Offshore

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A thousand rigs could be needed to meet world goals

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There is a great deal of discussion today about future demand for offshore mobile drilling units. The increasing world demand coupled with recent skyrocketing crude oil prices has created an obvious market for offshore oil and gas exploration.

Offshore oil will form a very large part of future world production. Will the existing, under construction, and planned rig fleet be able to accommodate this production? How many unplanned units will be required? As part of an intensive research assign-

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Rig demand 1975-2025 based on reserves

Case	1	2	3	4
Construction period for unplanned mobile rigs (years)	25	20	15	10
Year last unplanned rig built	2000	1995	1990	1985
Estimated no. rigs to perform subsea completion	72	72	72	72
Total number unplanned rigs at 25 year rig life	850	850	850	850
Number rigs/year to be constructed in 1976 and onwards	34	42	57	85
Number 1st classs rigs in operation				
1975	375	375	375	375
1980	470	510	585	725
1985	565	645	795	1075
1990	660	780	1005	1000
1995	755	915	930	925
2000	850	840	855	850
2005	680	630	570	425
2010	510	420	285	0
2015	340	210	0	
2020	170	0		
2025	0			

ment, Engineering Technology Analysts, Inc. (ETA) of Houston has prepared comprehensive internal studies of the offshore rig market in answer to these questions. Excerpts from these studies, including short and long term projections of rig demand, are presented here.

Looking at the worldwide mobile rig situation, a historical perspective is vital to an estimation of future demand and supply. Many areas show obvious trends. North America, most particularly the Gulf of Mexico, has the longest history of offshore drilling and the greatest total number of units. The North Sea fleet is rapidly gaining in number, however, with half of the semisubmersibles now under construction committed for operation in its severe climate.

A big "sleeper" may prove to be the Mediterranean. Its mild weather conditions and less stringent equipment requirements are attracting a number of French, Italian, and Greek owners.

Until about 1970 the worldwide rig fleet was dominated by jackups. Strong interest in semisubmersibles then began to grow as a solution to the problems caused by the deep waters and severe climate of the North Sea, and has continued until very recently.

As early as 1972, however, studies were published showing a sound basis for renewed interest in deepwater jackups (Lovie, P. M., Lowery, E. L., "Jackup for 400 ft Water Depths Feasible," Oil & Gas Journal, Jan. 10, 1972). This was echoed in several studies by investor groups in 1973.

As design technology has advanced, jackups for 350-400 ft water depths are now becoming a reality and the trend seems to be reversing.

Cost trends

This is basically a matter of economics. Oil can be produced faster and more economically from the shallower areas which can use jackups for a more immediate return on the investment in drilling and production. Also the costs of building and operating jackups have risen less drastically than those of semisubmersibles and drillships.

If existing cost trends continue, it is possible that by 1985 semisubmersibles may cost $120 million and jackups $100 million. Two jackups were contracted in Japan recently for about $33 million each; four or five years ago the identical type rigs cost about a third of this. Costs are even greater for units designed to operate under more severe criteria.

The new and larger dynamically positioned semisubmersible designs today may involve costs of $60 to $65 million, and the drillships currently being announced for construction at $45 million would cost $60 million if they were contracted for construction two or three years from now.

Thus many mobile drilling units are currently appreciating rather than depreciating in value.

While the increase in rig construction costs is partly due to rising costs of materials and labor, another important factor is the growing size and advanced technological progress of today's rig designs.

Mobile rig trends

Existing jackups have gone from 50 and 100 ft up to 350-ft water depth capabilities in the past 20 years. Units operating today in 350-ft depths are really "standing on their tiptoes" in relatively mild areas and criteria such as nonhurricane conditions in the Gulf of Mexico.

However, two jackups* will be com-

Rig forecast based on offshore production

1985 offshore production, million b/d	35.7	40.8	46.0	51.0
1985 less 1972 offshore production, million b/d	26.6	31.7	36.9	41.9
Unplanned rigs required per year in 1976-1981	0	36	72	108
Retirements per year in 1975- at ½ of 20 year rate	5	5	5	5
Losses per year at 1% in 1975-1981	4	5	6	7
Total unplanned construction per year in 1976-1981	9	46	83	120
Cumulative unplanned construction in 1976-1981	54	264	498	720
Cumulative unplanned construction in 1982 operation	0	216	432	648
Cumulative planned & unplanned construction in 1982 operation	375	591	807	1,023

Note: Planned construction represents rigs that have already been committed for construction. Unplanned construction thus represents rigs not yet committed for construction.

Ideal rig mix in construction

World oil production offshore			
Percent of total production	40	45	50
Total units in 1982 operation	591	807	1023
Existing fleet plus unplanned construction:			
Ideal 48% jackups	284	387	491
Ideal 27% Drillships	159	218	276
Ideal 25% Semisubmersibles	148	202	256
Unplanned construction only:			
Jackups	123	226	330
Drillships	67	126	184
Semisubmersibles	26	80	134

*"Dyvi Beta" and "Dyvi Gamma" due for delivery in June and November 1976 from CFEM for K/S Dyvi Drilling II A/S of Oslo, Norway. These are of ETA Europe Class design, being built to Det Norske Veritas and Norwegian Ship Control requirements.

FIG. 1 (Cont'd)

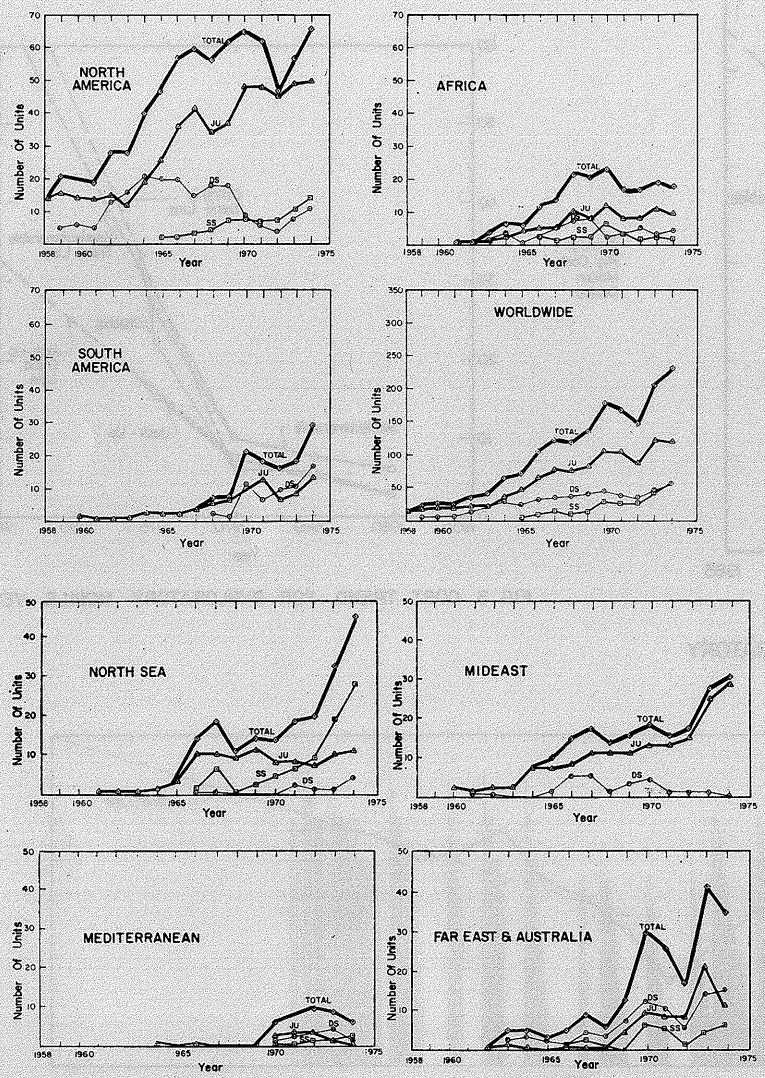

FIG. 1 ANNUAL AREA DISTRIBUTION OF FIRST CLASS RIGS BY TYPE

pleted in 1976 which can operate in 350 ft of water in the severe conditions of the North Sea, with an extended water depth capability of about 430 ft in the Gulf of Mexico. An increasing trend now is the investigation of jackups as combination drilling-production platforms to speed the cash flow from new commercial fields.

With the advances in mooring systems and the use of dynamic positioning, the water depth capability for drillships seems to be virtually unlimited. The drillship fleet has grown rapidly with over half of the vessels in existence today having been built as conversions rather than as new ships. Concurrently, the size of drillships is increasing.

Drillship conversions are now being investigated on 25,000 to 35,000 ton bulk carriers as opposed to the much smaller vessels of two or three years ago. Even for new vessels, drillship lengths are clustering around 500 ft.

These sizes are more suitable for drilling in deep waters and rougher seas; in addition, they facilitate the use of dynamic positioning. The larger, dynamically positioned drillships are highly mobile and can easily operate in remote areas and occasionally in very deep waters with a minimum of logistics support and without the need for anchor handling equipment or support vessels.

Semisubmersibles currently offer water depth capabilities generally ranging from 600 to 1,500 ft and compared to jackups or drillships are better able to withstand severe weather conditions in these water depths.

Around 1970, the trend began toward the "giant" semisubmersibles for the North Sea. The trend is toward increasing deck envelope size (length x width without allowance for cut-out areas). However, many of these units are operating today in water depths and criteria below their ultimate expected capabilities, an inefficent practice considering the huge operating costs.

Interest therefore is now turning to the "compact" semisubmersibles, which cost 65% to 75% as much as the "giants" while achieving 90% to 95% of their performance,. thus decreasing the downside risk. The ETA S-5 semisubmersible, for example, uses 4,700 tons of steel, about half that used by the larger units.

One of the controlling features of semisubmersible demand is believed to be the future expected use of these units for development drilling with production accomplished by subsea completion.

Another is the opening of new areas for exploration in deeper, rougher waters where these units are most efficient.

Future rig fleet

The worldwide rig fleet at the end of 1974 is expected to consist of 25 submersibles and 262 first class rigs (121 jackups, 69 drillships, and 72 semisubmersibles). Several estimates of rig life have been made affecting the projected life of the fleet. Replacements for retiring and lost rigs, as well as additions to the fleet to meet the expected demand, will be necessary.

A short range forecast of the desired rig fleet in 1982 is based on offshore production. The estimated worldwide production which will be handled offshore is indicated by extrapolation from past trends in U.S. production.

Taking the minimum estimate of additional offshore production required in 1985, 26.6 million b/d, and incorporating rig retirements and losses, nine offshore mobile drilling units per year will be needed in addition to those planned for construction.

Increasing offshore production by

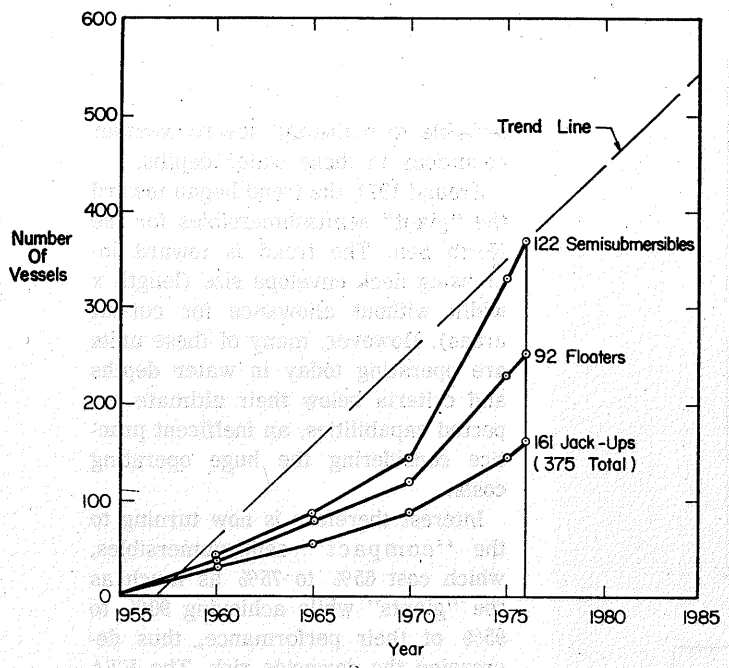

FIG. 2 ACCUMULATIVE NUMBER OF OPERATING EXPLORATORY VESSELS BY YEAR

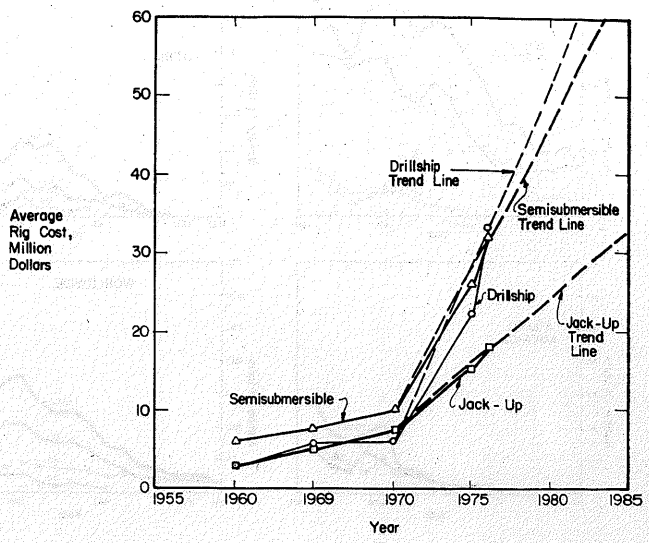

FIG. 3 COST TREND FOR EXPLORATORY MOBILE VESSELS

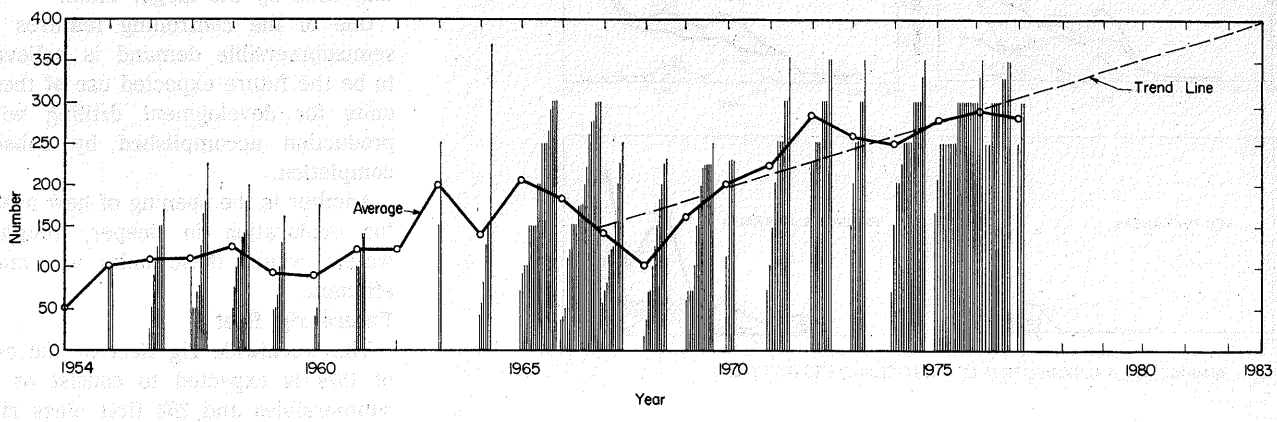

FIG. 4 NUMBER OF JACK-UPS BUILT BY WATER DEPTH BY YEAR

31.7 million b/d calls for an increase in demand to 46 rigs per year.

Thus, a relatively small increase of 19% in the demand for offshore oil production creates a very large increase of 411% in the demand for new offshore units. If one considers offshore production of 51 million b/d in 1985, about 120 new units would have to be delivered each year in the 1976-1981 period.

The U.S. Federal Energy Administration's most recent study reveals the strong dependence of U.S. production on the price of oil. In 1985, production could vary from about 7 million b/d at $4 per barrel up to about 21 million b/d at $20 per barrel. Oil production is well developed in the U.S., with a reserve-to-production ratio for crude oil of 11.1 at the beginning of 1974.

A recent survey shows that the additional recoverable crude in the U.S. from stripper wells varies between 250 million barrels at $5 per barrel to 2.8 billion barrels at $14 per barrel.

At $11 per barrel, the economics justify an increase in the recoverable amount to 2.3 billion barrels (about 8 months' supply), for a 6% increase in the ultimate recoverables.

This pattern, however, is not applicable in the newly developing offshore areas and the newer, still developing onshore fields. Thus the demand for offshore drilling rigs is sensitive to the price of crude oil.

Rig market

A long term indication of how sensitive the rig market is to the demand for offshore production can be found from past offshore work and looking at the amount of discoveries to be made. To determine the number of rigs needed per year, accounting for historical rig losses and retirements, the rig requirements were calculated for finding the ultimate undiscovered recoverable reserves. This forecast ignores the economics involved.

Obviously some of this oil will be far too expensive to recover by today's standards. Nevertheless, there is a possibility that the public could eventually choose to continue using oil (perhaps at a slightly reduced consumption rate) no matter how expensive it becomes.

An estimate is used for the ultimate

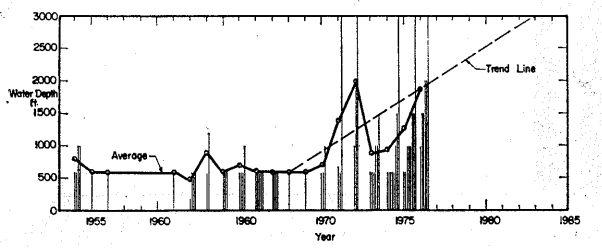

FIG. 5 TREND IN WATER DEPTH CAPABILITY OF DRILLSHIPS

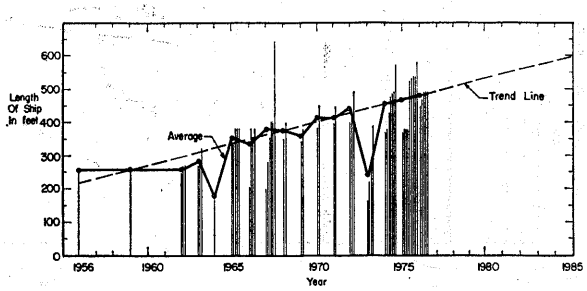

FIG. 6 TREND IN DRILLSHIP SIZE

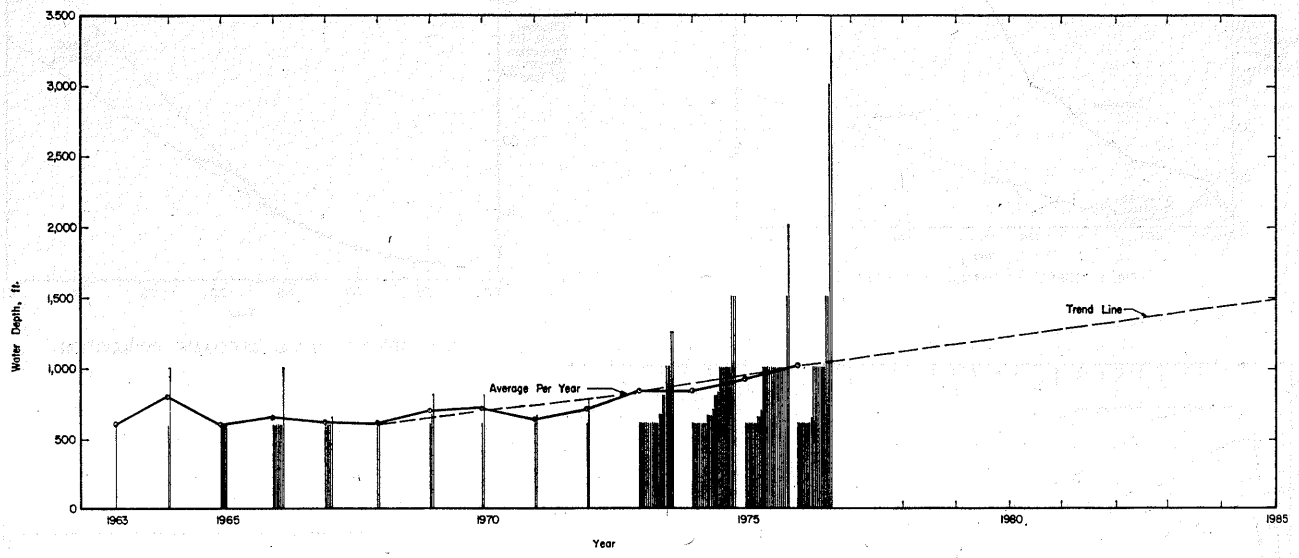

FIG. 7 TREND IN WATER DEPTH CAPABILITY OF SEMISUBMERSIBLES

recoverable reserves offshore less the discovered recoverable reserves and production of 1,411 billion barrels. Looking at possible construction rates, we can translate this into a demand for 778 new rigs through the year 2000.

The growing trend toward the use of subsea completions will increase this demand further. Assuming 20% of the required number of production wells will be accomplished by subsea completion, a demand is foreseen for about 72 additional rigs, making a total of 850 offshore mobile drilling units.

The above formulations can be summarized for four cases studied of the construction period required for delivery of the necessary unplanned rigs to complete discovery of the total offshore recoverable reserves. Case 1 represents a 25 year span for completion of the required units, at equal annual rates. The process is repeated for 20, 15, and 10 year periods. It is seen that annual rig construction will range from 34 mobile units per year (a quantity slightly under the present worldwide shipyard capacity) to 85 units per year.

The maximum numbers of operating rigs for the four cases studied vary between 850 in the year 2000 (Case 1) to 1,075 in 1985 (Case 4).

The time span involved is naturally dependent on economics. If the world were willing to pay only $2 per barrel for crude oil, the ultimate total reserves would then last hundreds of years instead of the 50-60 years indicated here. Shipyard capacities will also be a somewhat limiting factor in determining the time span during which the required construction will take place.

In 1975, the U.S. government is planning to offer about 19 million acres in selected offshore areas of the U.S. for drilling which will probably result in the lease of about 10 million acres. This is an amount equivalent to the acreage leased in the Gulf of Mexico in the total 20 years of lease sales.

If the U.S. is to be self-sufficient in oil by 1985, with unchanged current trends and all of the increased demand to be met by U.S. offshore production, it would take a rig fleet of 800 offshore mobile units operating from the

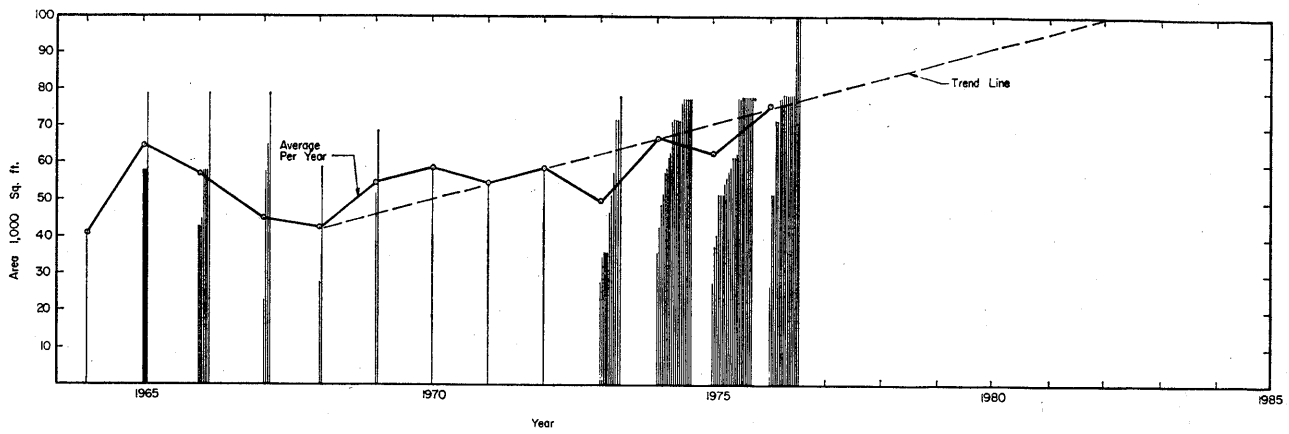

FIG. 8 TREND IN DECK ENVELOPE SIZE FOR SEMISUBMERSIBLES

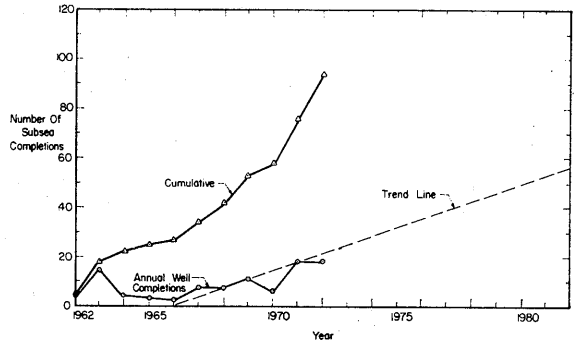

FIG. 9 TRENDS IN SUBSEA COMPLETIONS

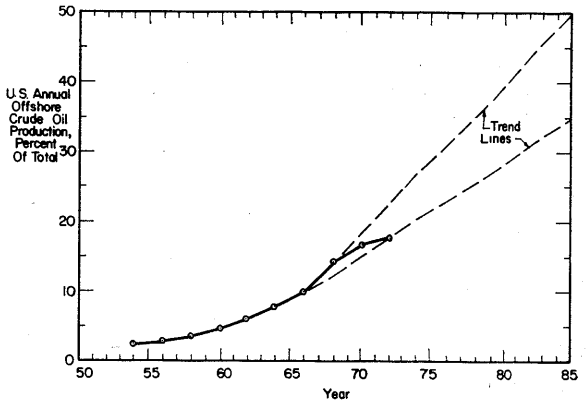

FIG. 11 TRENDS IN U.S. OFFSHORE PRODUCTION

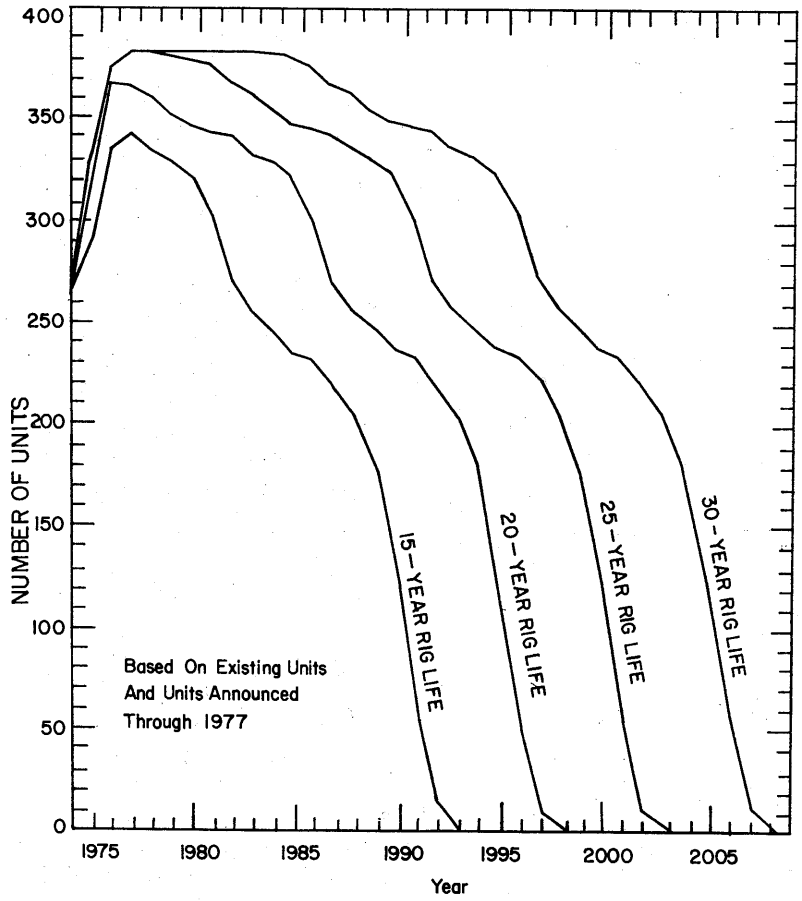

FIG. 10 LIFE EXPECTANCY OF EXISTING FIRST CLASS WORLD WIDE MOBILE RIG FLEET

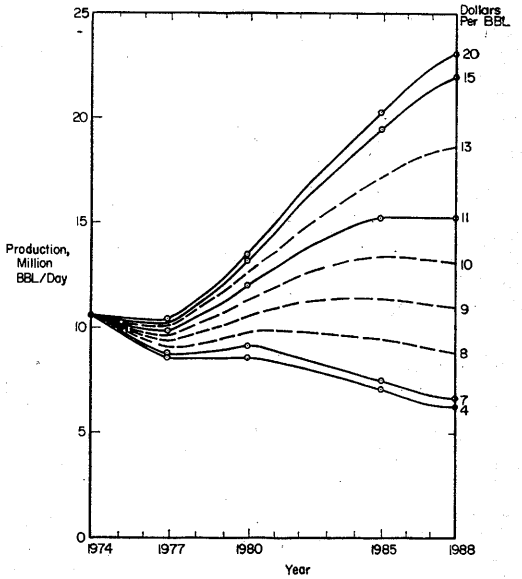

FIG. 12 US OIL OUTPUT-ACCELERATED DEVELOPMENT 1974 - 1988

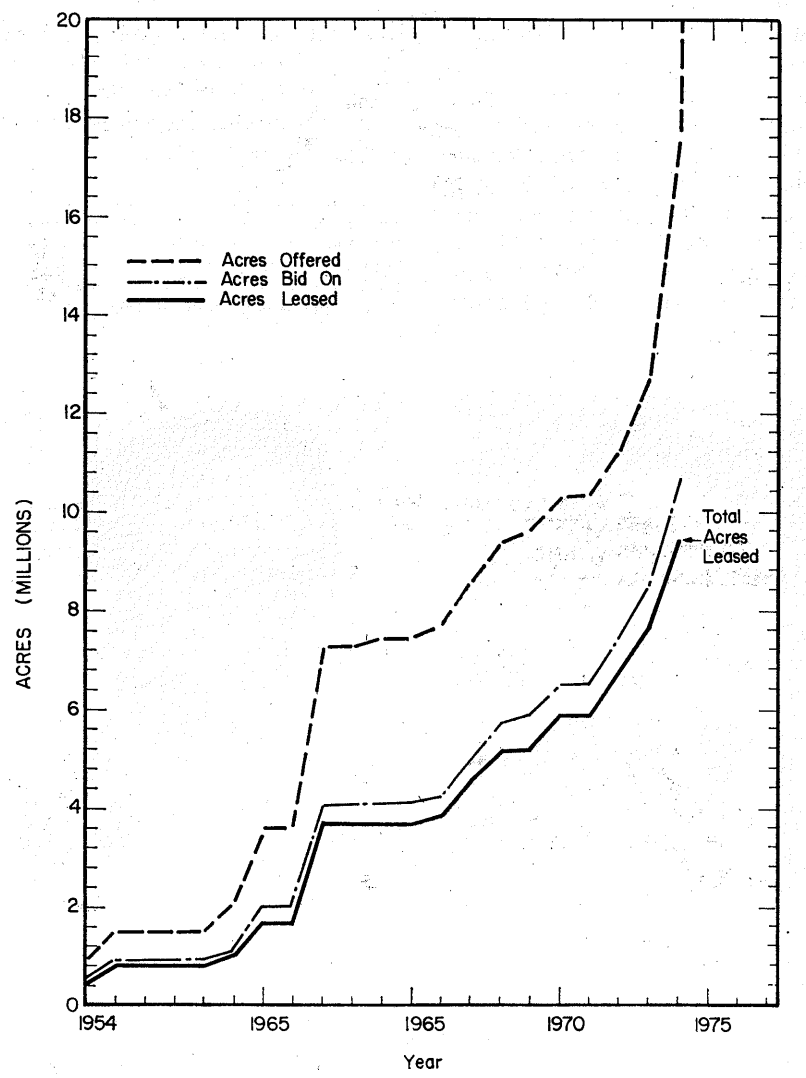

FIG. 13 CUMULATIVE ACRES LEASED, GULF OF MEXICO

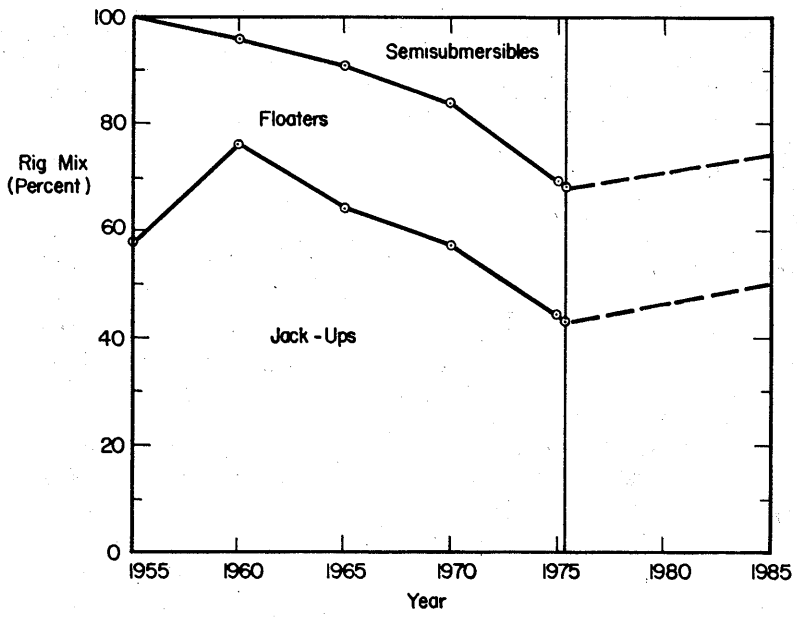

FIG.14 COMPOSITION OF WORLDWIDE EXPLORATORY FLEET

present to 1985 to achieve that self-sufficiency, i.e. more than twice the current worldwide fleet.

Ideal rig mix

Given today's rig fleet and the current and future capabilities of the type of units, what will be the ideal rig mix to handle the demand for offshore production?

A study of world bathymetry was made for water depths up to 3,000 ft to determine areas suitable for jackups versus drillships or semisubmersibles. Worldwide weather data were also reviewed to determine areas of extremely harsh environments. It was concluded that sufficient work is available in the rough waters offshore Eastern Canada, Africa, Australia, and the North Sea to keep the large semisubmersibles now operating and under construction or planned fully occupied until retirement.

Based on these bathymetry and weather studies and incorporating rig mobility and assessments of geological formations, it was determined that the ideal rig mix is 48% jackups, 27% drillships, and 25% semisubmersibles.

Current construction trends oppose the achievement of the ideal rig mix by 1985. The rig mix of unplanned construction to bring the world rig fleet to the ideal mix is based on the percentages of offshore production demanded. Thus there are significant opportunities existing in the marketplace for potential rig builders to build additional units to correct this imbalance. Likewise, there are profitable opportunities existing today for owners of certain types of units until a closer alignment of the actual rig mix and the ideal rig mix is achieved.

Shipyard capabilities

In 1973, 31 new offshore mobile drilling rigs were delivered. The rig order book is 55 for 1974, 68 for 1975, 45 for 1976, and 8 for 1977, with delivery dates being extended in many cases. The current normal worldwide shipyard capacity for offshore rigs is estimated at about 35-40 units per year.

The above studies predict a rig demand well beyond the capacities of the worldwide shipyards at least through 1982. Taking a high estimate based on 50% of the world's production being offshore in 1985, with the

cumulative planned and unplanned rig construction, 1,023 rigs would have to be operating in 1982.

This demand figure will be impossible to achieve under present conditions considering that only 375 offshore rigs are expected to be in operation by the beginning of 1976. With the current maximum shipyard capacity of about 40 rigs per year for 1977-1982, the maximum supply of rigs for operation in 1982 would be 615 rather than the demand of 1,023.

One factor in increasing future shipyard capabilities is the possibility of rig production through the combined strategies of serial production of standard designs and subcontracting of major components. Very significant savings can be realized by building several rigs in a series. The current shortages of vital construction materials and the necessity of upgrading rig designs for new environments and therefore construction technology are complicating factors.

Significant economies are being obtained through advanced technology with the new generation of rig designs offering improved performance at 65% to 85% of the steel weight used in past designs.

The subcontracting method, utilizing for example construction of the jackup hull and legs at separate shipyards and assembly at a third shipyard, would thus improve shipyard capacities. This technique has been successfully used in Scandinavia in the construction of semisubmersibles.

Another possibility for increased rig construction may be found if shipbuilding demand continues to decline, which is currently happening due to the downturn in the tanker market. Many shipyards can then profitably turn to offshore rig construction if demand follows the trends projected here.

Conclusions

The demand for offshore mobile drilling units is thus extremely sensitive to a number of factors: the price of crude oil, the offshore production desired, the opening of new areas for drilling, and return on investment. The supply is tempered by rising costs and shipyard capabilities.

Although it is difficult to predict the production situation 10 years from now due to the uncertain effects of political and economical activity, our studies lead us to estimate that not less than 40% of the worldwide production will be handled offshore at that time, creating a rig demand of at least 600 units by 1982.

The long term study of reserves and other studies on expected production demands indicate a demand for up to 60 new units per year for the next 15 years.

Even with the most pessimistic outlook, all of the data derived from this study indicate that with the increasing worldwide demand for offshore oil, the demand for new rigs cannot fall below the total worldwide rate of construction of about 40 rigs per year (i.e., about the worldwide current rig building capacity) for the forseeable future.

It now seems obvious that the annual construction of offshore mobile drilling units should be increased considerably to meet future production demand and necessary discovery rates, particularly for the U.S. to achieve self-sufficiency in exploration and production by 1985. □

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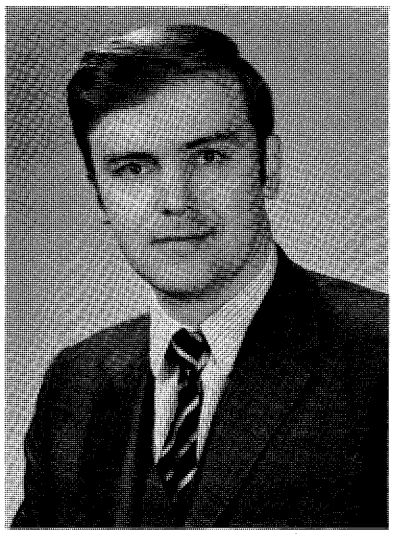

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