



McClelland engineers, inc. / geotechnical consultants

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September 1, 1981
P0181-0217

Conoco Inc.
5 Greenway Plaza East
Suite 2704
Houston, Texas

Attention: Mr. Jack Chan

Proposal for Geotechnical Investigation
Platform "A" Conductor Pullout Test Location
Block 58, West Delta Area
Gulf of Mexico

Gentlemen:

In response to your request on August 17, 1981, we are pleased to submit this proposal to perform a geotechnical investigation at the above offshore site. We understand a pullout load test program on a driven conductor is planned adjacent to this platform. The purpose of this proposed program is to aid interpretation of the pullout test to improve foundation design of a tension leg platform (TLP) proposed for deepwater tracts in the Gulf of Mexico. This investigation, if authorized, will be conducted in accordance with Blanket Contract No. H-14-9 dated November 28, 1979 and the fee schedules presented.

Introduction

The primary purpose of this geotechnical investigation will be to explore soil and foundation conditions and to determine the shear strength properties of the soil at this location. A secondary purpose will be to evaluate the effects of sampling technique upon sample disturbance. We understand a preliminary scope has been developed, and the field investigation will be conducted in two phases. The first phase will be performed before the conductor pullout test and will consist only of cone testing. The second phase will be performed concurrently with the pullout test and will consist of a sample boring. We understand the current plan calls for both phases to be conducted off the existing platform.

Although we have presented a cost estimate for the initial phase, we have developed three alternate scopes that deserve your consideration. We have presented alternate scopes to achieve your desired objectives and provide the opportunity to minimize costs.

With the other options, we propose to obtain all shear strength information prior to the conductor pullout test. This approach will: (1) allow a better assessment of sample disturbance, thus allowing a better interpretation of the shear strength to correlate with the skin friction measured during the conductor pullout tests, (2) permit a comparison of sampling techniques and test results used at previous deepwater sites, and (3) be considerably cheaper than conducting two field investigations requiring separate mobilizations. These scopes will use a variety of in-situ testing, sampling, and laboratory techniques that will include cone testing, remote vane testing, and a combination of 2-1/4-in.-diameter percussion sampling and 3-in.-diameter push sampling. The techniques will be similar to those successfully used on the recent deepwater boring performed off the Zapata Concord located in Green Canyon 137 and currently being mobilized for the Viosca Knoll 864 site.

Field Investigation

The following sections discuss the proposed field programs for four options. Options IA and IIA are designed to operate from the existing platform; Options IB and IIB will use the M/V "R. L. Perkins." Options IA and IIA will obtain cone data only while Option IB and IIB are more extensive programs, including soil sampling and in-situ testing in addition to the cone penetrometer testing.

Option IA. This option will operate from the existing platform and obtain cone data only. We plan to mount a truck-mounted 1500 drilling rig on the platform. Cone penetrometer testing will be performed continuously to 250-ft depth using a latch-in cone penetrometer from our "Stingray" system. The "Stingray" system has proven to be a useful tool in the North Sea, Mediterranean Sea, and offshore Africa, for cone penetrometer tests to substantial penetrations. The cone will be advanced using the rig's hydraulic pulldown for a 30-in. continuous push. Current cone technology limits the acquisition of high quality data to soils having shear strengths greater than 200 psf. Previous borings indicate shear strengths of 200 psf will not be encountered until about 10- to 15-ft depth. If you consider it highly desirable to obtain in-situ soil data in the extremely weak sediment above this depth, several alternatives exist that will allow us to acquire this information. However, these alternatives are not proposed at this time. We estimate 3.0 days will be required to complete this option.

Operations from this platform will require considerable support equipment. We understand this platform is no longer in service and doesn't have a crane, electric power, or living quarters. A sizeable crane will be required to properly place equipment on the platform; this will probably require a derrick barge. In addition, we will need electric power, drilling water, welders, and food and lodging for the drilling crews.

Option IB. This option proposes a more detailed investigation than Option IA. The scope consists of cone penetrometer testing, remote vane testing, and soil sampling. This scope of work will require two 250-ft deep borings. The first boring will consist of continuous cone penetrometer testing using the equipment and procedures described in Option IA. The

second boring will be drilled to obtain soil samples and perform remote vane testing. We plan to recover liner samples in soils with strength less than 0.3 ksf. The 3-in.-diameter push sampler will be used at 6-ft intervals from the seafloor to 40-ft penetration and at 10-ft intervals below 40-ft penetration. The 2-1/4-in.-diameter driven samples will be taken at 10-ft intervals below 40-ft penetration. In-situ undrained shear strengths will be measured with the remote vane at 6-ft intervals to 40-ft depth and 10-ft intervals below 40 ft.

We estimate this option will require 5.0 days from the arrival of our crews at Grand Isle to final departure.

Option IIA. The field work with this option consists only of cone penetrometer testing from the deck of the M/V "R. L. Perkins." Cone testing will be performed with our recently developed "Swordfish" system. Our "Swordfish" has been successfully tested to 289-ft penetration at your Eugene Island 208, Well No. 9 location. Cone testing will be conducted continuously from about 10- to 250-ft depth. The same cone limitations on testing extremely weak sediments exist for the "Swordfish" system as stated in Option IA.

The M/V "R. L. Perkins" can drill the boring within 100 ft of the platform. This is accomplished by tying the boat stern to the platform and setting the two bow anchors. This operation is self-contained and will not require any support services. We estimate 2.5 days are required to complete the field program for this option.

Option IIB. This option will use the M/V "R. L. Perkins" to perform the scope of work planned for Option IIA; however, the option will include the more detailed investigation planned for Option IB. Thus, the scope consists of cone penetrometer testing, remote vane testing, and soil sampling with two sampling techniques. One boring will consist of continuous cone testing from about 10- to 250-ft depth. A second boring will be drilled to obtain soil samples and perform remote vane testing. Sampling and remote vane testing will follow procedures identified in Option IB.

Both borings will be drilled within 100 ft of the platform, using the platform as part of our anchoring system. We estimate this option will require 4.75 days to complete.

Vessel and Equipment

We propose to perform the soil exploration program for Options IIA and IIB using the M/V "R. L. Perkins," a modified oil field supply boat in the 175-ft class, outfitted for geotechnical drilling and capable of operating in water depths between about 18 and 600 ft. The equipment and facilities aboard the vessel will include the following:

- Four-point mooring system with spare anchors, spare cable, and spare engine parts
- Drilling and sampling equipment--skid-mounted, diesel-powered Failing 2000 rotary drilling rig and accessories; motion compensation equipment; complete tools, bits, supplies, and spares to enable drilling, sampling and in-situ testing in soil
- Field Laboratory - facility to examine soil samples and perform unconfined compression and miniature vane tests

Soil sampling and testing capabilities include cone penetration testing, remote vane testing, gamma logging, 2-1/4-in.-diameter percussion sampling, and 3-in.-diameter push sampling. The 3-in. push sampler is a latch-in unit that operates with the Swordfish system and is designed to give high quality samples with only modest disturbance.

Our experienced and qualified drill crews will consist of a supervising engineer, crew leader and two 4-man drill teams, including one soil technician per crew, so that work can proceed continuously on a daily 24-hr basis. Swordfish and Remote Vane operations require an additional engineer and an electronics technician to complement the crew above. Besides directing the drilling, sampling and in-situ testing program, the engineer will coordinate the onboard testing and sample preparation, maintain detailed records, and prepare preliminary field boring logs.

Brochures concerning the M/V "R. L. Perkins," our Remote Vane, and the Swordfish system are enclosed for your information.

Laboratory Programs

If Option IB or IIB are selected, we recommend a limited number of push and driven samples to be tested for strength properties concurrently with the drilling operation. The remainder of the samples will be packaged for transportation to our laboratory in Houston. In addition to the conventional laboratory testing program, an advanced laboratory testing program will be conducted to better evaluate soil conditions at the site and to confirm the effects of sampling technique on sample disturbance.

The conventional laboratory testing program will consist of performing classification tests such as water content and liquid and plastic limit tests and strength tests such as miniature vane, unconfined compression, and unconsolidated-undrained triaxial compression on undisturbed and remolded soil specimens. The advanced testing program will include consolidation tests, simple shear tests, isotropically consolidated-undrained triaxial compression tests with pore pressure measurement that are needed for the SHANSEP (stress history and normalized soil engineering properties) approach to evaluate soil parameters required for design.

Engineering Analysis and Report

A data report summarizing our operations and a log of the cone penetration test results will be presented for Option IA or IIA. We plan a more

extensive analysis if Option IB or IIB are selected since comparisons of all the different types of strength data is highly recommended for this phase of the study. Using data developed during the laboratory and field phases of the study, we will evaluate soil conditions at the site and develop information required to interpret the conductor pullout load test results. All data will be presented in an engineering report.

Basis for Charges and Cost

Charges for the field investigation phase with any of these four options will be in accordance with prices given on Enclosure No. 1. Unit prices for laboratory and field tests are shown on our Schedule 42.01a (Apr 81), included as Enclosure No. 2. Our standard fees and general conditions for engineering and technical services are shown on Schedule 40.01 (Mar 79) as Enclosure 3. We invite your attention to the limitation of liability provided in Para. 2.6 of the latter schedule and to the provision for removing this limitation if you desire.

Cost Estimate

Detailed cost estimates for the various field investigation options are presented on Attachment Nos. 4 through 7. We estimate that our field charges for Option IA and IB will be \$35,800 and \$60,050, respectively. However, these estimates do not include the cost of a derrick barge, support vessel, electric power on the platform, etc. We estimate these additional costs may be \$60,000 to \$70,000 per day, resulting in a total field cost for Options IA and IB of \$230,800 and \$385,050, respectively.

We estimate that the total field charges for Options IIA and IIB will be about \$42,400 and \$84,850, respectively. Thus, a substantial savings is possible by using a vessel that is currently mobilized with the required drilling, sampling, and testing equipment. Any weather delays associated with any of these options are excluded from the charges previously described.

Enclosure No. 8 presents our detailed budget estimates for the laboratory investigation, engineering analysis, and report reproduction. We estimate that Option IA or IIA will cost about \$6,055 while Option IB or IIB will cost about \$29,040. The total cost for all phases of the work using the four options is also presented on Enclosure 8.

We appreciate the opportunity to submit this cost estimate and look forward to working with you on this project. If you have any questions regarding this study, please call us.

Very truly yours,

McCLELLAND ENGINEERS, INC.

Alan G Young
Alan G Young, F.E.
Engineer Manager

JPW/AGY/ps
Encl.

Copies Submitted: (6)

FIELD CHARGES FOR OFFSHORE
FOUNDATION INVESTIGATION
WEST DELTA AREA, BLOCK 58

OPTIONS IA AND IB

1. Mobilization and demobilization
 - 1.1. Option IA - truckmounted equipment, cone penetrometer equipment and two drill crews, in yard \$1,000 lump sum
 - 1.2. Option IB - truckmounted equipment, cone penetrometer, remote vane, latch-in push sampler and 2 drill crews, in yard \$2,000 lump sum
 - 1.3. Travel from Houston to Grand Isle and return \$10/mile
2. Field technical services from arrival dockside to final departure from dockside
 - 2.1. Option IA \$7,400/day
 - 2.2. Option IB \$8,400/day
3. Drilling mud and cement Cost + 15%
4. Third party charges Client or Cost + 15%

OPTIONS IIA AND IIB

1. Field technical services and marine equipment⁽¹⁾;
 - 1.1. Option IIA - drilling vessel and vessel crew⁽²⁾, two drilling crews⁽³⁾, engineers and Swordfish system from time crews arrive dockside to final departure from dockside⁽⁴⁾ ⁽⁵⁾ \$14,200/day
 - 1.2. Option IIB - same as Item 1.1. plus remote vane, and latch-in push sampler \$15,200/day
2. Drilling mud and cement Cost + 15%
3. Fuel and lube Cost + 15%

NOTES:

- (1) Charges for drilling and marine personnel and equipment, Items 1.1. and 1.2., apply to both standby and working periods and will continue during drilling, sampling, special testing, and marine equipment breakdown periods in accordance with the following:
 - (a) The first four hours of each breakdown period are fully chargeable.
 - (b) If any breakdown is not repaired during the first four hours, then the next 48 breakdown hours, cumulative throughout the period of the work, of such breakdown periods in excess of four hours are also fully chargeable.

- (c) If after 48 cumulative breakdown hours in (b) have been exhausted and subsequent breakdowns are associated with:
1. Drilling and sampling equipment used for activities in Item 2.1., no further charges will be made during subsequent breakdown periods, except those indicated in (a).
 2. Special testing and sampling equipment used for activities in Item 2.2., (1) no further charges will be made for the rental and hourly use of the disabled equipment only, (2) reduced rates of \$6,325 per day and \$440 per man-day will be charged for Items 1.1. and 1.2., respectively, and (3) charges for personnel associated with special testing and sampling equipment will be reduced by 20 percent during subsequent breakdown periods, except those indicated in (a).

Charges for auxiliary vessel, surveying, and other third party charges, Item 1.4., will continue during the breakdown period of drilling vessel and equipment.

- (2) Drilling vessel is the M/V "R.L. Perkins", an oilfield supply boat manned by a 6-man crew; pertinent characteristics of the drill vessel and rig are:

Tonnage: 199 gross; 135 net
Dimensions: 185 ft x 38 ft x 14 ft
Deck Space: 120 ft x 31 ft
Berths: 21 persons
Center Well: 24-in.-diameter
Main Engines: Two D-399 Caterpillars, 1500 hp each
Bow Thruster: 400 hp M&T Harbormaster
Generators: Two 75 kw Delco with 6-71 GM
Electronics: Complete navigation and communication systems, including radar, SSB, VHF, and magnetic compass
Mooring: Four point system consisting of two winches, 1-1/4-in. galvanized steel core cables with 9,000-lb bow and 6,000-lb stern anchors; bow anchor lines approximately 4000 ft and stern lines 3000 ft. For drilling in water deeper than about 800 ft, special anchoring arrangements can be made, the additional cost of which to be borne by Client
Drill Rig: Skid-mounted, diesel-powered Failing rig with 3-drum hoist, rotary and mud pump; auxiliary diesel-powered mud mixing pump; 3.5-in. API IF drill pipe, drilling and sampling tools and accessories
Mud System: Four 900-cu ft Smatco bulk tanks below deck; 100-cu ft holding tank on deck, 450-cfm Gardner Denver compressor for mud transfer.

- (3) A standard drilling crew consists of driller, geotechnical technician, two helpers, and an electronics technician.
- (4) Home port for M/V "R.L. Perkins" is Larose, Louisiana. Home base for drill crews is Houston, Texas. Charges for the vessel will begin when it departs Larose and will continue until it either returns to Larose or commences work for another client. A vessel and drilling equipment charge of \$5,450 per day will be made while the vessel is traveling without McClelland personnel. If client directs suspension of operations before an assignment is completed, drilling vessel will return to Larose, Louisiana, and will resume operations at client's request, subject to crew and equipment availability. Alternately, the vessel can be docked at any port directed, and drill crews can be removed; charges will include the vessel and drilling equipment charge of \$5,450 per day, equipment and marine rental rates as applicable under Item I., and round trip crew transportation of \$0.65 per man-mile between Houston and dock point.
- (5) Rate applies for travel time, standby, drilling, and in-situ testing.

For general terms and conditions applicable to all services and for fees related to professional services, see Schedule 40.01 (Enclosure No. 3).

**LABORATORY AND FIELD SOIL TESTING FEES
HOUSTON OFFICE**

Sheet 1 of 4

Test No.

Unit Price
(US Dollars)

1. CLASSIFICATION AND INDEX TESTS

Properties

1.1. Water content or visual classification	\$ 2.75
1.2. Water content and visual classification	\$ 5.00
1.3. Plastic and liquid limits, Casagrande Method	\$ 28.00
1.4. Plastic and liquid limits, fall cone method	\$ 28.00
1.5. Liquidity index	\$ 33.00
1.6. Density	\$ 20.00
1.7. Specific gravity	\$ 50.00

Grain-Size Tests

1.8. Sieve analysis, through #200 sieve	\$ 24.00
1.8.1. Additional sieves finer than #200, each.	\$ 6.00
1.9. Percent passing a single sieve	\$ 13.50
1.10. Hydrometer test	\$ 50.00
1.11. Double hydrometer test	\$100.00

Permeability Tests

1.12. Permeability of sand (constant head)	\$200.00
1.13. Permeability of silt or clay (falling head)	\$250.00

Shrinkage Tests

1.14. Linear (bar) shrinkage	\$ 30.00
1.15. Volumetric shrinkage	\$ 35.00

Organic Content

1.16. Organic content, oven method	\$ 20.00
1.17. Organic content, hydrogen peroxide method	\$ 60.00

Other Tests

1.18. Maximum-minimum densities	\$ 80.00
1.19. Pinhole dispersion	\$200.00
1.20. Slake	\$ 20.00
1.21. Crumb	\$ 20.00
1.22. Solubility in hydrochloric acid	\$ 20.00
1.23. Resistivity	\$ 22.00
1.24. Microscopic examination	\$ 25.00
1.25. Pore water extraction	\$ 30.00
1.26. Ph test (water)	\$ 3.50
1.27. Ph test (soil)	\$ 17.00

Test No.	Unit Price (US Dollars)
1. CLASSIFICATION AND INDEX TESTS (Continued)	
<u>Test Variations</u>	
A. Sample preparation, soil admixtures for Items 1.3. and 1.4.	\$ 30.00
B. Special sample processing and slaking, per sample for Items 1.3., 1.4., 1.8 through 1.10.	\$ 20.00
C. Non-corrosive permeants for Items 1.12. and 1.13.	\$ 30.00
D. Corrosive or reactive pore fluid or test fluid for any test on this schedule	negotiable
E. Microwave moistures for Items 1.3. and 1.4.	\$ 5.00
F. Extrude tube samples and visual classification	\$ 20.00
2. STRENGTH TESTS	
<u>Strength Estimates</u>	
2.1. Hand penetrometer	\$ 2.50
2.2. Torvane	\$ 2.50
2.3. Fall cone	\$ 6.00
<u>Miniature Vane</u>	
2.4. Miniature vane, standard	\$ 13.50
2.5. Miniature vane, cyclic (10 cycles)	\$ 30.00
2.5.1. Additional cycles, each	\$ 4.00
<u>Triaxial Compression</u>	
2.6. Unconfined compression, soil	\$ 22.00
2.7. Unconfined compression rock (including specimen end preparation)	\$ 40.00
2.8. Unconsolidated-undrained (UU or Q)	\$ 28.00
2.9. Consolidated-undrained (CU or Qc), including pore pressure*	\$475.00
2.10. Consolidated-drained (CD or S), sand*	\$200.00
2.11. Consolidated-drained (CD or S), silt or clay*	\$250.00
2.12. Cyclic consolidated-undrained, including pore pressure measurements, to 1000 cycles*	\$550.00
2.12.1. Additional cycles, per 1000 cycles	\$ 50.00
<u>Direct Shear</u>	
2.13. Unconsolidated-undrained (UU or Q)	\$100.00
2.14. Consolidated-undrained (CU or Qc)*	\$250.00
2.15. Consolidated-drained (CD or S)*	\$250.00
2.15.1. Residual (2 cycles)	\$100.00

*Consolidation time readings taken only during one loading increment.

Test No.	Unit Price (US Dollars)
2. STRENGTH TESTS (Continued)	
<u>Simple Shear</u>	
2.16. Consolidated-undrained, constant rate of strain. . .	\$250.00
2.17. Consolidated-undrained, cyclic (3 stress levels) to 1000 cycles	\$500.00
2.17.1. Additional cycles, per 1000 cycles	\$ 50.00
2.17.2. Additional stress levels, each	\$100.00
2.18. Resonant column, consolidated-undrained, including pore pressure measurements (3 consolidation pressures)	\$600.00
2.18.1. Additional consolidation pressures, each. .	\$ 60.00
<u>Test Variations</u>	
G. Multiple-stage tests for Items 2.10. and 2.15. (sand only)	\$200.00
H. Mohr's diagram (for multiple-stage or multi-specimens)	\$ 20.00
I. Consolidated anisotropically	\$150.00
J. Consolidated K ₀	\$200.00
K. Confining pressure over 965 kpa (140 psi for Items 2.8. through 2.12.)	\$ 80.00
L. Special trimming charge for difficult-to-trim soils for Test Items 2.9., 2.11., 2.13 through 2.15.	\$ 70.00
M. Sample preparation: hand-trimmed specimen	\$ 20.00
N. Sample preparation: soil admixtures and curing.	\$ 30.00
O. Sample preparation: compacted specimen.	\$ 35.00
P. Stress-strain diagram, report ready	\$ 18.00
Q. Capping of strength tests for Items 2.6. and 2.8.	\$ 15.00
R. No pore pressure measurements, Item 2.9.	less \$150.00
S. Shearing time over 12 hours, add for each additional 4 hours, for Items 2.9., 2.11., and 2.15.	\$ 20.00
3. VOLUME CHANGE TESTS	
3.1. Consolidation, 7 or less loading increments from 24 to 1532 kpa (0.25 to 16 tsf)	\$250.00
3.1.1. Additional loading increments, each	\$ 30.00
3.1.2. Back pressured test	\$ 75.00
3.2. Constant rate of strain consolidation	\$250.00
3.2.1. Rebound and reload	\$ 60.00
3.3. Swell test, swell pressure and percent swell	\$175.00

Test No.	Unit Price (US Dollars)
4. EARTHWORK TESTS	
4.1. Optimum density and water content	
4.1.1. Standard Proctor	\$ 85.00
4.1.2. Modified Proctor	\$ 90.00
4.1.3. Harvard miniature	\$ 85.00
4.2. California Bearing Ratio (CBR), per specimen	\$125.00
4.3. Lime modification optimum (by using Ph).	\$300.00
4.4. Texas triaxial, per specimen	\$150.00
4.4.1. Compaction curve	\$100.00

Test Variations

T. Sample preparation: soil admixtures and curing. . . . \$ 30.00

5. MISCELLANEOUS

5.1. All tests not listed can be performed at either a quoted unit price or on an hourly basis.

5.2. Photograph of sample \$ 6.00
 5.2.1. Additional copies Cost + 15%

5.3. A charge of \$50.00 per hour is applicable for laboratory computer system use not associated with test procedures or normal plotting of test data.

5.4. A sample storage charge of \$10.00/cubic foot/month for inside storage and \$20.00/cubic foot/month for 100% humidity, controlled-temperature storage, plus handling charges, is applicable for all samples stored beyond 30 days after submission of our final report. (The minimum storage charge is \$100/month.)

Notes: (1) The following are included at no charge: visual classification with all strength and volume change tests except strength estimates, natural water content with miniature vane tests, natural water content and density with all triaxial compression, simple shear, resonant column and volume change tests, and remolding of samples.

(2) Rush assignments requiring unscheduled overtime are subject to a 50% surcharge.

**STANDARD FEES AND GENERAL CONDITIONS FOR
ENGINEERING AND TECHNICAL SERVICES**

1. Professional Services and Fees

- 1.1. Analysis, consultation and report preparation.** Fees for our professional services are based on the time of professional, technical and clerical personnel directly charged to the project. The fee is computed as 2.4 times salary cost for the chargeable time. Salary cost includes base payroll plus 34 percent for employee benefits, payroll taxes, and payroll insurance. A schedule of hourly rates for engineering and technical personnel by classification is available upon request.
- 1.2. Reimbursable expenses.** Expenses other than salary costs that are directly attributable to performance of our professional services are billed as follows:
 - a) for report reproduction by our graphics department, charges equivalent to commercial rates for similar commercial services; schedule available on request
 - b) for transportation in our company automobiles, \$0.25 per mile
 - c) for in-house computer use, rates established for individual systems; information furnished upon request
 - d) for outside computer service use, direct charges allocated to job times 2.5
 - e) for all other expenses, including but not limited to authorized travel, sample shipment, sub-contracts, consulting fees, long distance communications, outside reproduction, and mailing expense, cost plus 15 percent.

2. General Conditions

- 2.1. Payment.** Payment shall be due within 30 days after date of invoice. Interest at the rate of 10% per annum from 30 days after date of invoice to date payment is received will be added to all amounts not paid within 30 days after date of invoice. In the event that any law limiting the amount of interest or other charges permitted to be collected is interpreted so that this charge violates such law for any reason, the interest charge is hereby reduced to the extent necessary to eliminate such violation.
- 2.2. Records.** All pertinent records relating to services performed hereunder shall be retained for two years after completion of work. The Client shall have access to the records at all reasonable times during said period for audit purposes.
- 2.3. Samples.** All samples of soil and rock will be discarded 30 days after submission of our report unless the Client advises us otherwise. Upon request, we will deliver the samples in accordance with Client's instructions, charges collect, or will store them for an agreed charge.
- 2.4. Right-of-entry.** Unless otherwise agreed, Client will furnish right-of entry on the land for us to make the planned borings, surveys, and explorations. We will take reasonable precautions to minimize damage to the land caused by our equipment, but we have not included in our fee the cost of restoration or damage which may result from our operations. If Client desires us to restore the land to its former condition, we will accomplish this and add the cost to our fee.
- 2.5. Insurance and indemnity.** We will carry the following liability insurance: Workmen's Compensation and Employers' Liability, Comprehensive General Liability, and Comprehensive Automobile Liability, and we will furnish certificates of insurance on request. Within the limits and exclusions of such insurance, we agree to indemnify and save Client harmless from all losses, claims, demands, causes of action, and suits arising out of our willful or negligent acts or those of our officers, agents, employees, subcontractors, or subcontractor's employees, in performing at the worksite the services undertaken hereunder, in furnishing and using equipment and materials at the worksite, or in travelling to and from the worksite. If Client's contract or purchase order places greater responsibility upon us or requires further insurance coverage, we, if specifically directed by Client, will take out additional insurance (if procurable) at Client's expense. It is understood that we do not indemnify Client for damage arising out of Client's use of our data, advice, recommendations and reports. It is expressly understood that our indemnity commitments under this contract shall not exceed the amount and extent of coverage of our insurance.

2. General Conditions (continued)

2.6. Warranty and Limitation of Liability

- a) The only warranty or guarantee made by McClelland Engineers, Inc. in connection with its services performed hereunder is that we will use that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, express or implied, is made or intended by our proposal for consulting services or by our furnishing oral or written reports of the findings made.
- b) For any damage on account of any error, omission, or other professional negligence, our liability will be limited to a sum not to exceed \$50,000 or our fee less direct third-party costs, whichever is greater. In the event that Client does not wish to limit our professional liability to this sum, we agree to waive this limitation upon receiving Client's written request, and Client agrees to pay an additional consideration of 4 percent of our total fee or \$200, whichever is greater.

3. Related Services

Additional services that are frequently required for support of our professional activities are normally provided by one of the technical divisions of McClelland Engineers, Inc. Applicable charges are given in one or more schedules of the following series:

- 42. Laboratory Soil Testing Fees
- 43. Field Charges for Foundation Investigations
- 44. Rates for Construction Surveillance and Consultation

BUDGET ESTIMATE FOR FIELD INVESTIGATION
 CONE TESTING
 PLATFORM OPERATION
OPTION IA

1. Mobilization and Demobilization,		
1.1 In-yard		\$ 1,000 Lump Sum
1.2 Travel to Grand Isle, 800 mi @ \$10/mi		\$ 8,000
2. Drilling and cone equipment, two drilling crews, and engineers from arrival at Grand Isle, LA to final departure; cone testing using Stingray system,		
3.0 days* @ \$7,400/day		\$22,200
3. Drilling mud and cement, \$4,000 plus 15%		\$ 4,600
4. Derrick barge to lift equipment onto platform, support vessel, subsistence for drilling crew, electric power on platform, welders, fuel, lube, and terminal services		<u>Client</u>
	TOTAL	\$35,800 plus Client

*Time schedule of operations:

(1) Dock time and travel to West Delta 58	12 hrs
(2) Loading equipment on platform and rigging up	12 hrs
(3) CPT's to 250-ft penetration	30 hrs
(4) Rigging down and offloading equipment	7 hrs
(5) Travel to Grand Isle and dock time	10 hrs

BUDGET ESTIMATE FOR FIELD INVESTIGATION
 CONE TESTING, SOIL SAMPLING AND REMOTE VANE
 PLATFORM OPERATION

OPTION 1B

1.	Mobilization and Demobilization,	
1.1	In-yard	\$ 2,000 Lump Sum
1.2	Travel to Grand Isle, 800 mi @ \$10/mi	\$ 8,000
2.	Drilling and cone equipment, two drilling crews and engineers from arrival in Grand Isle, LA to final departure; cone testing using Stingray system; Remote vane testing; drilling and sampling,	
	5.0 days* @ \$8,400/day	\$42,000
3.	Drilling mud and cement, \$7,000 plus 15%	\$ 8,050
4.	Same charges as Item 4, Option 1A	_____
	TOTAL	\$60,050 plus Client

*Time schedule of operations:

(1)	Dock time and travel to West Delta 58	12 hrs
(2)	Load equipment on platform and rigging up	12 hrs
(3)	CPT's to 250-ft penetration	30 hrs
(4)	Sample boring and remote vane testing	48 hrs
(5)	Rigging down and offloading equipment	7 hrs
(6)	Travel to Grand Isle and deck time	10 hrs

BUDGET ESTIMATE FOR FIELD INVESTIGATION

CONE TESTING

M/V "R. L. PERKINS"

OPTION IIA

1.	Drilling vessel and vessel crew; two drilling crews and engineers from arrival at Dulac, LA to final departure from Dulac; cone testing using Swordfish system, 2.5 days* @ \$14,200/day	\$35,500
2.	Drilling mud and cement, \$4,000 plus 15%	\$ 4,600
3.	Fuel and lube, \$2,000 plus 15%	<u>\$ 2,300</u>
	TOTAL	\$42,400

*Time schedule of operations:

(1)	Dock time, travel to West Delta 58 and anchoring	15 hrs
(2)	CPT's to 250-ft penetration	36 hrs
(3)	Travel to Dulac and dock time	9 hrs

BUDGET ESTIMATE FOR FIELD INVESTIGATION
 CONE TESTING, SAMPLING AND REMOTE VANE
 M/V "R. L. PERKINS"

OPTION IIB

1.	Drilling vessel and crew; two drilling crews and engineers from arrival at Dulac, LA to final departure from Dulac; cone testing using Swordfish system; Remote vane testing; drilling and sampling, 4.75 days* @ \$15,200/day	\$72,200
2.	Drilling mud and cement, \$8,000 plus 15%	\$ 9,200
3.	Fuel and lube, \$3,000 plus 15%	<u>\$ 3,450</u>
	TOTAL	\$84,850

*Time schedule of operations:

(1)	Dock time, travel to West Delta 58 and anchoring	15 hrs
(2)	CPT's to 250-ft penetration	36 hrs
(3)	Move boat and rig up for next boring	6 hrs
(4)	Sample boring and remote vane testing	48 hrs
(5)	Travel to Dulac and dock time	9 hrs

ESTIMATED CHARGES FOR GEOTECHNICAL PROGRAM

	<u>OPTIONS IA AND IIA</u>	<u>OPTIONS IB AND IIB</u>		
<u>I. Laboratory Investigation</u>				
250 ft @ \$50/ft	N/A	\$12,500		
<u>II. Engineering Analysis and Report Preparation</u>				
Engineer Manager, \$77/hr	\$ 1,155	\$ 1,540		
Senior Engineer, \$60/hr	\$ 1,500	\$ 5,400		
Engineers, \$40/hr	\$ 2,400	\$ 7,200		
Drafting, \$25/hr	\$ 250	\$ 1,000		
Clerical, \$25/hr	\$ 500	\$ 500		
Report Reproduction	\$ 250	\$ 500		
Computer Charges	N/A	\$ 400		
	<u>\$ 6,055</u>	<u>\$16,540</u>		
		<u>OPTIONS</u>		
	<u>IA</u>	<u>IB</u>	<u>IIA</u>	<u>IIB</u>
III. Total estimated charges for field, laboratory, and engineering analyses phases, including estimated third party charges	\$236,855	\$414,090	\$48,455	\$113,890



Marine Geotechnical Investigation



M/V R.L. Perkins

Most anchoring operations are accomplished within an hour.

Anchors are 6,000-pound Navy stockless type. Anchor cables are 1 1/4-inch diameter galvanized wire core. Cable wear is reduced by swivel type roller fairleads located at all four mooring stanchions. During travel, bow anchors are hung in heavy duty anchor racks. Stern anchors are attached to a combination stern anchor rack/work platform. Spare anchors and cable are standard equipment.

Drilling equipment. To meet the challenge of projects in deeper water, a Failing 2000-S drill rig was selected for mounting on the work deck. Drilling operations are performed through a centerwell located midship. Powered by two Detroit 4-71 diesel engines, the rig is capable of drilling to a combined water-formation depth in excess of 2,000 feet. The rig can drill most borings with only one engine, thus, back-up power is available for increased reliability.

Borings are drilled using 30 foot joints of 3 1/2-inch OD, 3-inch ID drill pipe with API NC-44 tool joints. Samples of foundation soil are obtained using a wireline sampler operated through the bore of the drill pipe and open center bit. Drill collars and bumper subs are available if sea or formation conditions warrant their

use. If required, wireline rock coring equipment is also available. An electric cable winch is mounted adjacent the drillers platform to support *in-situ* testing.

A bulk mud system facilitates the mud mixing operation. Utilizing the four bulk mud tanks below deck, weight material or barite is transferred by compressed air to a surge tank mounted above the mud mixing hopper. The weight material is metered into a venturi mixing jet and circulated through the closed mud mixing system. Saltwater gel material is introduced in a similar manner, although it is stored in bag form due to its hydrotropic properties. An electro-mechanical agitator in the drilling fluid holding tank enhances mixing and improves yield. Piping is provided to utilize the main rig pump to mix mud should the primary pump fail.

A portable fiberglass building on deck serves as a warehouse for supplies and spare parts. A large inventory of spares is carried aboard.

Laboratory capabilities. The geotechnical laboratory, located opposite the crew lounge and accessible to the work deck, is divided into two interconnected areas. One is devoted to sample classification, testing and preservation activities. The other area or "clean area" is used to



The quarters area provides comfortable accommodations in two and four-man rooms.

support McClelland Engineers' electro-mechanical *in-situ* testing tools such as the Remote Vane, cone penetrometer and piezometer devices.

Crew requirement. The vessel is manned by a six-man crew, two four-man drilling crews and a geotechnical engineer. An additional engineer and/or electronics technician is usually added when investigations involve both sampling and *in-situ* testing operations.

Summary of features – M/V R. L. Perkins

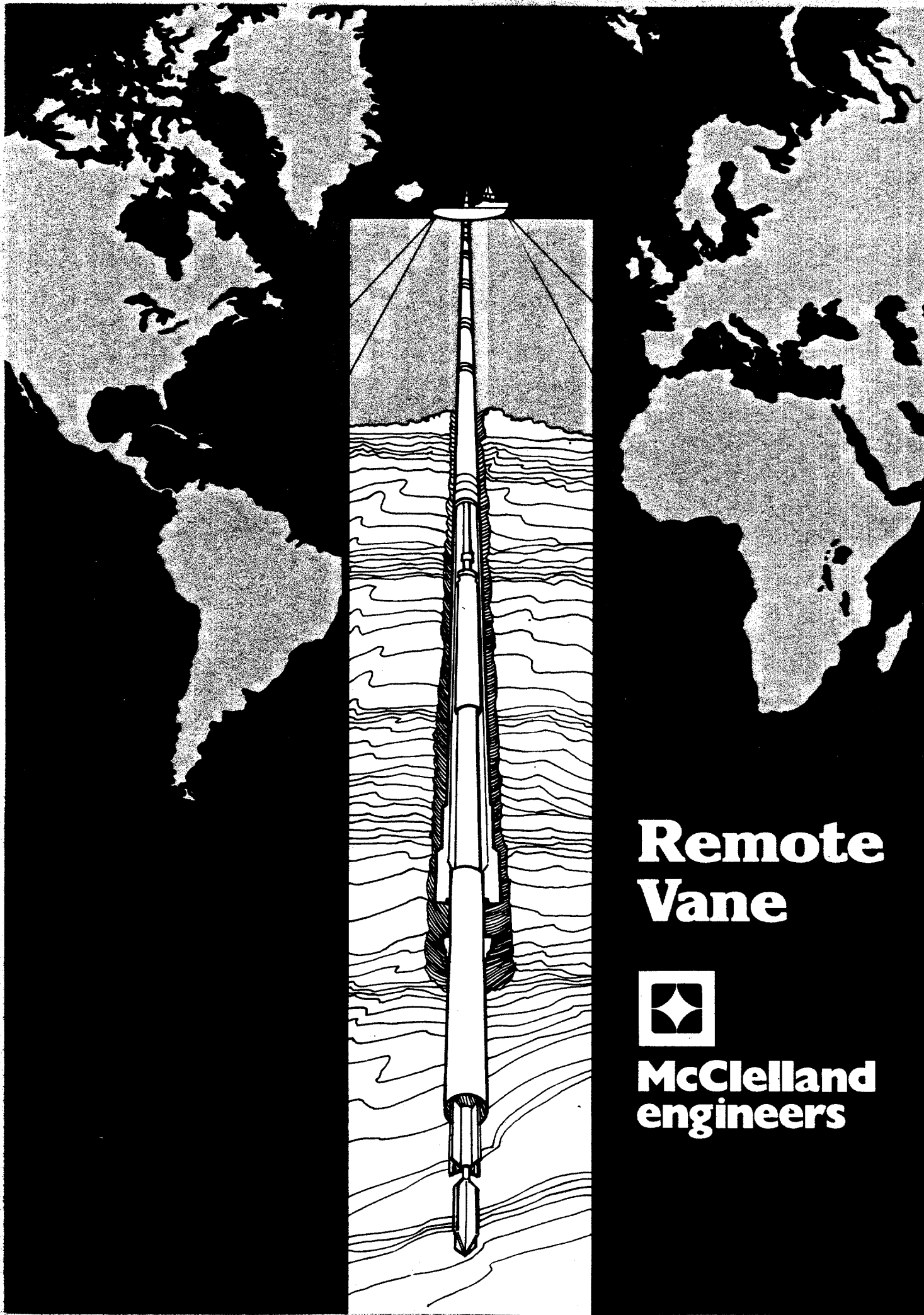
Drilling and sampling equipment

Drill rig	Failing Model 2000-S
Power source	Two 4-71 Detroit Diesels
Mud pump	Gardner-Denver 5" x 8", operated through 4-speed transmission
Derrick	53'
Mud mixing pump	Gardner-Denver 4 1/2" x 5"

Vessel specifications

Built	1978, North American Shipbuilding
Dimensions	185' x 38' x 14'
Open deck	110' x 31'
Fuel	60,000 gallons
Mud storage	Four 900 cu ft Smatco bulk tanks below deck

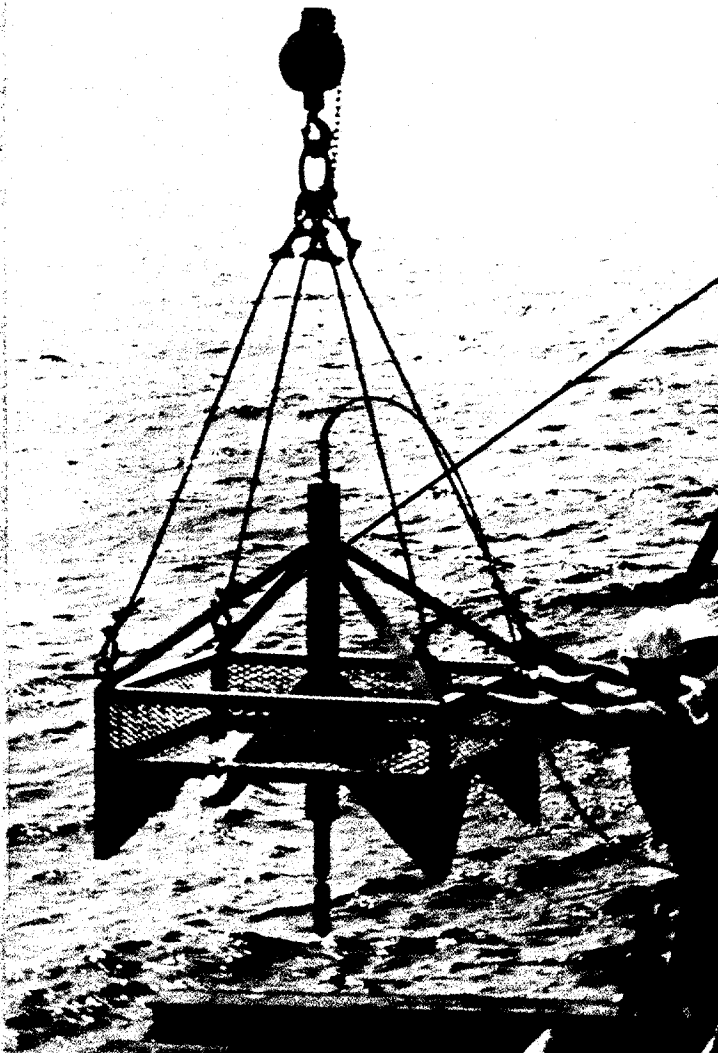
Accommodations	20 people
Facilities	Soils and electronic laboratories, lounge
Soil samplers	2 1/2" OD, 2-1/8" ID liner type sampler 2-1/8" thin-walled tube sampler, 2" split-barrel sampler, wireline operated (other combinations of sampling equipment are available)
Drill pipe	1500-3000', 3 1/2" OD, 3" ID IF (larger drill pipe available)
Propulsion	2-D 399 Caterpillars, 1500 hp each
Bow thruster	400 hp - M&T Harbormaster
Generators	Two 75 kw GM
Mooring spread	4-point system, 6000-lb anchors, 1 1/4" x 3000-5000' (stern), x 4000-8000' (bow), and spares
Navigation equipment	Radar, Loran, SSB, VHF, magnetic compass, alarm fathometer



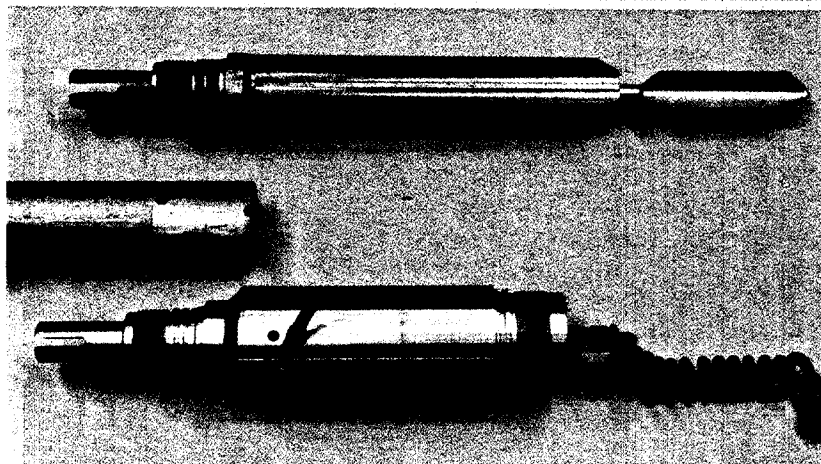
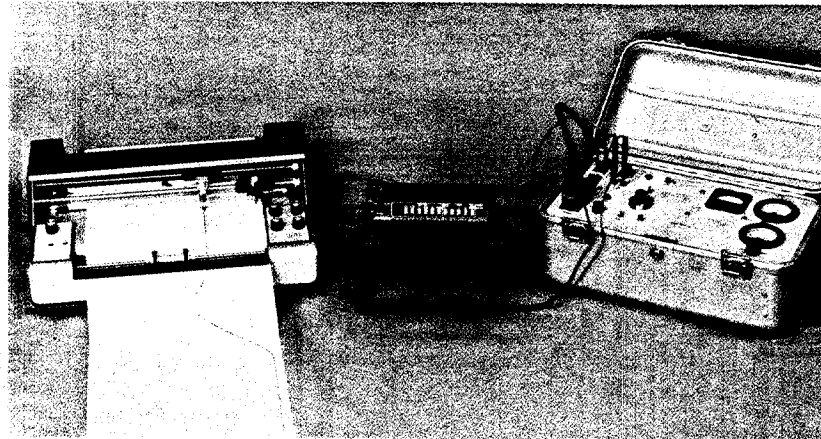
Remote Vane



**McClelland
engineers**



Halbut (stabilizing ballast collar)



Interchangeable field calibrator and reaction with vane blade

Downhole Tool Specifications

Overall Dimensions:

66-mm diameter x 6 m long (motion compensating section closed)

Soil Strength Measurements:

Range 0-300 kPa (0-6 ksf)
Resolution $\pm 0.25\%$ full scale
Accuracy $\pm 1\%$ full scale

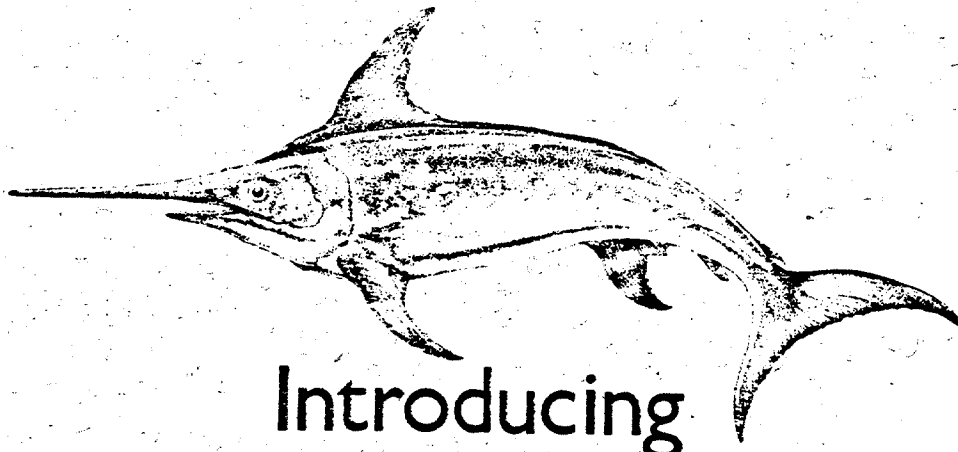
Remote Vane V Improvements

Electrical

- Totally modular for simplified maintenance
- Torque measurement accuracy better than 1%
- Fully temperature compensated
- High resolution chart recorder output
- Simplified on-deck calibration
- Downhole calibration capability

Mechanical

- Simplified mechanical assembly
- Easy conversion for Halbut operation
- 90% fewer parts in pawl assembly
- Need for tool pressurization eliminated
- Simplified maintenance



Introducing
Swordfish

 **McClelland engineers**

McClelland Engineers' Swordfish System is designed to improve the quality of in situ geotechnical testing offshore. The system uses a 10-foot long stroke hydraulic ram to perform cone penetrometer tests and to obtain high quality push samples.

The Swordfish development program represents a significant commitment by McClelland Engineers to improve the state-of-the-art acquisition of geotechnical data. The ultimate objective is to reduce construction costs to our clients by providing the highest quality data obtainable using advanced methods. Swordfish is ideally suited to supply boat operations in the Gulf of Mexico and overseas.

Swordfish combines the experience gained by McClelland Engineers during the last decade with our Remote Vane in situ shear strength-measurement device and our Stingray cone penetrometer operations worldwide.

CLIENT BENEFITS

McClelland Engineers' Swordfish performs cone penetrometer tests (CPT) that give

- better definition of subsurface stratigraphy from simultaneous, continuous CPT output of tip resistance and sleeve friction.
- better indication of in situ density of granular soils than determined by blow counts observed from a wire-line sampler. This improved data supports the use of higher unit end bearing values in axial pile capacity design.
- better interpretation of design shear strength profile due to continuous output of tip resistance data.

Swordfish also obtains three-inch diameter push samples that

- are of higher quality than percussion samples for testing strength, stress-strain, and consolidation characteristics of soils.
- have greater sampler penetration yielding more undisturbed sample; and eliminate the testing of soil samples taken near the bottom of the borehole that have been greatly disturbed by the drilling process.
- are of higher quality because of increased diameter and decreased area ratio.

SWORDFISH OPERATION

The 10-foot long stroke Swordfish hydraulic ram is lowered down the drill string using a custom designed flat umbilical. The cylinder latches into the drill bit and is remotely controlled by the system operator in the control booth. Reaction is provided by the drill string with drill collars as needed. A line tensioner connected to the drill rig elevator immobilizes the bit on the bottom of the borehole.

As a cone test or push sample operation is performed, test data and system parameters are continuously monitored and recorded in the control booth.

At the conclusion of the test, the Swordfish ram is unlatched from the bit. It is then brought back to the vessel to be cleaned and inspected for the next test.



SWORDFISH DESCRIPTION

Cone

The basic measurement device is the cone penetrometer which was developed and fully fabricated at our Houston facility. In 1980 these units completed more than 6,000 feet of cone tests with our Stingray System. It is available in ranges of one, five, and ten-ton load capacity. Tip resistance and sleeve friction are measured using temperature compensated strain gage transducers.

Sampling Unit

The sampling unit is a clamp-on device that attaches to the cone system. A sensor detects the sample and prevents sample disturbance due to overdriving. By using the same unit for both cone tests and push samples, the ability to maintain the system is enhanced. Deck time is also reduced.

Ram

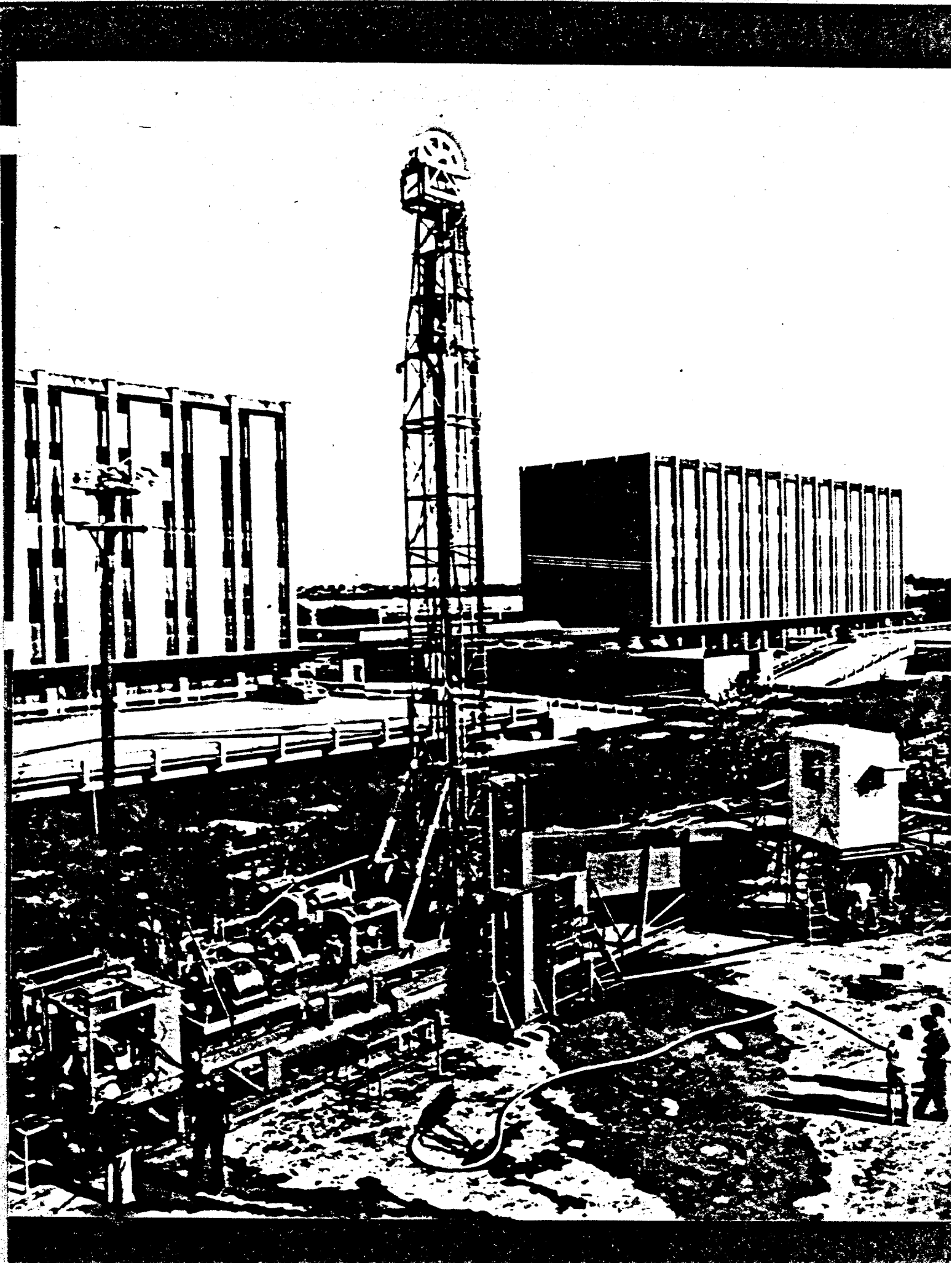
The Swordfish ram provides a continuous penetration rate for the cone and sampler. The unit has a 10-foot stroke and a maximum thrust in excess of 16,000 pounds. The ram has been engineered to withstand the rugged offshore environment by the proper selection of materials, material finishes, and a thorough testing program.

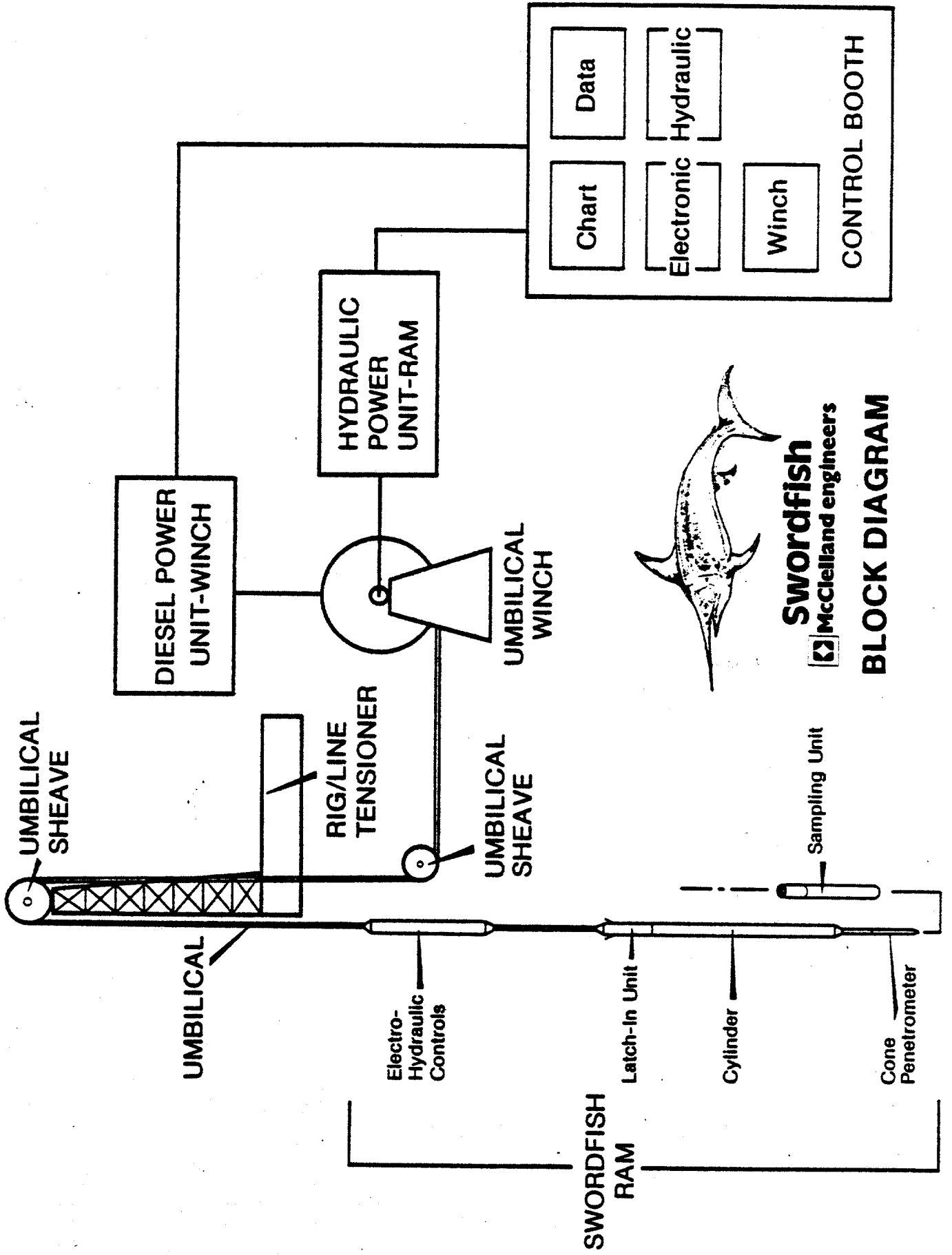
Control Booth

Swordfish can be completely controlled by the drill crew and the system operator in the control booth. The system electronics, hydraulics, and support equipment are controlled by remote panels in the booth. The entire test crew is in voice communication.

Support Equipment

A line tensioner is used to isolate the vessel heave motion from the drill string during testing. The system used is identical to the Stingray units which have proven reliability. The umbilical is handled by a constant torque winch.





Swordfish
McClelland engineers

BLOCK DIAGRAM

SWORDFISH SPECIFICATIONS

- Thrust - exceeds 16,000 pounds
- Stroke - three meters (10 feet)
- Rate of penetration
 - 2 cm/s
 - conforms to ASTM proposed standards
 - continuous read-out of rate on surface
 - independent of long umbilical effects such as hose expansion
- Three-inch diameter push sample capability with sample overdrive prevention system
- Designed for oil field supply boat operation
- Microprocessor controlled data acquisition and storage
- Real time analog recording for quick look at data and back-up
- Test depths to 500 meters (1600 feet) below vessel
- Rigorously tested in land trials
- Uses proven MEI electric cones
 - one-ton
 - five-ton
 - ten-ton
- In-field calibration for maximum data validity
- Single point control for all functions from control booth
- Field repairable umbilical

THE KEY TO SUCCESS

The success of any service organization is dependent on its people. The development of Swordfish has been a team effort at McClelland Engineers. Based on the requirements of our geotechnical engineering staff, our Equipment Development Group provided the mechanical and electrical engineering, the Exploration Department provided thirty years of offshore experience, and the Electro-Mechanical Group assisted in the tool assembly and testing. Staff members from all of these groups formed a dedicated task force that has nurtured the Swordfish through the yard test phase.

