

Development and Manufacture of Cost Effective Composite Drill Pipe

2006 Annual Technical Progress Report

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1.0 DISCLAIMER

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2.0 ABSTRACT

This technical report presents the engineering research, process development and data accomplishments that have transpired to date in support of the development of Cost Effective Composite Drill Pipe (CDP). The report presents progress made from October 1, 2005 through September 30, 2006 and contains the following discussions:

- Qualification Testing
- Prototype Development and Testing of “Smart Design” Configuration
- Field Test Demonstration
- Development of Ultra-Short Radius Composite Drill Pipe (USR-CDP)
- Development of Smart USR-CDP

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4.0 LIST OF GRAPHICAL MATERIALS

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5.0 INTRODUCTION

This writing assumes the reader has prior knowledge of this contract and the progress, development issues and technical hurdles within this program. To learn more of the history and detail of prior work and efforts it is recommended that reader refer to prior year annual reports (40262R5, 40262R10, 40262R15, 40262R20, 4026R25, 40262R30).

The objective of this contract is to develop and demonstrate “cost effective” Composite Drill Pipe. It is projected that this drill pipe will weigh less than half of its steel counter part. The resultant weight reduction will provide enabling technology that will increase the lateral distance that can be reached from an offshore drilling platform and the depth of water in which drilling and production operations can be carried out. Further, composite drill pipe has the capability to carry real time signal and power transmission within the pipe walls. CDP can also accommodate

much shorter drilling radius than is possible with metal drill pipe. As secondary benefits, the lighter weight drill pipe can increase the storage capability of floating off shore drilling platforms and provide substantial operational cost savings.

This co-operative agreement was awarded September 30, 1999 and has been amended sixteen times. Amendment A016 has an end date of November 30, 2007. The original contract consisted of ten major tasks of which eight have been substantially completed. Two additional tasks were added to include the development and field demonstration of Short Radius CDP because of early development successes and at the request of industry. The SR-CDP development is completed and the product was made commercially available in 2004. Amendment A008 was awarded September 30, 2003 to include the development of a “Smart” feature and to complete mechanical qualification testing of the ER/DW CDP. Work is ongoing to characterize the mechanical properties of the pipe and reduce to practice the Smart feature (direct electrical connection through the pipe wall and across the tool joints). Amendment A015 added Task 13 to design and construct “Smart” SR-CDP, build 1000 ft. of pipe and conduct field demonstrations of the “Smart” system.

6.0 EXECUTIVE SUMMARY

Design and analysis remains a continuous effort throughout this DOE contract and is an integral part of all ongoing CDP manufacturing operations. Initial work concentrated on specifying the requirements for a “typical” drill pipe which when converted to the capabilities of composites would enable extended reach and deep(er) water drilling. These requirements have continually been refined during this program and are updated as experience with the use and manufacture of CDP is obtained. The goal remains to further extend the reach for horizontal drilling and enable drilling into even deeper water.

The original design of the ER/DW-CDP was based on Toray T700 carbon fiber and Shell 9470/9405 epoxy resin. Shell sold the resin division to Resolution Performance Products who in turn discontinued manufacturing this particular resin system. This resin system became unavailable early in 2004. ACPT investigated alternative systems and settled on a high-temperature epoxy system manufactured by Bakelite.

During this same period, the Toray T700 carbon fiber became increasingly more difficult to acquire as the market demand for all carbon fibers exceeded the capacity to produce it. The carbon fiber market is currently experiencing shortages and the carbon fiber manufacturers are forecasting the shortage to last for two years before increased capacity comes on-line. ACPT has substituted fibers from Zoltek (Panex 35) to continue research and development of the CDP. However, the Panex 35 properties vary from the T700 properties. More specifically, the tensile strength of Panex 35 is approximately 10% less than T700. This translates to 10% less tension load capability in the CDP.

Tests were planned and conducted to characterize the mechanical and fatigue properties of the CDP. The elevated temperature tests of tension, compression and torque all failed due to mishandling by the laboratory conducting the tests. An Amendment request was made for additional funding to continue the testing, but was not awarded until September 21, 2006. Consequently, no progress has been made on this testing. This amendment request also included a request to field demonstrate the “Smart” pipe using the smaller diameter SR-CDP because of

the reduced cost. This was awarded June 23, 2006 and work is underway designing the Smart components for the SR-CDP and planning the field tests.

7.0 EXPERIMENTAL

7.1. Task 1 Mechanical Requirements

Task 1 is substantially complete. Defining the mechanical requirements for CDP has been and continues to be an on going effort. The mechanical specifications currently in use for design and manufacture of CDP are as follows:

7.1.1. Extended Reach/Deep Water Product Data

7.1.1.1. Mechanical Specifications

| | | |
|-------------------------|-------|-----------------------------------|
| Bending Stiffness | EI | $180 \times 10^6 \text{ lb-in}^2$ |
| Torsional Stiffness | GJ | $115 \times 10^6 \text{ lb-in}^2$ |
| Axial Stiffness | EA | $33.4 \times 10^6 \text{ lb}$ |
| Rated Tension Load | P | 450,000 lbs |
| Rated Torsion Load | T | 25,000 ft-lb |
| Rated Compression Load | P_c | 250,000 lbs |
| Rated Internal Pressure | P_i | 9,500 psi |
| Max Service Temperature | F | 350°F |

7.1.1.2. Physical Specifications

| | | |
|-----------------------|----|------------------|
| Tube Inside Diameter | ID | 5 in |
| Tube Outside Diameter | OD | 6 in |
| Length (Pin-to-Box) | L | 360 in (30 ft) |
| Centralizers | | 5 equally spaced |
| Weight | LB | 375 lbs |

7.1.1.3. Connection Specifications

| | | |
|------------------|----|------------------------|
| Pin/Box Diameter | OD | 7 in |
| Bore | ID | 5 in |
| Thread | IF | NC 56 or Customer Spec |

7.1.2. Short Radius Product Data

7.1.2.1. Mechanical Specifications

| | | |
|-------------------------|-------|-------------------------------------|
| Bending Stiffness | EI | $7.22 \times 10^6 \text{ lb-in}^2$ |
| Torsional Stiffness | GJ | $11.30 \times 10^6 \text{ lb-in}^2$ |
| Axial Stiffness | AE | $14.30 \times 10^6 \text{ lb}$ |
| Rated Tension Load | P | 25,000 lbs |
| Rated Torsion Load | T | 2,000 ft-lb |
| Rated Compression Load | P_c | 50,000 lbs |
| Rated Internal Pressure | P_i | 1,000 psi |
| Max Service Temperature | F | 350°F |

7.1.2.2. Physical Specifications

| | | |
|-----------------------|----|------------------|
| Pipe Inside Diameter | ID | 1 5/8 in |
| Pipe Outside Diameter | OD | 2 1/2 in |
| Length (Pin-to-Box) | | 360 in (30 ft) |
| Centralizers | | 5 equally spaced |
| Weight | | 92 lbs |

7.1.2.3. Connection Specifications

| | | |
|------------------|----|-----------------------|
| Pin/Box Diameter | OD | 3 3/8 in |
| Bore | ID | 1 5/8 in |
| Thread | IF | NC26 or customer spec |

7.1.2.4. Materials of Construction

| | |
|--------------------------|---|
| Pipe body | Filament wound E-glass/Graphite/Epoxy |
| Std Tool Joints | 4140HT steel |
| Non-magnetic Tool Joints | Stainless steel, Monel or customer spec |
| Wear Knots | Nitrile |

7.1.2.5. Availability

Price and delivery is quoted upon request. Length and diameter can be scaled to customer requirements. Mechanical properties can be customized to suit application.

7.2. Task 2 – Electrical and Magnetic Specifications

Task 2 has been completed.

7.3. Task 3 Physical Requirements

This work is complete and the results are included in Section 7.1. This is also an ongoing effort and the physical requirements will be updated as more actual drilling experience is obtained and as longer reach, deeper water capabilities are defined.

7.4. Task 4 Progress Report

Task 4 is completed. A first year report was presented at NETL in Morgantown on 8/31/01.

7.5. Task 5 Laboratory Testing

Laboratory testing is essentially complete. Task 5 included:

1. Screening and verification of mechanical properties of resins, fibers, and adhesives for design and fabrication of CDP.
2. Temperature and Environmental Resistance of all material to be used in the CDP.
3. Measurement of Erosion and Mechanical Abrasion characteristics of interior and exterior coatings for CDP.
4. Future work will be conducted in these areas to evaluate possible improvements for the CDP as currently designed.

7.6. Task 6 “Field Testing”

7.6.1. Field Testing of 1-5/8” CDP

This task has been completed.

7.6.2. Field Testing of 5” CDP

The planned field testing of ER/DW CDP is now an optional add-on to the program depending on the outcome of Task 12 Qualification Testing of Smart ER/DW CDP.

7.7. Task 7 Second Year Technical Reporting

An oral presentation of the accomplishments of this program was made at the NETL/DOE facilities in Morgantown, WV on 8/20/01. The report has been filed with DOE/NETL AAD Document Control. Task 7 is complete.

7.8. Task 8 Test Samples and Preliminary Drill Pipe Sections

This is ongoing as test specimens are continuing to be produced in support of tasks 10, 11 and 12.

7.9. Task 9: Pilot Plant Production

All Pilot Plant production will be performed at ACPT. The existing facilities have modified to accommodate Task 9.

7.10. Task 10: Design and Develop Wire through Wall of ER/DW CDP

This task is essentially complete. The process of embedding a twisted pair or other conductor in the wall of the pipe body has been demonstrated and reduced to practice. There is a maximum conductor size that will work with the composite laminate and the tool joint size. This becomes a variable for the different geometric configurations of pipe size and tool joint selection. Pipe design will vary depending on conductor size required for the application.

7.11. Task 11: Design Direct Electrical Connection Field Prototype for ER/DW CDP

The bayonet-style design of the electrical connector is shown in **Figure 1**. As described above, a bayonet is used to complete the electrical circuit when fluid pressure is increased after the drill pipe is made up and run in the hole. A spring holds the bayonet retracted until minimum drill pipe pressure is exceeded, after which the bayonet extends outward and pierces the insulating elastomer coating on the circular contact ring and completes the electrical connection.

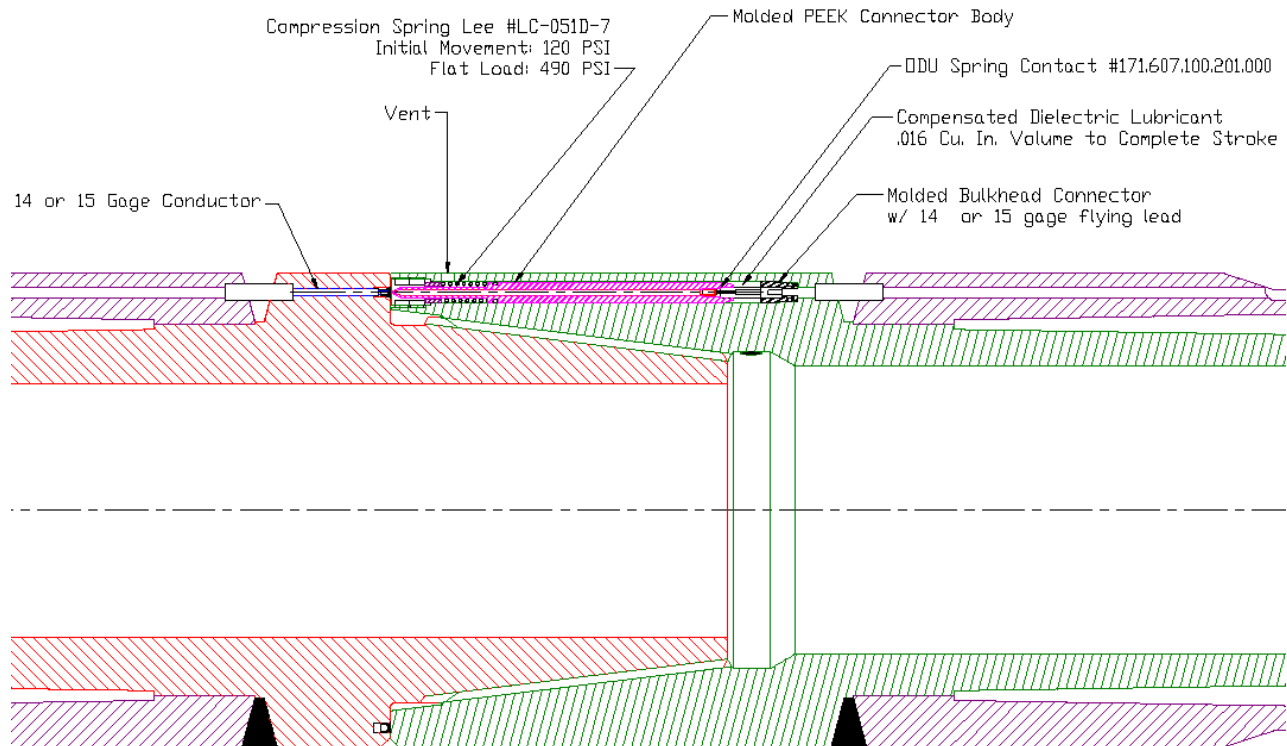


Figure 1 Design of Bayonet-Style Contact Assembly

The bayonet is coated with a high-durometer urethane for insulation from the tool joint body. A spring contactor is used to complete the circuit between the bayonet and the sealed feed through connector that is in turn connected to the 15 AWG conductor wire. The conductor wire passes through a portal machined along the length of the tool joint and terminates in the area where the composite pipe attaches to the tool joint components.

Use of a spring contactor allows axial movement between the bayonet and the feed-through bulkhead connector without full disengagement of the contactor. In this way, continuity is maintained during the stroke and retraction of the bayonet. All moving components are sealed in a pressure-balanced, oil-filled chamber. The oil is nonconductive. Pressure communication to the pipe bore is achieved through a floating piston mounted on a sealed plug and threaded into the tool joint body. As pressure increases in the pipe bore, it acts on the floating piston, which transfers the pressure to the seal bayonet. This causes a differential across the bayonet seal and forces the bayonet forward so that it pierces the insulating elastomer coating on the circular contact ring mounted in the pin joint of the connection.

The bayonet/circular contact ring has been successfully implemented and tested in 3 segments of composite drill pipe. The electrical connections showed unbroken electrical continuity and clean signals when energized with standpipe pressures slightly above 200 psig. The design modifications will now be finalized as they proved to be successful.

A total of 30 electrical cycles were made. These cycles consisted of turning power on with flow, holding the flow and pressure at which electrical contact is made for a period of 5 minutes followed by shutting electrical power off by either completely stopping fluid flow or reducing the flow rate to a level where the standpipe pressure falls below 200 psig. All tests were successful with no signs of leaks or any damage evident to the electrical contacts (bayonet and circular ring elements). During the break in cycle the standpipe pressure required to make electrical contact ranged from 200 to 262 psig. Break in was accomplished in 15 cycles after which it consistently required from 200 to 204 psig to make electrical connection between the bayonets and the contact rings. It is believed that the pressure differences before and after break in were due to seating in of the sealing elements. The next activity is to pursue the ring/ring direct electrical connection.

The basic dual-ring design for the electrical connection for CDP is shown in **Figure 2**. The dual-ring design features no moving parts (preferred), not does it require pressure to activated a connection, the electrical connection is live all the time. Each component of the tool joint is modified to accept an insulated contact ring in the face of the tool joint. Each ring is attached to a conductor, which is passed through a portal machined in the wall of the tool joint. This portal terminates where the composite pipe attaches to the metal tool joint components. The insulated contact ring on the pin connection is machined to provide a pilot on the face. Thin O-rings are placed on both the inside and outside diameter of the pilot. The O-rings will mate with the flat face surface of the corresponding contact ring in the box connection of the tool joint. The purpose of the O-rings is to prevent any conductive material, such as copper-filled pipe dope, from contacting the mating surfaces of the contact rings.

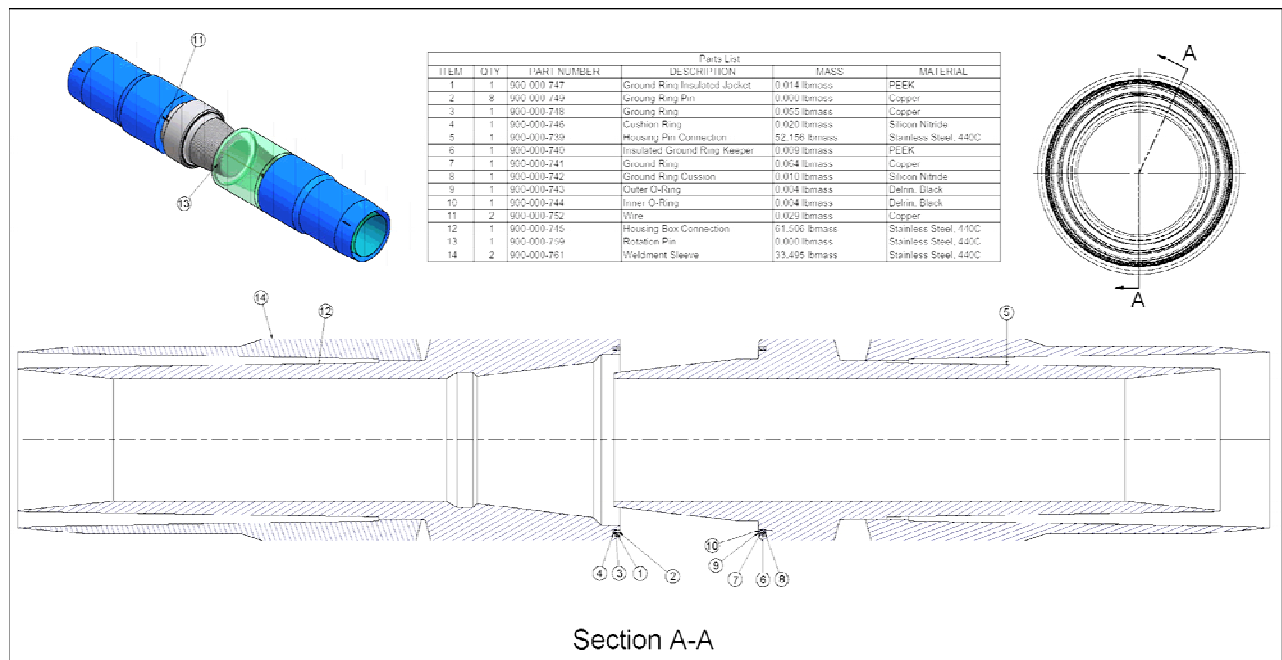


Figure 2 Dual-Ring Electrical Connection for CDP

As the tool joint is made up, the O-rings make contact with the flat face conductor ring in the box connection slightly before the pilot face makes contact with the corresponding flat-faced contact ring. Two aluminum fixture plates are under construction, which will allow testing of this concept without modification to any existing tool joint samples. All components are under construction and were made available in December 2005.

After successful bench testing, three sets of tool joints were made and delivered to ACPT to assemble with composite pipe. This work was completed in September 2006 and flow testing is currently underway.

7.12. Task 12: Qualification Testing of Smart ER/DW CDP

7.12.1. Background to Qualification Testing

ACPT contracted with Stress Engineering Services (SES) in Houston to conduct a battery of tests in accordance with the approved test plan. During the execution of the testing, it became apparent that SES was not capable of controlling proper test parameters and therefore several test results were invalid and the test specimens were destroyed. Final analysis and inspection of the tested pipe and test data concludes that the pipe was subjected to temperatures well above its glass transition temperature of 378F. ACPT has formally terminated the purchase order with SES for any remaining testing. The original contract amount was \$123,427. SES demanded \$80,117 in cancellation charges. ACPT offered to settle for \$48,640 and SES accepted. Approximately \$70,000 in test specimens was destroyed along with \$110,000 of lost program management and engineering hours. ACPT considers the settlement with Stress Engineering Services to be prudent because the only recourse for further recovery is litigation.

7.12.2. Status of Qualification Testing

Qualification testing consists of two primary categories, static and dynamic. Static tests are for mechanical property characterization and consist of tension, compression, torque and pressure. Dynamic tests characterize fatigue endurance limits and compatibility with drilling equipment. These tests consist of bending and tension cycles to failure along with blow-out-prevention (BOP) shear and seal.

Three successful tensile tests on the current design were conducted on specimens made with Toray T700 carbon fiber. Toray fiber became unavailable in 2004 (due to worldwide shortage in the industry) and Amendment A011 was awarded to characterize additional fibers and resins used for the CDP. Zoltek Panex 35 carbon fiber was substituted and progress to date has resulted in one tensile test and one torque test. This lack of progress is mainly attributed to the problems associated with SES.

The Zoltek fiber has a tensile strength 10-15% less than the Toray fiber. The one acceptable tensile test completed by SES confirms this reduction in tensile capacity as the pipe failed at 493,000 lbs, which is about 15% less than the Toray fiber results of 598,000 lbs. Two additional tensile tests are required to complete this mechanical characterization item. SES completed one torque test on the Zoltek specimens. These results were unexpectedly low.

All elevated temperature test results were well below expected values. This is an indication that the epoxy resin is unsuitable for hot/wet environments where the temperature exceeds 250F. Based on these results we are not recommending additional testing at elevated temperatures. In addition, we are not recommending completing the dynamic tests until a suitable resin system becomes available.

As a result of the SES termination, the qualification test plan requires additional resources. Listed below is a tabulation of the remaining tests that will be conducted. Completion of these tests will finish the mechanical characterization of the pipe.

| Static Tests | Test Laboratory | Quantity |
|---------------------------------|-----------------|----------|
| Destructive Tensile/Ambient | TMT | 2 |
| Destructive Compression/Ambient | TMT | 3 |
| Destructive Torsional/Ambient | TMT | 3 |
| Destructive Burst/Ambient | Wyle | 3 |
| Destructive Collapse/Ambient | Wyle | 3 |
| Total | | 14 |

7.13. Task 13: Field Test Demonstration of Smart Short Radius Composite Drill Pipe

ACPT shall perform a field test demonstration of the smart short radius composite drill pipe. ACPT shall submit to the COR a Field Test Plan and required information for the National Environmental Policy Act (NEPA) no later than thirty days prior to initiating any field testing. ACPT shall not proceed with field testing until the NEPA review and approval process has been completed. The following subtasks shall be completed as part of this task:

7.13.1. Design, Fabricate and Test Ultra-Short Radius 2-1/2 Inch CDP

ACPT shall design and fabricate a 2-1/2 inch pipe capable of operating continuously at 10 meter radius for one million cycles. This composite pipe body will be adapted for use with the Smart system of wire-through-wall and dual ring connector tool joints for a field demonstration. Up to 8 test specimens will be manufactured and tested for fatigue resistance. A suitable test fixture will be designed and constructed to operate the pipe at a 10 meter radius until failure while recording completed cycles. Iterative design improvements will be made as necessary to produce a working design.

7.13.2. Design, Fabricate and Test Dual-Ring Direct Electrical Connection for 2-1/2 Inch CDP

The development team will produce detailed engineering designs of the dual-ring contacts for the NC26 tool joint. In addition, calculations will be made defining the impact of the machining operations made to the pin and box shoulders to accept the contacts with respect to the mechanical integrity of the tool joint. Following completion of these activities, the approved drawings will be released to manufacturing to create a mold and produce a limited number of test pieces. The test pieces will be

installed into the NC26 tool joints and tested for performance and reliability. Iterative design improvements will be made as necessary to produce a working design.

7.13.3. Optimize Fabrication and Assembly of 2-1/2 Inch Smart Composite Drill Pipe

A limited number of 10 ft. pup joints shall be made to work out the preferred means of assembling the smart composite drill pipe in terms of the quality of manufacture, the time for manufacture and the costs to manufacture. The goal is to apply the “lessons learned” from this process to optimize the fabrication of the full-length pipe sections as well as provide the information necessary to model the economics of the smart composite drill pipe against conventional metallic drill pipe.

7.13.4. Fabricate 1080 ft. of 2-1/2 Inch Smart Composite Drill Pipe (30 ft. Segments)

ACPT shall construct 36 sections of 2-1/2 inch diameter smart composite drill pipe. Each completed pipe section will be individually serialized and subjected to a variety of quantitative quality checks prior to its release to field operations.

7.13.5. Design and Fabricate Test Subs for Supporting Field Tests

ACPT shall design and fabricate test subs to be placed immediately above the topmost smart composite drill pipe section to supply DC power down the composite drill pipe and below the bottommost smart composite drill pipe to take the power from the smart composite drill pipe and deliver to the electrical load consisting of the third party MWD directional/gamma/mud pulsator. The top sub shall consist of a beryllium copper pressure barrel that is connected to a NC26 pin. The bottom sub shall be capable of connecting to a wire-line that will be used to bridge from the lower section of smart composite drill pipe across the heavy weight drill pipe and/or collars stacked to provide the required range of weight of bit to the directional BHA. The wet connect will be fishable and retrievable. The finished subs will be fully validated via lab testing prior to running in the hole and employ state-of-the-art components and best practices to assure their performance and reliability.

7.13.6. Conduct Full Scale Flow Tests of the Smart Composite Drill Pipe and BHA Components

ACPT shall assemble the top sub, 1080 ft. section of composite drill pipe, bottom sub, 30 ft. section of drill collar and the directional bottom-hole assembly along the surface of the ground. The “drill string” will then be supplied electrical power via the lithium battery pack and fluid flow from a triplex mud pump so a “stem to stern” test of the electrical power supply and mud-pulse telemetry system can be obtained. The assembled section will then be shortened in 100 ft. increments upon stage disassembly to provide a plot of the DC resistance/AC impedance and current draw expected as sections of SCDP are added in the field.

7.13.7. Prepare Field Test Plans

ACPT shall prepare detailed test plans for the field tests. The written plan shall be submitted to the DOE COR for review and comment prior to commencing the actual drilling program. The plan shall contain the following elements:

- Definition of the drill string components and BHA including fishing diagrams, placement of jars, size and number of collars, etc.
- Drill Bit program
- Identification of vendors for rental equipment
- Definition of the mud program
- Well plan trajectory with KOP, BUR, anti-collision analysis, etc.
- Planned short trips, contingencies
- Daily report formats and data collection requirements
- End of Well Report
- On-Site Personnel and Definition of Responsibilities
- Rig Floor Procedures for SCDP handling and Testing
- HSE review

7.13.8. Conduct Field Tests at RMOTC

ACPT shall task evaluate the performance and reliability of the 2-1/2 inch smart composite drill pipe by using it to drill a directional well at the RMOTC test site. The well plan shall be designed to maximize the amount of drilled footage, which can be achieved before the lease line/basement rock boundaries are encountered. ACPT shall prepare formal daily reports and submit them on-line to ACPT and DOE daily in addition to IADC reporting requirements. An EOW report will also be submitted. The specific well plan shall be based on the specific well DOE makes available for this application.

7.13.9. Refine Dual-Ring Design for Commercialization

ACPT shall evaluate the test results from the drilling program along with a detailed inspection report for each stand of serialized smart short radius composite drill pipe conducted upon return of the drill string to ACPT. The information collected from these activities will be used to modify the design of the smart drill pipe to improve any aspects, which are not found to exhibit the desired levels of performance or reliability. The changes will be validated by building a limited number of test pieces incorporating the desired modifications and subjecting them to HALT (highly accelerated life testing) evaluation to provide a high level of confidence and acceptance of the design.

7.13.10. Reports, Schedules and Milestones

ACPT shall maintain effective liaison with the Department of Energy through written reports, technical presentations and verbal communications over the duration of the field test demonstration.

7.14. Task 14: Final Report

A final report will be prepared in accordance with contract requirements.

8.0 RESULTS AND DISCUSSION

8.1. Direct Electrical Connection for Rotary Shoulder Tool Joints

Following the completed design of the bayonet ring design, ACPT completed the fabrication of three prototype pipe assemblies. Maurer Technology successfully completed the laboratory testing of the pipe with providing DC electrical power and AC data communication through the pipe.

8.1.1. Design Direct Electrical Connection for 5½-in. CDP

Two basic designs for the direct electrical connection have been developed during the period and are now being manufactured. These are a 1) dual-ring design and 2) ring/bayonet design. The ring/ring design was completed and three test joints were sent to Maurer in September 2006. Testing is currently underway. Initial results are positive.

8.1.2. Work Planned for Next Period

The next goal is to complete the dual ring design, have the components made and produce 1080 ft of USR-CDP for field demonstration..

8.2. Mechanical Testing of ER/DW-CDP

ACPT contracted with Stress Engineering Services (SES) in Houston to conduct a battery of tests in accordance with the approved test plan. Final analysis and inspection of the tested pipe and test data concludes that the pipe was subjected to temperatures well above its glass transition temperature of 378F. ACPT has formally terminated the purchase order with SES for any remaining testing. Amendment A015 was awarded, in part, to complete the remaining ambient temperature tests to characterize the CDP. See section 7.12 for further explanation.

Commercial Orders for SR-CDP

ACPT has received an order from Torch International for 2000 ft of SR-CDP. The CDP was utilized for ultra-short radius drilling for Petroleum Development of Oman (PDO). There were several field failures of the pipe, this lead to the USR-CDP development. The USR-CDP is currently being tested in Oman by Torch.

15 joints of SR-CDP were sold to Maverick Energy for re-entering wells in west Texas. All reports have been positive.

9.0 CONCLUSION

ACPT will begin to market the USR CDP after testing is completed. We do expect to begin selling more USR-CDP in the near future.

ACPT and Noble Downhole Technology have embarked on a development effort to demonstrate the practicality of a direct electrical contact, data/power, through wall transmission design intended to make the pipe “Smart”. Future efforts will be focused on constructing prototypes and testing the connections.

Directional Technologies has embarked on designing the USR-CDP “Smart” pipe system. The design will be finalized in January 2007 with a scheduled field demonstration to be completed by November 2007.

10.0 REFERENCES

1. Leslie, Dr. J.C.; Jean, J ; Truong, L ; Neubert, H ; and Leslie, J.C. II; 2000 Annual Technical Progress Report “Cost Effective Composite Drill Pipe; DOE/NETL Report No. 40262R05; 10/30/2000
2. Leslie, Dr. J.C.; Jean, J ; Truong, L ; Neubert, H ; 2001 Annual Technical Progress Report “Cost Effective Composite Drill Pipe”; DOE/NETL Report No. 40262R10; 10/30/2001
3. Leslie, Dr. J.C., Composite Drill Pipe for Extended-Reach and Deep Water Applications, Paper #14266, Offshore Technology Conference, Houston, Texas, May 2002
4. Leslie, Dr. J.C., Composite Drill Pipe an Enabling Technology for Extended Reach and Deep Water Drilling, Gas Technology Institute’s First Conference and Exhibition on Natural Gas Technologies, Orlando, Florida, October 2002.
5. Leslie, Dr. J.C.; Jean, J.R., Heard, J.T.; Truong, L ; Neubert, H ; 2002 Annual Technical Progress Report “Cost Effective Composite Drill Pipe; DOE/NETL Report No. 40262R15; 9/20/2002
6. Leslie, Dr. J.C., Developing a Cost Effective Composite Drill Pipe, “Gas Tips”, Hart/IRI Fuels Information Services, Winter 2002, Volume 8, Number 1.
7. Leslie, Dr. J.C. ; Jean, J ; Truong, L ; Neubert, H ; and Leslie, J. II. ; “Cost Effective Composite Drill Pipe: Increased ERD, Lower Cost Deepwater Drilling and Real Time LWD/MWD Communications” ; SPE Paper No. 67764 ; SPE/IADC Conference ; The Netherlands, 2/27-3/1/01.

11.0 List of Acronyms and Abbreviations

ACPT

Advanced Composite Products and Technology, Inc., 1

CDP

Composite Drill Pipe, 3

DOE

U.S. Department of Energy, 6

ER/DW-CDP

Extended Reach/Deep Water-Composite Drill Pipe, 3

SR-CDP

Short Radius-Composite Drill Pipe, 3

USR-CDP

Ultra-Short Radius-Composite Drill Pipe