68	9.79	10.28	39.86	206.47	0.0064	2.4667	34.43	44.85
11:27:05	2.4711	1901.36	110	1881	399	19.24	12.12	10.80	55.45	206.67	0.0044	2.4711	45.00	46.10
11:27:25	2.4767	1901.62	110	1882	399	18.94	12.41	11.37	45.58	206.9	0.0056	2.4767	41.86	43.99
11:27:42	2.4814	1901.87	109	1961	395	20.56	10.89	11.13	53.21	207.13	0.0047	2.4814	48.71	43.43
11:28:01	2.4867	1902.12	111	1903	404	22.90	8.63	10.76	49.09	207.52	0.0053	2.4867	73.89	45.80
11:28:21	2.4922	1902.38	111	1788	404	24.74	6.85	10.17	44.81	207.68	0.0056	2.4922	28.80	46.56
11:28:36	2.4984	1902.63	113	1867	411	23.47	8.08	9.36	59.02	207.87	0.0042	2.4984	69.30	47.85
11:28:51	2.5036	1902.89	109	1861	395	23.93	7.64	8.41	63.16	208.17	0.0042	2.5036	48.00	47.38
11:29:11	2.5061	1903.14	108	1803	395	24.42	7.17	7.62	44.34	208.42	0.0056	2.5061	45.00	49.75
11:29:35	2.5128	1903.40	111	1726	403	25.74	5.99	7.13	39.19	208.69	0.0067	2.5128	40.59	49.66
11:29:48	2.5164	1903.65	109	1915	396	23.85	7.71	7.30	72.81	208.91	0.0036	2.5164	60.82	55.58
11:30:06	2.5219	1903.90	113	1810	411	24.53	7.07	7.16	44.45	209.33	0.0056	2.5219	75.60	56.21
11:30:36	2.5303	1904.05	110	1926	400	25.32	6.31	6.83	18.11	209.34	0.0083	2.5303	1.30	44.59

DOE high power mortor test Amaco Catoosa Test Site

DOE HP Motor No. 2

Well No. 6	Date: 12/17/98												
Starting Depth =	1781			Bit Type =	Walker McDonald MP58H						Average ROP Excluding Stops		
Ending Depth =	1916			Bit Size =	8.75								
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33	
Hours On Bit =	2.80			Mud Type =		Water Based					Hours On Bit =	2.80	
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34	
Drillstring (ft) =	1769.66			Pipe (ft) =	1041.05		Collar (ft)	740.61					

Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:30:54	2.5347	1904.30	106	1859	393	23.51	8.05	7.01	58.44	309.58	0.0044	2.5347	84.00	45.36
11:31:15	2.5406	1904.58	107	1751	396	24.73	8.87	7.28	41.74	209.83	0.0058	2.5405	42.66	45.16
11:31:30	2.5447	1904.81	111	1996	403	22.17	8.33	7.53	59.93	210.26	0.0042	2.5447	1:03.30	46.19
11:31:45	2.5489	1905.06	107	1900	389	22.91	8.61	7.83	64.20	210.37	0.0042	2.5489	26.40	44.90
11:32:06	2.5563	1905.31	112	1807	410	23.81	7.77	8.13	36.48	210.64	0.0064	2.5553	42.26	44.14
11:32:25	2.5600	1905.57	111	1914	405	21.98	9.51	8.42	53.71	210.88	0.0047	2.5600	50.82	45.95
11:32:54	2.5628	1905.82	104	2001	379	21.32	10.15	9.07	104.83	211.25	0.0025	2.5625	148.00	47.06
11:33:01	2.5700	1906.07	109	1939	396	21.86	9.61	9.13	34.39	211.34	0.0075	2.5700	12.00	45.16
11:33:14	2.5736	1906.32	107	1872	392	21.76	9.76	9.36	66.33	211.65	0.0036	2.5736	85.85	45.38
11:33:31	2.5783	1906.57	112	1941	407	21.48	9.66	9.61	54.32	211.85	0.0047	2.5783	42.35	45.65
11:33:56	2.5836	1906.82	106	1950	386	18.42	12.81	10.49	46.63	212.1	0.0053	2.5836	47.37	45.46
11:34:08	2.5886	1907.07	111	1927	404	17.01	14.25	11.31	51.02	212.37	0.0050	2.5886	54.00	45.46
11:34:24	2.5931	1907.33	109	1918	398	18.36	12.97	11.86	58.03	212.76	0.0044	2.5931	87.75	45.40
11:34:40	2.5975	1907.59	110	1926	401	19.92	11.48	12.32	67.15	212.92	0.0044	2.5975	38.00	44.90
11:34:56	2.6019	1907.84	106	1898	389	21.02	10.43	12.41	66.63	213.16	0.0044	2.6019	54.00	44.12
11:35:15	2.6072	1908.09	111	1936	403	18.39	12.85	12.42	47.48	213.39	0.0053	2.6072	36.00	44.76
11:36:25	2.6100	1908.34	106	2377	399	19.33	12.04	11.97	57.40	213.74	0.0028	2.6100	140.40	44.75
11:35:54	2.6181	1908.59	110	1783	401	23.82	7.65	10.91	38.69	213.89	0.0081	2.6181	18.02	45.08
11:36:11	2.6228	1908.84	116	1858	421	24.88	7.11	10.04	54.47	214.11	0.0047	2.6228	46.59	45.08
11:36:17	2.6244	1909.10	103	2625	378	22.22	8.28	9.81	155.21	214.42	0.0017	2.6244	166.00	45.84
11:36:36	2.6306	1909.35	112	1901	407	21.23	10.23	8.39	40.73	214.85	0.0061	2.6305	37.64	44.36
11:36:56	2.6350	1909.60	113	1919	411	20.73	10.71	9.00	57.88	215.03	0.0044	2.6350	85.50	44.12
11:37:13	2.6400	1909.85	110	1902	401	20.12	11.28	9.72	45.89	215.11	0.0050	2.6400	18.00	43.18
11:37:27	2.6439	1910.11	109	2302	397	19.84	11.58	10.61	63.54	215.47	0.0039	2.6439	92.57	44.12
11:37:57	2.6522	1910.28	111	1696	405	24.13	7.45	10.25	20.71	215.61	0.0083	2.6522	16.83	43.67
11:38:14	2.6569	1910.53	109	1952	397	20.42	11.06	10.40	54.39	215.81	0.0047	2.6569	42.35	43.66
11:38:36	2.6631	1910.78	111	1885	405	21.66	9.81	10.22	40.53	216.12	0.0061	2.6631	50.73	43.67
11:38:55	2.6683	1911.04	110	1899	401	20.82	10.61	10.13	49.05	216.31	0.0053	2.6683	36.00	43.23
11:39:13	2.6731	1911.29	105	1992	384	20.57	10.57	9.93	53.75	216.63	0.0047	2.6731	65.89	43.05
11:39:33	2.6789	1911.54	113	1885	411	21.67	9.81	10.40	42.68	216.96	0.0058	2.6789	41.14	43.31

DOE high power mortor test Amaco Catoosa Test Site

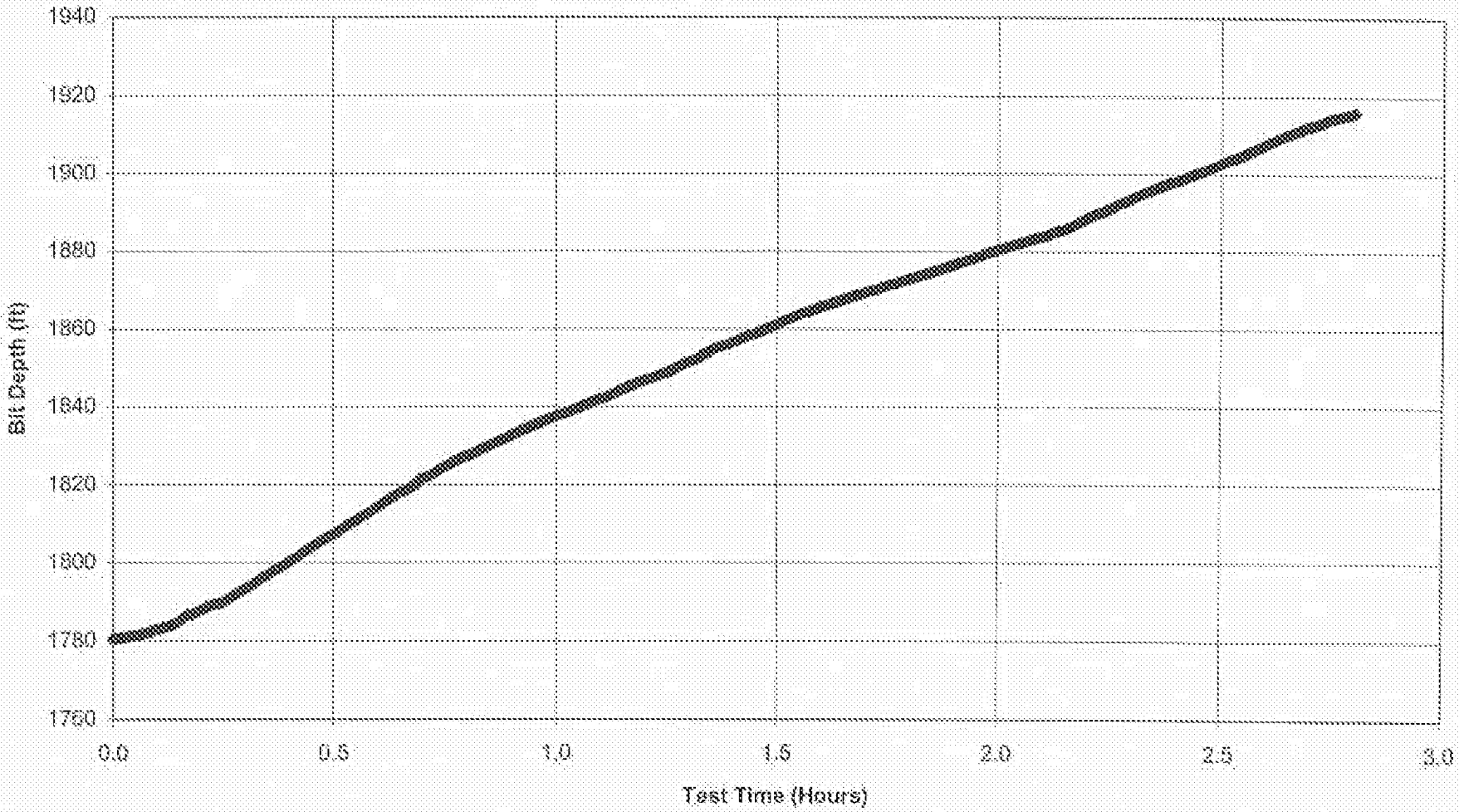
DOE HP Motor No. 2

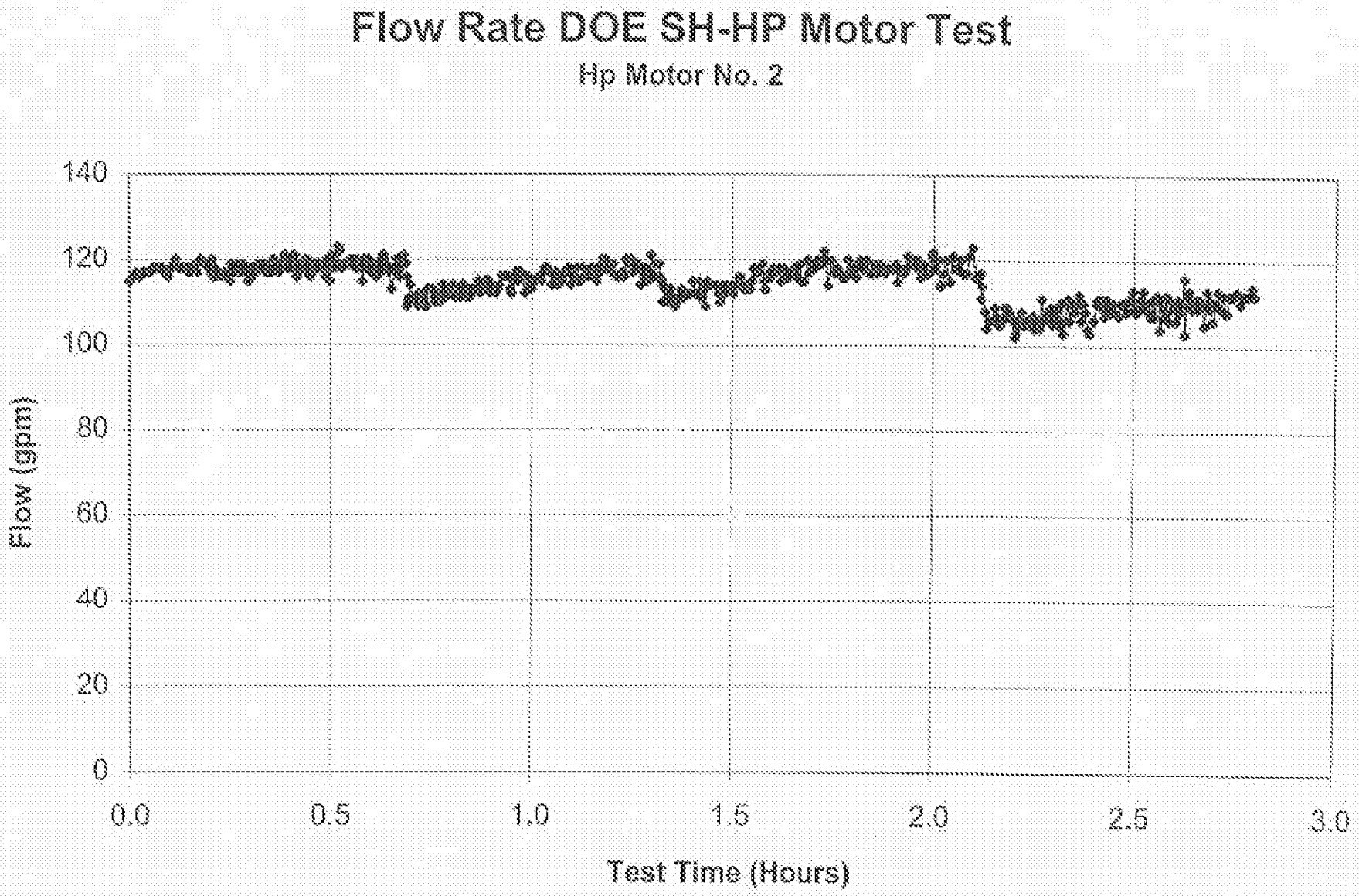
Well No. 6	Date: 12/17/98													
Starting Depth =	1751			Bit Type =	Walker McDonald MP53H						Average ROP Excluding Stops			
Ending Depth =	1916			Bit Size =	4.75									
Total Depth Drilled	135			Bit Nozzles =		9, 9, 12, 12					Depth Drilled =	135.33		
Hours On Bit =	2.60			Mud Type =		Water Based					Hours On Bit =	3.60		
Average ROP =	48.34			Mud Weight (lbs/gal) =		8.70					Average ROP	48.34		
Drillstring (ft) =	1789.66			Pipe (ft) =	1041.05		Collar (ft)	740.61						

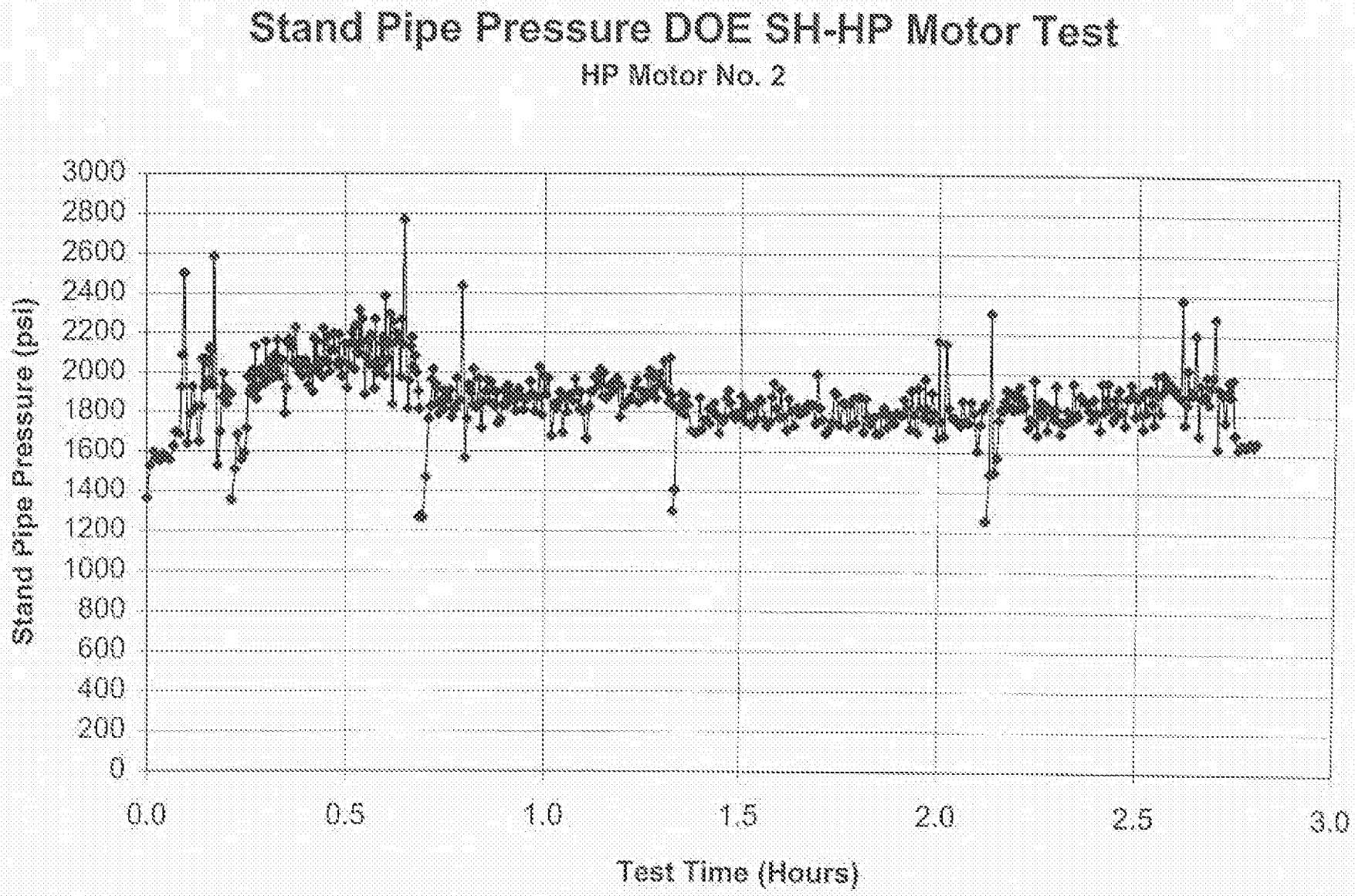
Time (HH:MM:SS)	Time From Start (HH:MM:SS)	Bit Depth (Feet)	Flow (gpm)	Pressure (psi)	Calculated Speed (rpm)	Hook Load (Kips)	WOB (Kips)	Average WOB (Kips)	ROP (ft/hr)	Feet On Bit	Incremental Hours On Bit	Hours On Bit	ROP (ft/hr)	ROP (ft/hr)
11:39:54	2.6847	1911.79	109	1942	398	21.81	9.87	10.17	42.08	217.06	0.0058	2.6847	34.29	44.04
11:40:06	2.6881	1912.03	111	1990	403	22.56	8.91	9.99	79.06	217.49	0.0033	2.6881	128.00	45.79
11:40:24	2.6931	1912.39	108	2284	398	23.22	8.32	9.60	50.00	217.56	0.0050	2.6931	14.00	44.84
11:40:54	2.7014	1912.41	110	1629	400	27.38	4.32	8.25	12.73	217.76	0.0083	2.7014	99.00	43.92
11:41:03	2.7053	1912.65	113	1930	410	22.83	8.68	8.02	66.65	217.96	0.0039	2.7053	51.43	44.07
11:41:38	2.7136	1912.85	109	1899	395	27.18	4.53	6.95	23.29	218.13	0.0083	2.7136	28.40	43.86
11:42:00	2.7197	1913.10	112	1763	409	28.31	7.28	6.83	41.21	218.86	0.0061	2.7197	70.36	43.99
11:42:19	2.7250	1913.39	108	1918	393	22.68	8.86	6.89	47.93	218.83	0.0053	2.7250	13.26	43.86
11:42:34	2.7292	1913.61	108	1966	394	22.31	9.19	7.87	58.36	218.83	0.0042	2.7292	72.00	43.17
11:42:56	2.7353	1913.85	112	1892	405	22.82	8.69	7.97	41.15	219.15	0.0061	2.7353	56.00	43.95
11:43:08	2.7386	1914.11	112	1976	409	22.01	8.48	8.66	75.44	219.44	0.0033	2.7386	67.00	43.75
11:43:33	2.7456	1914.35	112	1702	407	25.62	6.03	8.41	36.15	219.63	0.0069	2.7456	25.62	43.24
11:44:03	2.7539	1914.55	113	1626	410	26.10	5.58	7.79	22.18	219.83	0.0083	2.7539	32.40	43.75
11:44:30	2.7614	1914.80	110	1667	399	25.85	5.81	7.11	33.75	220.15	0.0075	2.7614	32.00	43.14
11:45:00	2.7697	1914.97	112	1643	409	25.30	6.33	6.64	20.28	220.29	0.0083	2.7697	19.20	42.76
11:45:24	2.7764	1915.23	112	1642	408	25.25	6.37	6.03	37.59	220.52	0.0067	2.7764	34.50	42.41
11:45:52	2.7842	1915.47	112	1658	409	25.62	6.03	6.02	32.66	220.76	0.0078	2.7842	30.86	42.03
11:46:22	2.7925	1915.61	114	1641	415	28.57	6.00	6.51	17.75	221.05	0.0083	2.7925	34.80	41.58
11:46:47	2.7994	1915.87	112	1660	407	24.36	7.22	6.79	36.20	221.13	0.0069	2.7994	11.52	41.32

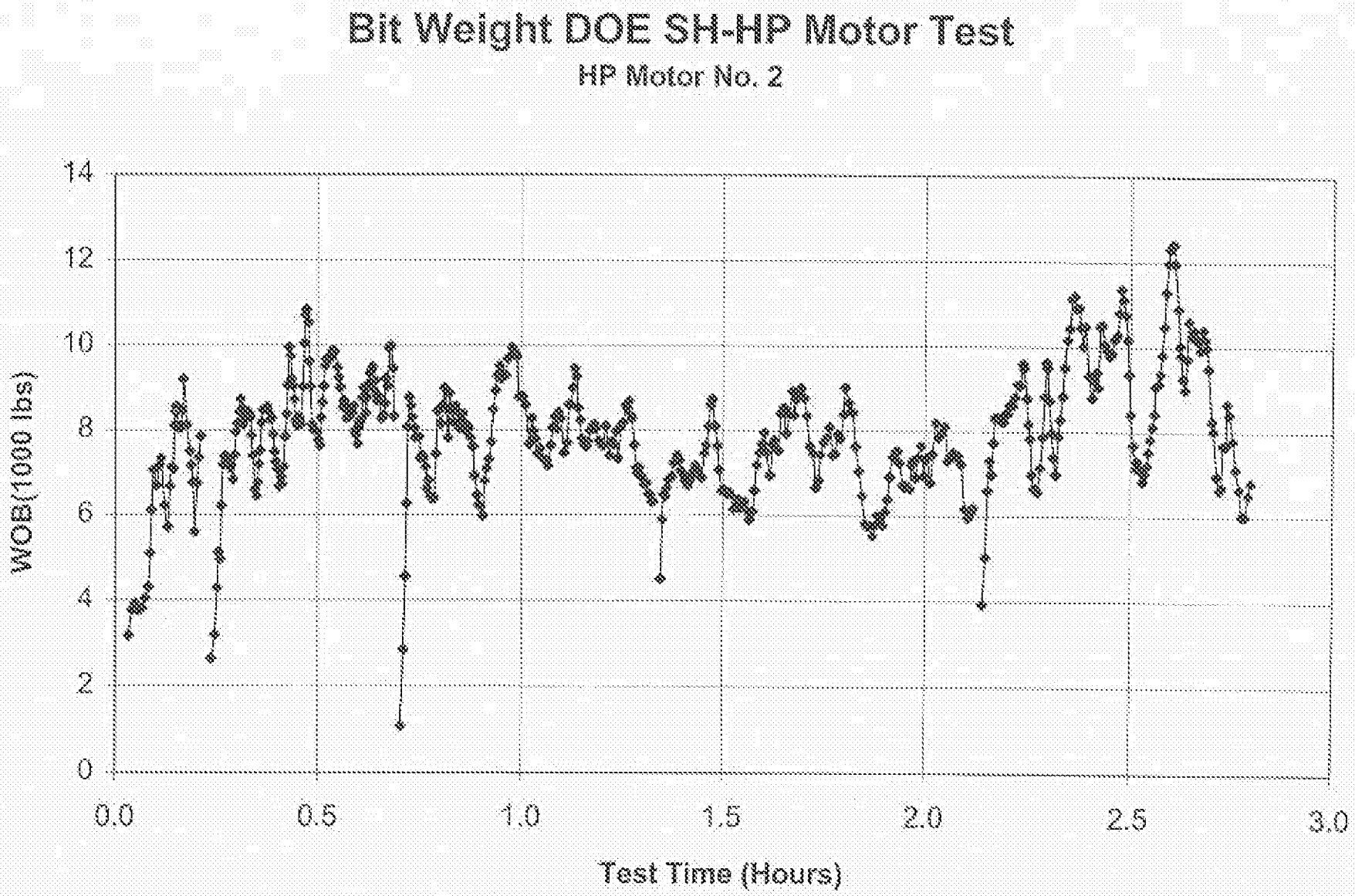
Bit Depth DOE HP Motor Test

HP Motor No. 2



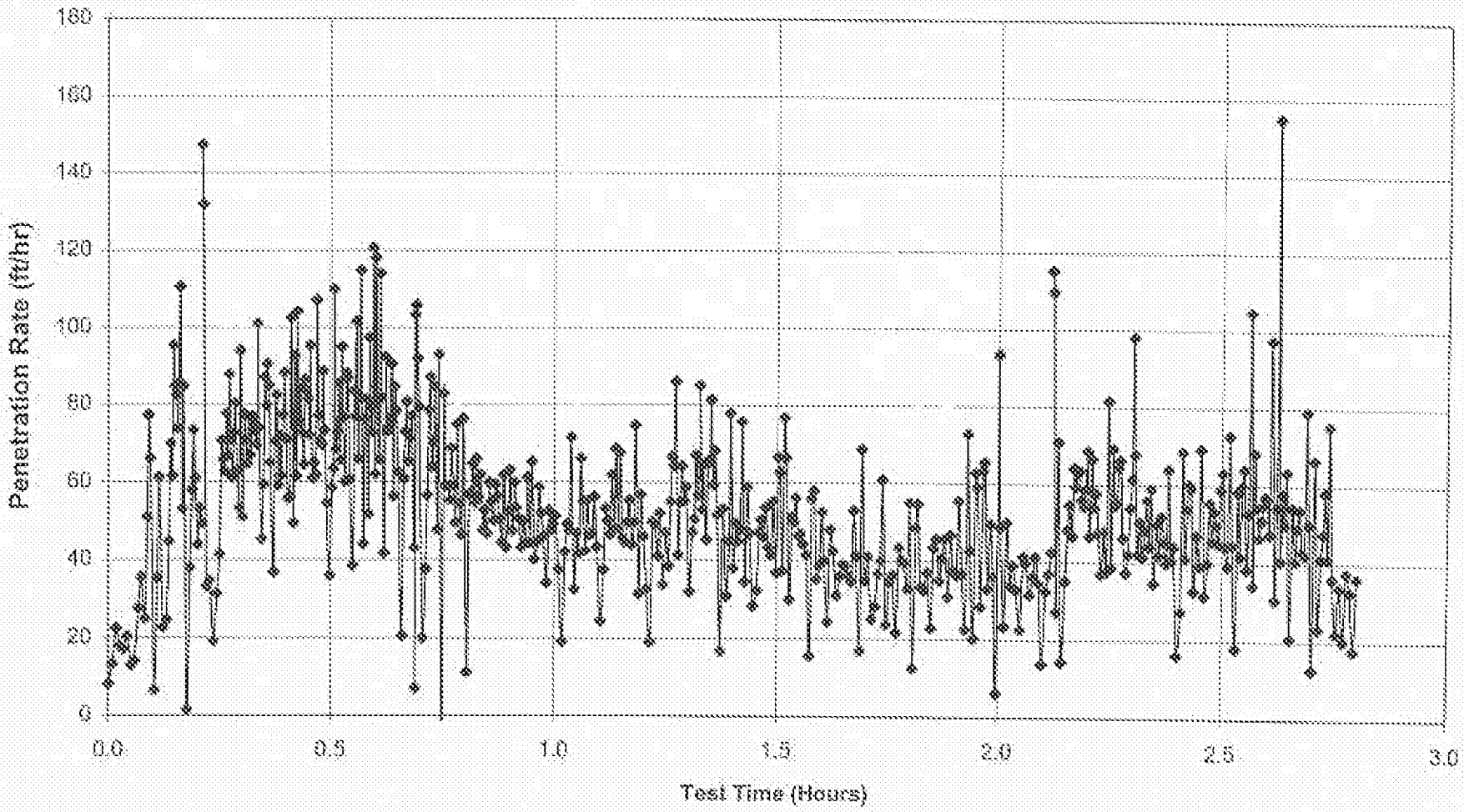

Flow Rate DOE SH-HP Motor Test
Hp Motor No. 2
140
120
100
80
60
40
20
0
Flow (gpm)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Test Time (Hours)

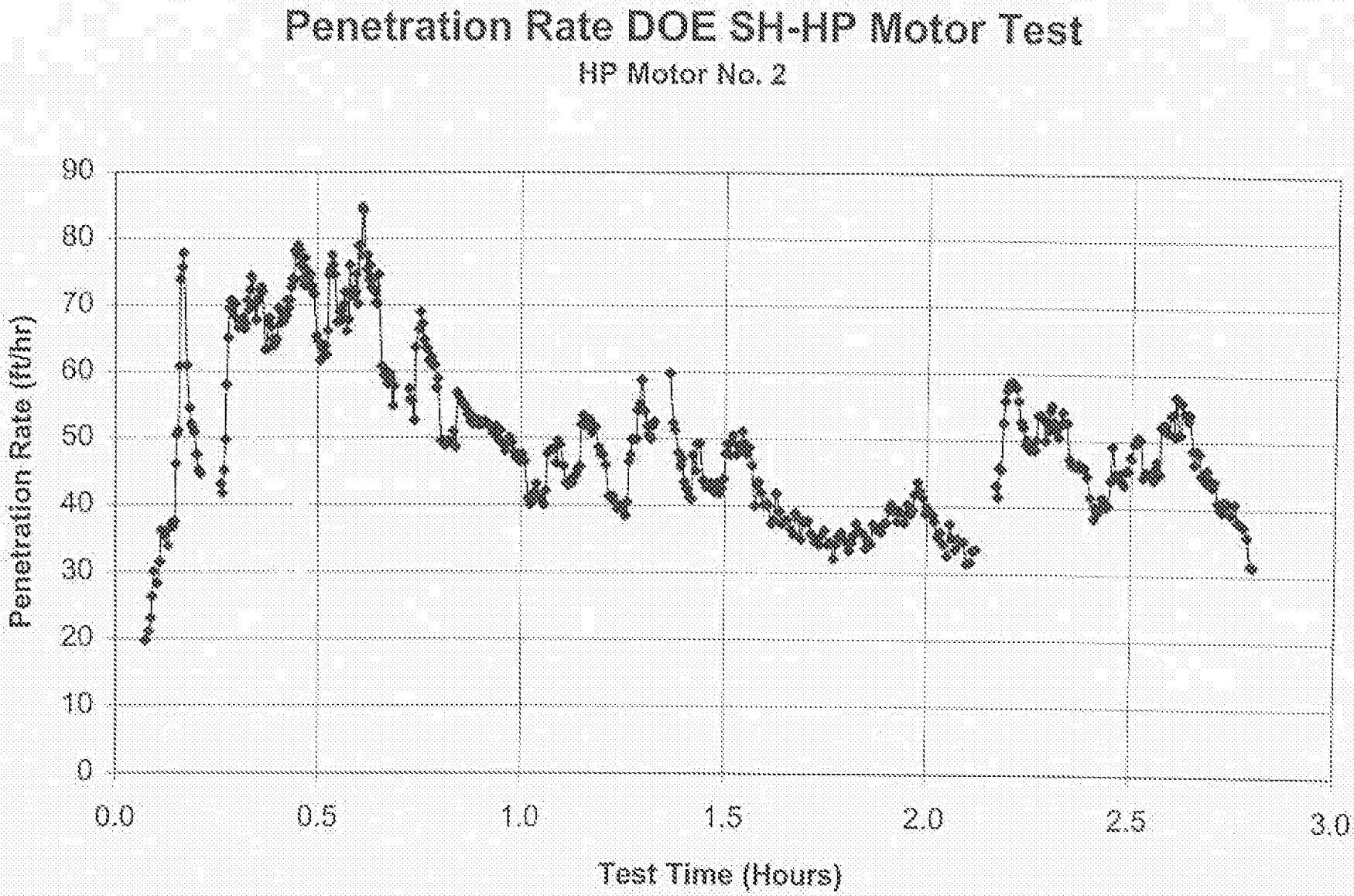

Stand Pipe Pressure DOE SH-HP Motor Test
HP Motor No. 2
Stand Pipe Pressure (psi)
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Test Time (Hours)


Bit Weight DOE SH-HP Motor Test
HP Motor No. 2
WOB(1000 lbs)
14
12
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Test Time (Hours)

Penetration Rate DOE HP Motor Test

HP Motor No. 2




Penetration Rate DOE SH-HP Motor Test
HP Motor No. 2
Penetration Rate (ft/hr)
90
80
70
60
50
40
30
20
10
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Test Time (Hours)

ROP As A Function Of Bit Weight

DOE HP Motor No. 2