Procedures for Bidding and Supervising a Contract Drilling Operation

By J. N. MUSCOVALLEY

Loffland Brothers Co.

INTRODUCTION

In the 15-20 year period since most oil companies divested themselves of company-owned drilling rigs, one problem has continually arisen: that problem being training of drilling personnel within these companies to successfully supervise a drilling operation made up of an assortment of drilling contractors.

Due to many varying reasons, the type and amount of supervision that these drilling contractors have required have changed with time. Most oil companies today still feel that they need to train men in drilling techniques so that they can actually go to a rig and "make hole". The opportunity for these men to gain experience in this field is usually limited due to the ever-decreasing number of wells drilled. Consequently, the company fears the day when the last of their company drilling personnel with actual rig experience reach retirement age.

The Oil and Gas Journal, in an editorial in the issue of October 1966, said "the standard drilling tool of tomorrow—and it's here today—is a highly sophisticated combinaiton of devices adapted from a wide range of scientific disciplines. No more is drilling a matter of punching holes in the ground by main force and ignorance. It's become a complicated science."[1] The drilling contractor of today is the first to acknowledge the truth of this statement. Because of this, drilling contractors, like the oil companies, have had to continuously train their employees in new drilling techniques. Unlike the oil companies, the contractor personnel have had the everyday experience of applying these new techniques to drilling. The most successful drilling contractor today is the contractor who has the personnel and the control to successfully apply these techniques.

Since the contractor is developing drilling personnel and has proven his ability to consistently improve drilling performance, the oil operator should train his drilling department personnel to take maximum advantage of the contractor's ability. Today's drilling men should be trained in the areas where they will spend most of their time; these areas are bidding, bid evaluation, and the supervision of a contract drilling operation.

BID PREPARATION

To prepare an intelligent and meaningful bid request the operator must have personnel who are familiar with the economics of oil well drilling. The author of a bid request must be familiar with the various areas that affect the contractor's cost because these costs are then reflected in the total cost to the operator. For this reason, the bidding of the drilling of a well should be more involved and be given more thought than merely filling in the blanks on a company bid request form. Verbal requests and verbal bids compound the confusion and lead to painful negotiations at some later date concerning details of the drilling contract.

Consequently it is imperative that a considerable amount of planning and preparation time be allowed before a request is submitted to the contractors for bid. The planning which should be incorporated in the bid has usually been done within the oil company before the decision was made to drill the well. Someone within the company's drilling department must now decide what information the contractor will need to make an intelligent bid.

The contractor needs to know nearly as much as the oil operator about a proposed well. The three broad categories a bid request should cover are:

(1) Technical Information
(2) Material Assignments
(3) Special Provisions

The technical information portion of a bid request is that part which gives the well location, casing programs, mud program, deviation requirements, equipment requirements, etc. The material assignments spell out which party will furnish the various materials needed for the drilling and completion of the well. The special provisions portion will assign responsibilities, list applicable exceptions, and enumerate protective clauses for both parties.

Only when all of these items have been agreed to by both parties is a bid a successful instrument from which a contract can be drawn. The value of the written bid submitted in this manner is as follows:

(1) The operator knows exactly what he is buying.
(2) The contractor knows exactly what he is required to furnish, both services and material.
(3) The operator and the contractor have each other committed in writing.
(4) All bids can be evaluated on an equal basis.

Technical Information

The technical portion of the bid request is the portion which requires the most preparation time of the operator's staff. This is also the portion on which the contractor will have to concentrate to be able to make a profitable and successful bid. Areas where problems usually arise are in equipment specifications, casing sizes, setting depths and mud specifications.

Equipment Requirements

Over the years, operators have gone to various lengths to insure that the equipment which the contractor bid was suitable for the job. Some operators have required that the rig have a pump of some arbitrary horsepower; others specify that the rig should have a certain size drawworks and some require a list of specifications on all of the major components.

The importance of equipment depends a lot on the nature of the contract. A simple footage bid with no daywork involved should not specify that the contractor furnish a 700-hp mud pump. The contractor will know the size pump that is required for the job and will run this pump to obtain its maximum performance. However, if the operation is on daywork for a large part of the well, the operator always feels that it is necessary to specify the pump size, for now payment is directly proportional to time.

Personnel unfamiliar with drilling equipment, can determine the equipment requirements in several ways. First, calculations should be made to determine the maximum conditions which will exist while drilling the well. Maximum casing loads and the maximum height of the blow-out preventer stacks are easily calculated and this information can be used as a criterion for determining the size and capacity of this part of the equipment. It is much more difficult to determine the horespower and the mud pumps which should be used on a well. The best known method for doing this is for the operator to use the past experience of his own company and also that of his competitors. In a particular area, an analysis should be made of a wide variety of wells drilled within a particular depth bracket. Then a comparison between horsepower versus time to drill various intervals of hole should be made. Compare pump size in the same manner. This information is readily available from the bit manufacturers' bit records, as well as from the contractors themselves. From these facts a meaningful decision can be reached regarding the equipment requirements for this depth range.

Another approach to equipment requirements is the typical engineer's approach of calculating maximum hydraulic horsepower required, maximum rotary horsepower anticipated, maximum hoisting horsepower for fast trips, etc. The only fallacy with this reasoning is that these maximum conditions are usually encountered for only a small percentage of the time on a well. Therefore, for the majority of the time on the well, this equipment will be operating at less than maximum, but the operator will have the extra expense of the larger rig all of the time.

The first approach mentioned, that based on experience, will usually provide the operator with an idea of the optimum combination of equipment for the minimum well cost.

Another bit of research and ground work which the operator's personnel must do is to develop a library of brochures of commonly used drilling equipment and performance curves. This will permit the operator to place his own rating on each piece of contractor equipment. For example, if a bid specification asks the contractor to list the horsepower on the rig which is bid, the contractor will bid the maximum horsepower the engine will develop. However, if the operator spells out that horsepower requirements are to be based on 3000-ft altitude, 100° temperature, and 80 per cent of maximum, he will begin to get more meaningful information. Then when the contractor says that he will furnish three "Brand X, Model 1" engines the operator can check the engine manufacturer's curves and determine that these engines do meet the requirement.

All rigs are designed around horsepower. Consequently, by setting the horsepower requirement, much of the other equipment on the rig will also be determined.

Casing Programs:

The cheapest string of pipe is not necessarily the most economical casing program. The size hole which must be drilled for the casing string and the size hole which can be drilled through the casing string must also be considered. The reason for this is that contractors can drill some hole sizes much cheaper than others; certain hole sizes have become "standard" and the bits for these hole sizes have been perfected to a degree far above that of "off-sized" bits. To determine what hole sizes are the most economical, a check of past records, discussions with bit manufacturers, and discussions with contractors will provide all the information that is needed.

Another point to predetermine as closely as possible is the setting depth of the intermediate and oil strings. For example, if it is planned to complete a well at 11,800 ft, the bid request should not read 12,000 ft. An example of the cost to the operator of this type of bid follows:

CASE I

Bid base on 12,000' of hole:	
Per day cost of rig	
Daily average of all contractor well cost	$1600.00/day
Estimated time to drill to 12,000'	42 days
Total cost (cost/day x days)	$67,200.00
Cost/foot (total cost ÷ by depth)	$5.60

This same type example could be given for intermediate casing strings. If the contractor is called upon to drill 200 more feet of large diameter hole, where he planned to drill a smaller hole with little or no mud, he may be penalized by one-half to one day's rig time. In this case the contractor is penalized a large portion of his anticipated profit.

CASE II

Bid based on 11,800' of hole:	
Per day cost of rig	
Daily average of all contractor well cost	$1600.00/day
Estimated time to drill to 11,800'	40 days
Total cost (cost/day x days)	$64,000.00
Cost/foot (total cost ÷ by depth)	$5.42

Cost to operator for specifying deeper depth (Case I — Case II) x footage drilled = extra cost

($5.60 — $5.42) x 11,800' = $2124.00

Mud Program:

The mud program which is specified in a bid request is undoubtedly the most important feature of the bid request to the contractor. Gradually, ambiguous terms such as "sample mud" are disappearing. Bid requests are still common which state that from the intermediate casing seat to total depth the mud will have a maximum weight of 9.5 ppg and a 60 sec/qt viscosity when it is anticipated that 60 per cent of the hole will be drilled with water and the other 40 per cent with an 8.8 ppg mud weight and a 40 sec/qt viscosity. By signing this type contract the contractor has left himself open to anyone asking for "just a little" mud at any time on the hole. An example of what a minimum mud can do to the contractor is shown below:

Assume a 1000 ft interval of limestone which is ordinarily drilled with two 8-3/4 in. tungsten carbide sealed-bearing rock bits. These bits are pulled for bearing wear after 25 hours each, but with fresh water as the circulating medium, the bits will drill at the rate of 20 ft/hr.

Now consider the same interval with a "minimum sample mud" in the hole. The minimum mud in the West Texas Area in a situation such as this will usually require a 32-34 sec/qt funnel viscosity. Although there is no direct comparison between funnel viscosity and centipoise viscosity, it is generally assumed that this type mud would

Time Involved — Case I	
1000 ft ÷ 20 ft/hr	= 50 hrs
2 trips @ 5 hrs each	= 10 hrs
Total time	= 60 hrs
Rig Cost — Exclusive of rock bits	
1275.00/day with drill pipe	= $53.13/hr
Total Cost to Drill Interval:	
6 hrs x $53.13/hr	= $3187.80
2 bits @ $1175.00 each	= $2350.00
Total Cost	= $5537.80
Cost/ft	= $5.54

give a 2-3 cp viscosity. From Fig. I the quantity of bentonite that would have to be added to give this viscosity can now be determined.[2] The mud system would not weigh 8.5 + ppg. From Fig. II it is apparent that an 8.5 + ppg mud will contain 1.5 to 2.0 per cent solids by volume, based on adding bentonite to fresh water.[3] Figure III then gives the effect of this quantity of solids on drilling rate.[4] In this graph, based on drilling limestone, the penetration rate has been reduced from 6.5 ft/hr to 5.0 ft/hr due to only 1.5 per cent solids. This represents a 23 per cent reduction in penetration rate. Carrying this decrease on to the example from above, the cost to increase the viscosity to 34 sec/qt can now be calculated:

Penetration Rate Reduced by 23 per cent	
20 ft/hr less 23 per cent	= 15.4 ft/hr
Time Involved: Case II	
1000 ft ÷ 15.4 ft/hr	= 65 hrs
3 trips @ 5 hrs each	= 15 hrs
Total time	= 80 hrs
Rig Cost: Exclusive of rock bits	
$1275.00/day with drill pipe	= $53.13/hr
Bit Cost:	
Based on 25 hrs maximum bit life as in previous example:	
65 hrs ÷ 25 hrs/bit	= 2.6 bits
2.6 bits @ $1175.00 each	= $3055.00
Total Cost to Drill Interval:	
80 hrs x $53.13/hr	= $4250.40
Bit cost from above	3055.00
Total cost	= $7305.40
Cost/ft	= $7.31

Increased Cost to Contractor:	
Case II — Case I	= $7305.40 — $5537.80
	= $1767.60
Increased cost/ft	= $1.77/ft

A cost such as this can soon put the contractor in the red on any well. For this reason the more specifically a mud program is presented in the bid request, the more accurate the bid can be made. Most operators have the mud company work up a proposed mud program before the well is drilled. The inclusion of this information in the bid request is a definite aid to the contractor.

Material Assignments

The cost of drilling a well represents an accumulation of the cost of many items, some large and some small. The bid request should make clear which party will be expected to furnish each of these items. The reason that this is necessary is because these responsibilities vary from area to area, from company to company, and even from individual to individual. A simple check list is the most common method of handling this section of a bid with a notation behind each item stating whether it is furnished by the contractor or the operator.

A problem which can develop over this portion of a bid is that although the item was listed, the description was not specific enough to permit an accurate cost estimate to be made. An example of this would be "cellar—to be furnished by contractor". The contractor would immediately include in his bid a $150.00, 6 ft x 6 ft x 6 ft wooden cellar. However, the operator may have intended to have a 12 ft x 12 ft x 12 ft cellar with 12-in. reinforced concrete walls. This cellar would cost $2500.00.

For the most part, this portion of a bid can be prepared in a very short period of time and it will simplify matters for both the operator and the contractor throughout the drilling of the well.

Special Provisions

The special provisions of the bid request usually are statements of company-wide policies regarding loss circulation, blow-outs, time of payment, and assignments of responsibilities under varying conditions. Within many companies

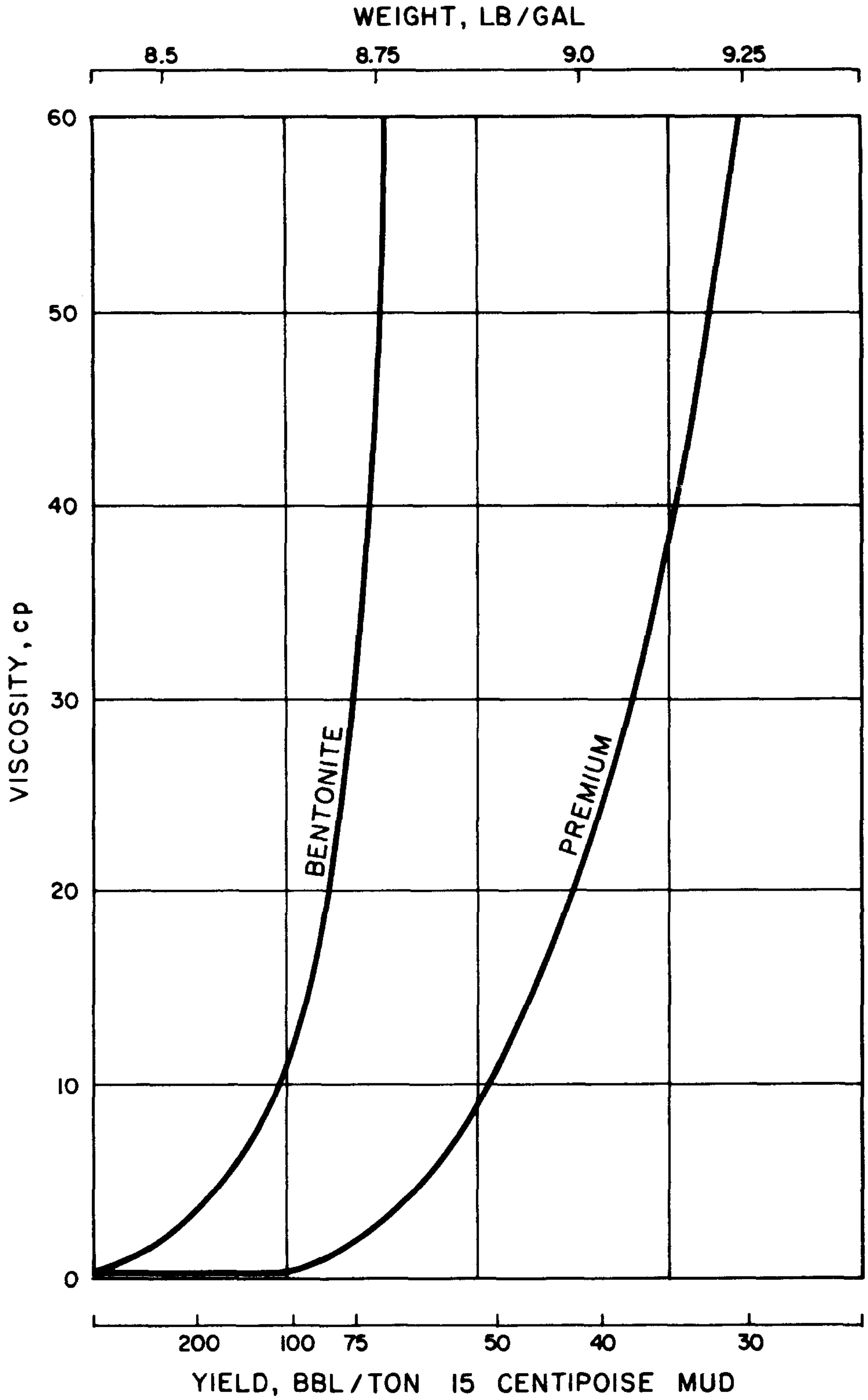

FIG. I

TYPICAL YIELD CURVES

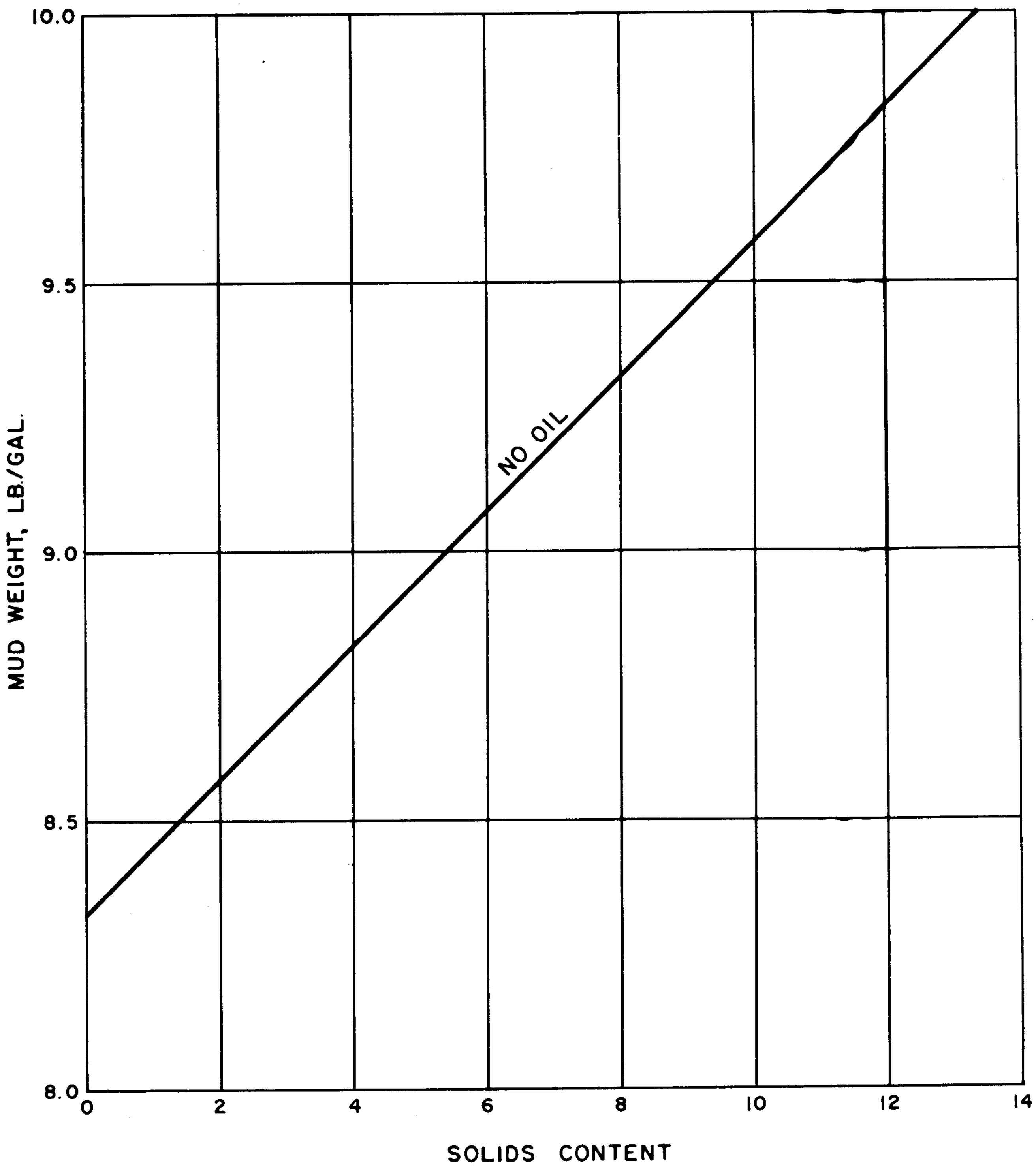

FIG. II

MUD WEIGHT* Vs. SOLIDS CONTENT

*GRAVITY OF SOLIDS = 2.5

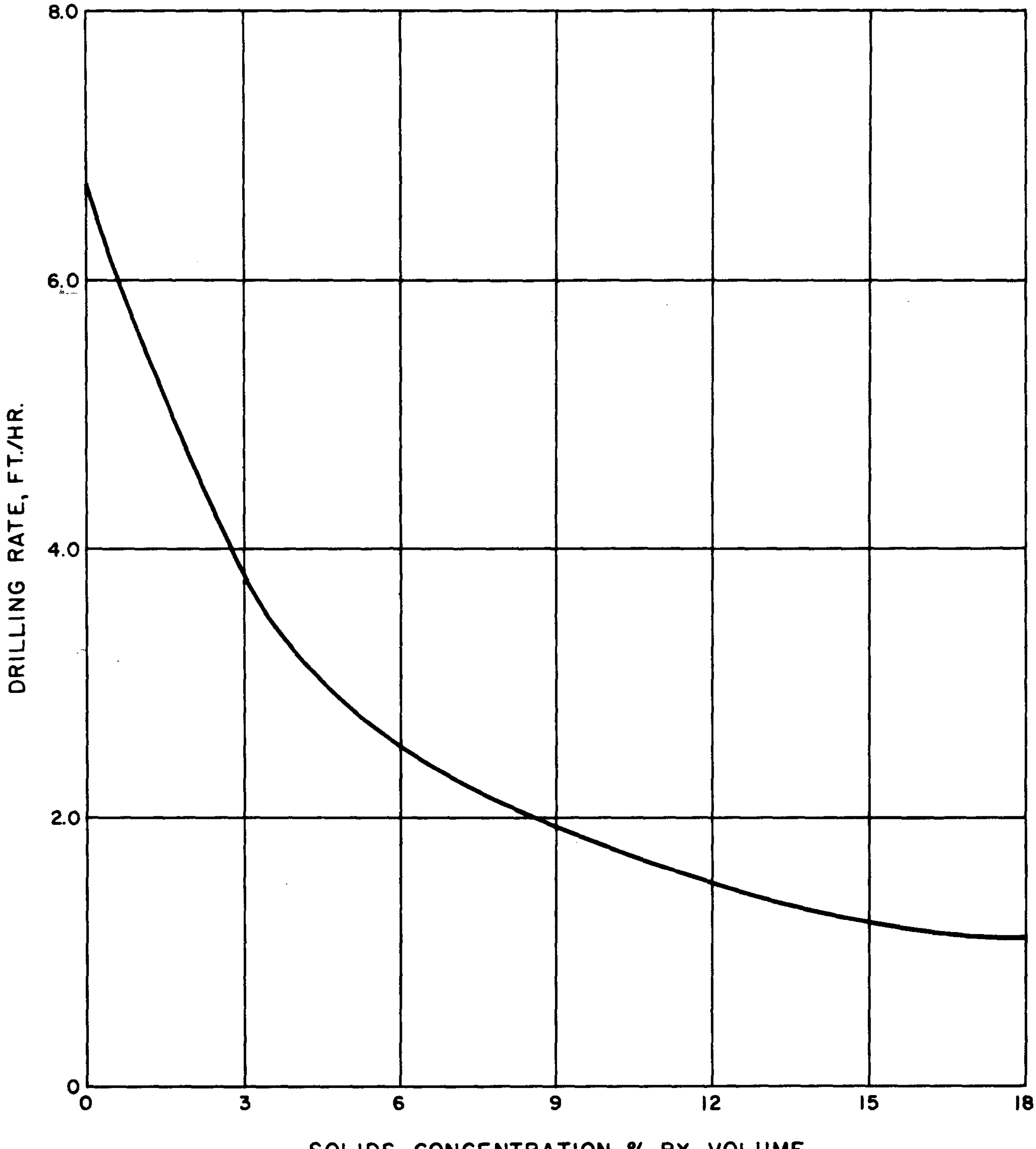

FIG. III

FIELD TEST

LIMESTONE DRILLING

there are standard clauses governing these matters but like material assignments, these practices vary from area to area and even from individual to individual.

The inclusion of these clauses at the time of the bid will expedite the handling of all trouble at a later date and leave no doubt as to responsibilities.

BID EVALUATION

Bid evaluation can be relatively simple if the bid request was properly prepared and presented. Providing all of the items mentioned under bid preparation are included in the bid, the contractor can mail a completed bid back to the operator by simply filling-in the blanks. If the bid was not properly presented, the contractor will have to include many qualifying remarks. Because every contractor will take a different approach to a nebulous bid the operator's personnel will have a near impossible task of putting a monetary value on the clauses or exceptions made with each bid.

To further simplify bid evaluation the operator should be selective in regard to those permitted to bid on each well. Contractors who have proven financial stability, well-maintained equipment, experience in the depth range area of operation, and a reputation of consistently good performance should be permitted to bid. Consideration should be given to the wage scale paid by the contractor for this will determine the caliber of personnel that he will have available for the job. Whether the contract is to be footage, daywork, or a combination of the two, time on a well represents cost to the operator. These costs are attributable to delayed completion of the productive well, mud maintenance and supervisory costs.

The operator's personnel can obtain information on a contractor's performance and ability through studying field bit records and comparing time on a well versus contractor. If these studies show that a contractor is consistently slower than his competitors, there is good reason to doubt his ability in the business which is supposed to be his specialty. Conversations with bit manufacturers, supply companies, other operators and the contractors themselves will provide answers to questions pertaining to financial stability, equipment maintenance, wage scale, and past experience in an area or depth range.

A small point, but one which will make bid evaluation much easier, is to provide the depth intervals on the well at which the daywork rates should be broken. These intervals should correspond first with the casing program and second with any other factor that might affect costs, such as depth, additional equipment, or additional personnel requirements.

An example of this would be a bid with the following casing program and special requirements:

<u>Casing Program:</u>

2 in. at 2000 ft
13-3/8 in. at 6500 ft
9-5/8 in. at 12000 ft
7 in. at 16000 ft
4-1/2 in. at 20000 ft

<u>Special Requirements:</u>

Degasser to be furnished by contractor from 14,000 ft to TD
Two Toolpushers will be required from 10,000 ft to TD

The bid request, for easiest interpretation, should then read:

<u>Daywork Rates:</u>	0 - 2,000 ft	———
	2,000 ft - 6,500 ft	———
	6,500 ft - 10,000 ft	———
	10,000 ft - 12,000 ft	———
	12,000 ft - 14,000 ft	———
	14,000 ft - 16,000 ft	———
	16,000 ft - 20,000 ft	———

In this manner the contractor can isolate his costs for each hole size and condition. Every place that the contractor has had a cost change he has had the opportunity to express that cost to the operator. The operator can determine the cost to drill each interval of hole more accurately and is less apt to pay for items not in use. In the example above, if there were no break at 10,000 ft the contractor would have to include the extra cost of the second toolpusher for the complete interval of hole from 6500 ft to 12,000 ft.

Finally, the operator should prepare an accurate, interval-by-interval, anticipated drilling curve. Then by plugging the contractors' bids into the time formula from this curve, the total contractor cost to the operator can be determined.

If only select contractors are permitted to bid, if all contractors have bid according to the requirements which have been set forth, if all equipment meets the minimum specifications, the contractor who submitted the lowest bid is selected.

SUPERVISION

Once the contractor has been selected, the operator's job becomes one of supervision. The supervision of drilling contractors varies greatly from company to company as well as from contract to contract. Normally, a rig on a footage contract will be visited only occasionally by a drilling foreman. These visits are usually restricted to trips to run casing, take a drill stem test, or to complete the well. A rig on a daywork contract, however, will usually have one or more full-time drilling foremen who stay on the rig to supervise the entire drilling operation.

Frequently on the daywork contract the drilling foreman feels that to obtain the maximum benefit for his company and to perform his job in the most satisfactory manner he should actually perform the services of the toolpusher; this should not be the case. A toolpusher is a unique combination of supervisor and technician. As was previously mentioned he has had to keep abreast of new drilling techniques and he has had the experience of putting these techniques to work for his benefit. The drilling foreman on the other hand has seldom had this opportunity.

All too frequently, when a drilling foreman does assume the toolpusher's responsibilities, a deterioration in the operation is soon noted. This deterioration can usually be attributed directly to the lack of experience on the part of the drilling foreman and to the loss of initiative on the part of all rig personnel. When this occurs more supervision from the oil company management is usually applied which further slows the operation as orders are communicated, discussed, and passed back and forth between the field and the management.

A suggested procedure of supervision of daywork operations is to approach the job in much the same way that most other oil field services are handled.

Initially have a meeting of key contractor personnel, discuss the planned drilling program and then give them the opportunity to make suggestions for improving the program or to agree on the basic plan of the original program. Explain to the contractor the progress which is anticipated and base this progress upon reasonable goals that experience has indicated can be obtained.

Let the contractor drill the well with a minimum of supervision; since drilling is his sole business it stands to reason that he is a specialist in this field. Since he has survived the industry decline he has had to be successful in applying new technology and since he was the chosen contractor he must have the equipment and the ability to drill this well.

Detailed graphs of anticipated depth versus anticipated days as shown in Fig. 4 will provide a good control device for the operator. Obviously, these graphs must be realistic to be of any value. Frequent visits by the drilling foreman with the toolpusher will keep both parties advised concerning anticipated drilling hazards, hole conditions, changes in lithology, and any changes in overall planning. If the contractor fails to maintain the performance curve, the contractor's superintendent should be consulted to see if he has any suggestions which might improve the operation. More than likely, under these conditions, the superintendent will have already been in touch with his toolpusher to try to seek ways of improvement. Improved communications between operator and contractor will prevent many would-be drilling problems from ever occurring.

On an operation such as this most operators are concerned when a fishing job occurs or when some severe problem does develop. The drilling foreman should go to the rig on a full-time basis when these things do occur but once again, he should not go with the idea of assuming the toolpusher's job. He should be there to co-ordinate the activities of the toolpusher, the fisherman, and any other service companies which may be involved. By consulting with these men, co-ordinating their efforts, communicating their decisions to his management and in turn management decisions to these men, he will insure the best possible results.

The success of a drilling operation supervised in this manner depends on a spirit of cooperation and good communications. It also depends on how well the operation was planned, how it was bid and on the selection of a competent contractor. The reward to the operator is reduced drilling costs due to reduced supervisory cost and a more efficient drilling operation.

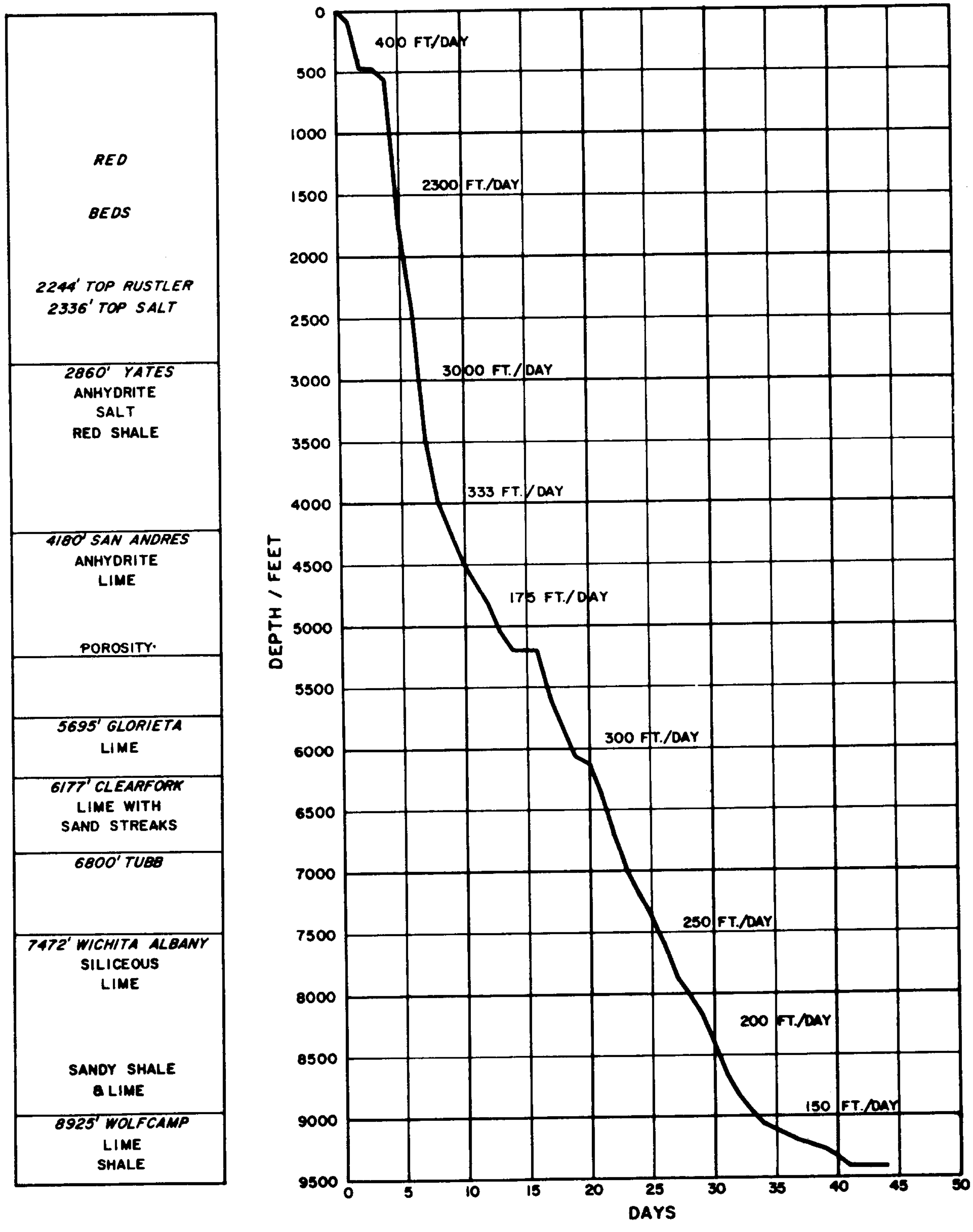

FIG. IV
OPERATION CONTROL GRAPH

REFERENCES

1. Editorial, The Oil and Gas Journal, The Petroleum Publishing Company, p. 97, October 10, 1966

2. Cole, F. W. and Moore, P. L., Drilling Operations Manual, The Petroleum Publishing Company, p. 6-14, 1965

3. Moore, P. L. "Circulating System Pressure Losses With Low-Solids Emulsion Muds", University of Oklahoma Research Institute Pamphlet, p. 5

4. Moore, P. L. "Economics Associated With Low Solids Emulsion Systems", University of Oklahoma Research Institute Pamphlet, p. 3