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PROGRESS REPORT
NO. 7

DEVELOPMENT OF
IMPROVED BLOWOUT PREVENTION PROCEDURES
TO BE USED IN DEEP WATER DRILLING OPERATIONS

SUBMITTED TO

THE UNITED STATES GEOLOGICAL SURVEY

DEPARTMENT OF THE INTERIOR

RESTON, VIRGINIA

PETROLEUM ENGINEERING DEPARTMENT

LOUISIANA STATE UNIVERSITY

BATON ROUGE, LOUISIANA 70803

DECEMBER 1, 1980

PROGRESS REPORT

August 16, 1980 - November 15, 1980

Development of Improved Blowout Prevention Procedures for Deep Water Drilling Operations

Contract No. 14-08-0001-17225, Mod. 2
Effective Date: August 23, 1978
Expiration Date: August 31, 1982
Funded Amount - $630,789.00

Sponsored by

The United States Geological Survey

The Department of Interior

Reston, Virginia

Principal Investigators:

William R. Holden, Professor
Petroleum Engineering Department

A. T. Bourgoyne, Professor and Chairman
Petroleum Engineering Department

Bill R. Hise, Professor
Petroleum Engineering Department

December 1, 1980

RESEARCH OBJECTIVES

The primary objectives of the proposed research are the development of improved blowout prevention procedures to be used in deep water, floating drilling operations. The overall research plan was divided into eight tasks which would take approximately four years for completion. The project funding received under the present contract is $630,789 to perform the following tasks:

Task Description

1. Design of well for accurately modeling blowout control operations on a floating drilling vessel in deep water.
   a. Well scalling and design.
   b. Preparation of bids and specifications.
2. Construction of well for accurately modeling blowout control operations on a floating drilling vessel in deep water.
   a. Procurement of well equipment.
   b. Well drilling and completion.
3. Documentation of blowout control equipment configuration and procedures used on all floating drilling vessels capable of drilling in deep water.
   a. Equipment configuration.
   b. Shut-in procedures.
   c. Start-up procedures.
   d. Pump-out procedures.
4. Experimental study of shut-in procedures for blowout control on floating drilling vessels in deep water.
   a. Experimental determination of frictional area coefficient profile of modern adjustable chokes and HCR valves used in blowout control operations.

b. Experimental determination of frictional area coefficient profile of modern annular blowout preventers during closure.

c. Development of mathematical model of pressure surges occurring during well closure

d. Experimental evaluation of pressure surge model.

5. Experimental study of procedures for handling upward gas migration during the shut-in period.

   a. Evaluation of conventional approach requiring use of surface drill pipe pressure.

   b. Evaluation of volumetric methods.

   c. Laboratory investigation of gas bubble fragmentation while rising in a static annulus.

   d. Development of mathematical model of well behavior during shut-in period following a gas kick.

   e. Determination of optimal method of handling upward gas migration during shut-in period.

6. Experimental study of start-up procedures for blowout control on floating drilling vessels in deep water.

   a. Evaluation of present day start-up procedures which use existing equipment.

   b. Evaluation of possible future start-up procedures which would require development of new equipment.

7. Experimental study of pump-out procedures for blowout control operations on a floating drilling vessel in deep water.

   a. Evaluation of present day pump-out procedures which use existing equipment.

   b. Evaluation of present day pump-out procedures which would require development of new equipment.

ACCOMPLISHMENTS

Task 1, well scaling and design, has been completed and a scale model of the proposed new facility has been constructed. A final review of the proposed design was conducted with the help of industrial advisors chosen from both research and operations. The external reviewers recommended that if additional funding could be obtained, the design of the well should be changed from a dual completion to a triple completion to allow modeling of both the subsea choke line and kill line instead of only the subsea choke line. This would allow experimental investigation of a wider range of well control procedures. This alternative well design was fully explored during the past two months.

Funding approval for Task 2a was received in September 1980 and funding approval for Task 2b was received in October 1980. Construction work has been proceeding rapidly during October and November. A portion of the well workover which could be done without a drilling rig has already been accomplished. This included:

1. Setting a bridge plug at 6200 ft in the 7 5/8 in. casing.
2. Obtaining a casing collar location log on the 7 5/8 in. casing.
3. Setting a cement plug from 6175 to 6200 ft.
4. Setting a Packer at 3028 ft.

This well work was done using a truck mounted wireline unit. A rig has been scheduled for late December to complete the well in the desired configuration.

Considerable work has also been done on surface site preparation. The location has been graded and the shell mat placement has been done. Equipment foundations (see attached photographs) are now being poured.

Data collection for Tasks 3, 4a, 4b, and 5 are all essentially complete. However, written documentation of these tasks are still in progress. A small amount of the experimental work done in Tasks 4a and

4b will have to be repeated. Three M.S. thesis dealing with these tasks are now in preparation.

Experimental work on Tasks 6 and 7 will begin as soon as the construction work (Task 2) is complete. This will probably be sometime in February 1981. Experimental procedures for Tasks 6 and 7 are now being planned in more detail.

PROBLEMS

One major problem encountered since the last progress report was caused by a stipulation placed in the contract by the USGS authorizing the government to terminate the contract for convenience if LSU's payroll distribution system is not brought into compliance with OMB Circular A-21 by January 1, 1981. Campus correspondence received by the Petroleum Engineering Department in late November indicated that the problem has been resolved and LSU has received permission for implementation of the new A-21 accounting method effective July 1, 1981.

A second problem has developed because of the resignation of Professor B. R. Hise from the Petroleum Engineering faculty to work as an oil and gas consultant in Baton Rouge. Mr. Hise was one of the three key personnel listed as essential to the research. Our proposed solution to this problem is discussed under the "significant changes" section of this progress report.

LISTED PROPERTY ACQUIRED

The items listed under instrumentation on page 13 of the contract have now been received. However, items 5a, 5b, 5c (Fisher Porter Mag Meter and Converter and Halliburton Recorder) were purchased using non-contract funds. A Soltec Corporation Recorder was purchased at a cost of $5948 for Item 5d instead of the TI recorder when standard state bidding procedures were followed. Texas Instrument did not provide the lowest bid.

SIGNIFICANT CHANGES

Several significant changes in the project are felt to be desirable. These changes will not impact the total cost of the project, but will require only reallocation of funds and personnel.

1. It is proposed that Dr. J. P. Langlinais, who has replaced Mr. Hise on our faculty, also replace Mr. Hise in this contract. A copy of Dr. Langlinais' resume is included in Appendix A. Dr. Langlinais was introduced to Mr. John Gregory, our COR, during a recent visit by Mr. Gregory to LSU. If this change is not considered desirable, there remains a possibility that we could hire Mr. Hise as a consultant to work on the project.
2. It is proposed that the budget for Task 2 be reallocated to allow the design of the well to be changed from a dual completion to a triple completion. Even though the triple completion is more expensive, because of additional equipment grants which could be received from industry, the more desirable completion could be achieved at no additional cost to the USGS. Shown in Table 1 is the proposed reallocation of funds budgeted for Tasks 2a and 2b for the cost of the new facilities. The total funds listed previously as items 1c (see Table 4 of Feb. 1980 proposal) for Task 2a and Items 1-10 for Task 2b was $232,853. The proposal total cost to the USGS for these items is also $232,853. The letter "A" shown under the USGS estimated cost column means that another source of funding for these items would be made available through industrial funding. The research advisory personnel from industry who desired the more complex well completion have been instrumental in obtaining the additional industrial funding needed.
3. It is proposed that Eric Softley of Miami, Florida, be retained on a consulting basis, to assist with Task 4. Dr. Softley has an

excellent background which could be of much assistance in formulating a mathematical model for calculating pressure surges associated with well closure during an impending blowout. Dr. Softley would do a portion of the work scheduled to be done by the three key personnel. The necessary budget adjustment required to allow this would be:

a. Increase professional services budget category (500 LSU object code) by $5000.

b. Decrease faculty salary budget category (111 LSU object code) by $3012.05.

c. Decrease overhead (670 LSU object code) by $1490.96.

d. Decrease Staff Benefits (680 LSU object code) by $496.99.

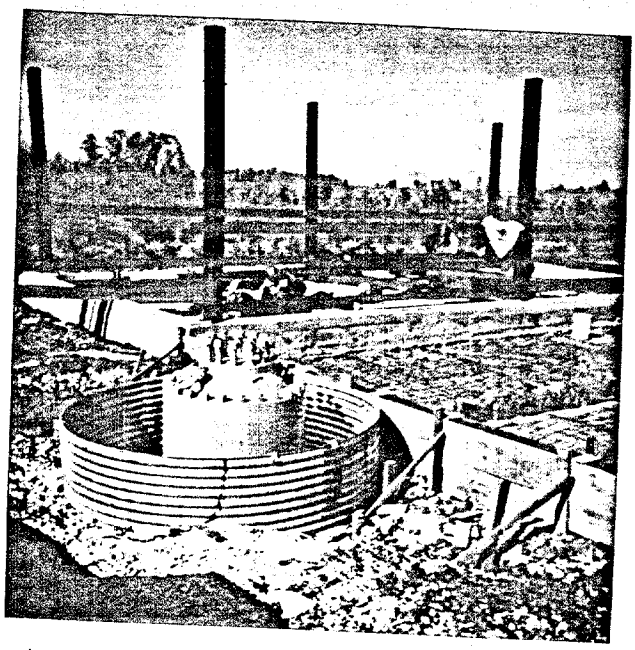
Mr. John Gregory is already familiar with Dr. Eric Softley's background and has used him on other projects.

Adam T Bourgoyne Jr

Dr. Adam T. Bourgoyne, Jr.
Chairman, Petroleum Engineering Department

Current Status of Foundation Work

on site of New Research Well Facility



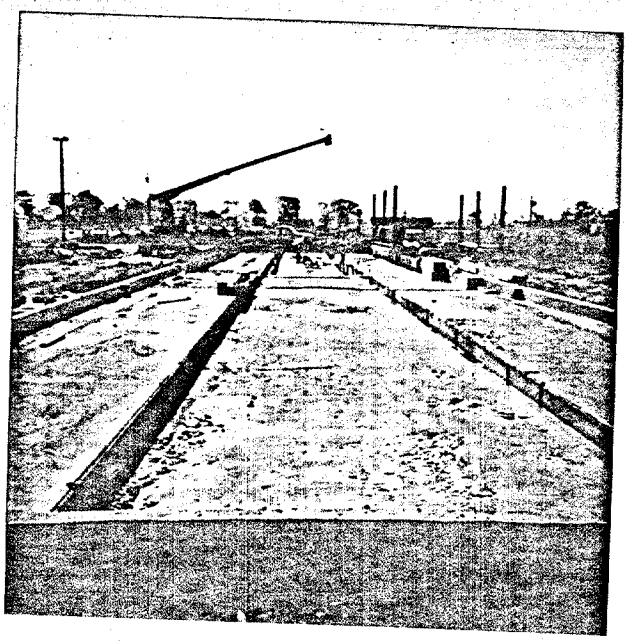


Table 1

Work Description	USGS Estimated Cost	USGS Budgeted Cost
Task 2a		
A. Site Improvement		
1. Grading, Petromats, Shellmats		
a. Industrial Service Corp.	$7991.00	
b. Shells Inc.		
(1) clam shell no. 1.	8955.00	
(2) clam shell no. 2.	3726.00	
(3) clam shell no. 3.	1280.00	
c. Best Record Construction	1900.00	
d. Metal Culvert.	800.00	
SUBTOTAL.	$24,652.00	
2. Engineering Services by		
Forte & Tablada.	$4342.00	
SUBTOTAL.	$28,994.00	$41,000.00
B. Foundations		
1. Olin Land (pipe Racks)	$ 770.00	
2. KE Mac Construction*	47,438.00	
3. LCR (Plastic drain pipe)	226.00	
SUBTOTAL.	$48,434.00	$29,000.00

* Includes cost of foundations and metal shell for control house and work room. Control house and work room to be finished using industrial grant funds.

Table 1 Continued

Work Description	USGS Estimated Cost	USGS Budgeted Cost
C. Instrumentation**		
1. Lymac Inc.	$ 559.00	
2. Honeywell Inc. (Transducers)	3,306.00	
3. Moody Price.	86.00	
4. Soltec Corp. (Recorder).	5,948.00	
5. Grant Supply	748.00	
SUBTOTAL	$10,647.00	$15,000.00
** Already purchased.		
SUBTOTAL	$88,075.00	$85,000.00
Task 2b		
1. a. Move Rig on Location.	$ 1,658.00	$ 2,360.00
b. Timbers (Reg 173).	547.00	
2. Rig time for well completion	28,000.00	9,912.00
3. Wireline work.	A	2,950.00
4. Cementing Services	A	1,180.00
5. Disposal of old mud and displacement of completion fluid.	A	1,652.00
6. Supervision.	A	3,186.00
7. Tubulars		
a. Vinson Supply (6000 ft of 2.875 in. and 6000 ft of 2.375 in.).	39,360.00	62,963.00
b. 6000 ft of 1.315 in.	13,500.00	14,200.00
8. Christmas tree and associated valves . .	33,078.00	23,600.00
9. Packer	A	8,850.00
10. Instrumentation.	8,635.00	17,000.00

Table 1 Continued

Work Description	USGS Estimated Cost	USGS Budgeted Cost
11. U.S. Machine Welding***.	$20,000.00	----
SUBTOTAL	$144,778.00	$147,853.00
TOTAL	$232,853.00	$232,853.00

A - Another source of funding wil be available.

*** Originally this was to be donated by Cameron Iron Works. However, work could not be scheduled for 18-24 months. This delay was not felt to be acceptable.

A P P E N D I X A

Resume of Dr. J. P. Langlinais

RESUME

NAME: Julius Langlinais AGE: 35

ADDRESS: 968 Bromley
Baton Rouge, LA 70808

WIFE'S NAME: Betty A. Langlinais CHILDREN: Michelle--13
Laura--12

EDUCATION:

B.S. --Physics, 1967, University of Southwestern Louisiana, GPA-3.55

M.S. --Physics, 1970, Louisiana State University, GPA-3.77

Ph.D. --Physics, 1971, Louisiana State University, GPA-3.77

Louisiana State Professional Engineering Registration— Petroleum, No. 17000

WORK EXPERIENCE:

8/80-present: Louisiana State University, Petroleum Engineering Dept.- Assistant Professor. Duties have included teaching undergraduate courses in Mineral Economics and Petrophysics along with involvement in other department activities.

3/78-8/80: Superior Oil Co., Lafayette, LA - Production Engineer. Duties have included recommendations concerning workovers, completions, remedial efforts, and various field studies to optimize production. Work was mostly with gas wells in inland waters of south Louisiana.

7/75-3/78: Continental Oil Co., New Orleans, LA - Reservoir and Production Engineer. As a Reservoir Engineer, became involved with reservoir studies, economic evaluations, as well as open hole logging. Production involved same as as above with Superior with the addition of surface safety equipment and surface production equipment. Gained extensive experience with gas lift design. Also was involved with the company's compliance with O.C.S. Order 8 (API RP 14-C:surface safety equipment). Conoco's operations were exclusively offshore and mainly oil wells.

9/71-5/75: University of Tampa, Tampa, Florida - Assistant and Associate Professor of Mathematics and Physics. Duties included teaching undergraduate courses in Physics, Mathematics, Computer Programming and Data Processing. Also:
-elected representative to faculty senate, 1975
-Library Committee chairman, 1973
-elected to O.D.K. (National Service Fraternity) by students, 1974

9/67-8/71: Louisiana State University, Baton Rouge, LA. As a graduate student, duties included teaching Senior level Modern Physics Lab. Also, N.D.E.A. Fellowship recipient for 3 years.

9/63-5/67: University of Southwestern Louisiana, Lafayette, LA. As an undergraduate, instructed elementary Physics Lab for last 3 semesters, 3 sections per semester.

Summer Employment: Worked summers as construction laborer, oil field contract laborer, equipment maintenance for electrical utility (2 summers), and summer student with the Theoretical Physics Group at the Savannah River Lab.

ACADEMIC AFFILIATIONS:

Society of Petroleum Engineers of AIME - Associate member
LA State Petroleum Engineer Registration - No. 17000 (by examination)
Sigma Pi Sigma (Physics Honor Society) - Chapter President, 1966
Kappa Mu Epsilon (Math Honor Society) - member
Phi Kappa Phi (National Scholastic Honor Society) - member

COMPANY SCHOOLS:

Reservoir Engineering - 2 weeks
Log Analysis - 1 week
Water Flooding - 1 week
Oil Field Geology - 1 week
Economic Analysis - 1 week
Completion Techniques - 2 weeks
Production Technology - 1 week
Hydrogen Sulfide Safety Training - 1 week
Well Control - 1 week

DOCTORAL DISSERTATION:

Entitled "Energy Bands of Ferromagnetic Nickel Using the Tight Binding Method", this was an applied theoretical effort involving extensive computer programming. It resulted in the papers Energy Bands in Ferromagnetic Nickel, Langlinais and Callaway, Physical Review, Vol 5 No 1, 124 (Jan 1972) and Energy Bands in Nickel using the Tight Binding Method, Callaway, Zhang, Norwood and Langlinais, International Journal of Quantum Chemistry 4, 425 (1971). Professor J. Callaway was my research coordinator and department chairman at that time. He enjoys an international reputation in the field of Solid State Physics and has published several authoritative textbooks on that subject.

REFERENCES:

Fred Masset, Ph.D.
Bissonet Dr.
New Orleans, LA
Home Phone: 504-455-7142

Dave Ford, Ph.D.
Asst. Dean of Faculty
Univ. of Tampa
Tampa, Florida
Bus. Ph.: 813-251-8861

Arch Garland
Division Engineer
Continental Oil Co.
Lafayette, LA
Bus. Ph.: 318-235-3501

PUBLICATIONS:

1. "Energy Bands in Ferromagntic," Langlinais and Callaway, Physical Review B, Vol 5 No 1, 124-234 (1972).

2. "Energy Bands in Nickel Using the Tight Binding Method," Callaway, Zhang, Norwood and Langlinais, Internationa Journal of Quantum Chemistry, 4, 425 (1971).

3. "Energy Bands of Ferromagnetic Nickel Using the Tight Binding Method," J. Langlinais, Doctoral dissertation — Louisiana State University.

4. "Deep Gas Lift Using Packoff Valves," J. Langlinais, Continental Oil Company Monthly Engineering Letter, (Jan 1977).

5. "Economical Recompletion to a Pay Sand Above the Top Packer," J. Langlinais and P. Brazan, Continental Oil Company Monthly Engineering Letter, (May 1976).