

Chapter IV.—Evaluation and Comparison of Exploration Alternatives

A. Introduction

The issues against which the exploration alternatives described in Chapter III were evaluated are identified and discussed in Chapter II. These can be summarized as follows:

1. Public Availability of Resource Information.
2. Public Control of Resource Development.
3. Return to the Public.
4. Efficiency of Exploration.

The exploration alternatives described in Chapter III all deal with separation of exploration from production as a means of resolving one or more of the above issues. It should be recognized that there are numerous other methods of modification of present lease practices to resolve one or more of the issues even though only one to two maybe indicated herein.

This Chapter is organized into three sections. The first compares limited, intermediate and full exploration programs. The second includes comparisons of systems which separate exploration from production with present leasing practices, as well as with possible modification of the present practices. These are considered in the context of the issues stated above. The third section then compares industry-executed to government-contracted exploration programs.

B. Consideration of Limited, Intermediate and Full Exploration Programs

In evaluating whether limited, intermediate or full exploration programs are most effective, the following observations can be made:

1. Any of these programs would start, with the best targets in each frontier area and proceed to the next best, as does the limited case. Therefore, the limited (large target) program would in fact be the first phase of an intermediate or full program.
2. A full program is impossible to quantify since no information on the number or size of small traps, if any, is available.
3. On the assumption that 50% of the total potential reserves exists in the traps included in the limited program, it is the most cost-effective or least-risk program.

It is evident that an intermediate program represents only an extension of a limited program. and that a full program is an extension of an intermediate program. Consequently, should it be decided to proceed with any exploration program preceding lease sales in frontier areas, the greatest flexibility can be achieved, without additional penalty to the resolution of the issues, by beginning with a limited program and deferring decisions to extend the program to an intermediate or full scale.

C. Comparison of New Exploration Systems (Government or Industry) to Present Leasing Practices—With Comment on Modification of Present Practice

This section will evaluate how the alternatives would affect resolutions of the issues identified earlier by comparing the proposed, new exploration system (called "Separation System") with the "Present Practice" and "Other Possibilities".

1. PUBLIC AVAILABILITY OF RESOURCE INFORMATION

Separation System

This method would require public disclosure of all resource information when it becomes available.

Since a controllable delay between discovery and production would exist, and since all resource data would be made public, there would be adequate information and time for impact planning.

Present Practice

Present practice requires that raw data from drilling results be provided to the Department of the Interior by the lessee. Early public disclosure is currently prohibited by regulation, and the industry is strongly opposed for competitive reasons to public disclosure of drilling data. For example, the lessee owning rights to a tract which covers only a portion of a trap derives information that is extremely valuable in evaluating adjacent tracts overlying the same trap. Thus, competitive considerations make the lessee strongly opposed to releasing data that could help the competition in future lease sales.

Other Possibilities

Leasing by trap instead of tract or by mandatory unitized exploration would greatly reduce industry opposition to releasing data.

2. PUBLIC CONTROL OF RESOURCE DEVELOPMENT

Separation System

The new system would retain production decisions in the hands of the government; as such the development rate can be publicly controlled. However, any delays in eventual production caused by the government after discovery could serve to reduce the present value of the resources, the costs of which would have to be weighed against social costs of the probable impacts from production.

This method would provide a mechanism to lease for production as resources are discovered, if desired. However, any new system would delay significantly the start of production for three reasons: (1) after discovery, the government would require a certain amount of time to decide whether a production lease would be offered, (2) a lease sale would be held, and (3) a production platform could not be ordered

¹See Definition of Terms, p. vi!.

until after the production lease was awarded.² (Normally the industry would order a platform soon after the initial discovery.)

The new system would allow for indefinite deferral of production, if desired. It also would allow for control of the rate of production by stipulating conditions for production in the lease. However, costs of deferral or non-production would have to be weighed against social cost of producing as discovered.

Present Practice

The present system has no provision, except those covering war and environmental emergencies, to postpone production indefinitely.

Other Possibilities

Provisions could be added to present lease requirements to provide authority for postponements. However, such provisions would have to be structured so that bids would not be reduced to discount the uncertainty of postponement.

(Presently development plans require approval by the Department of the Interior [and other agencies], which would probably also be required under a new system. Normally approval of plans has been without delay .)

Leases could be readily modified to require plans as to how the rate of development might be reduced to moderate impacts; however, a mechanism would have to be devised to compensate the lessee for modifications of his plan. Otherwise, it is possible that all bids would be lowered to discount the uncertainty and potential costs of deferred production.

Other possibilities include various forms of work programs* which could include profit-sharing, royalty, or still other methods of compensating both the producer and the government. The principal provisions any of these would require are for termination, and for compensation to the producer (from the government share) for any real costs the producer would incur in slowing or changing the production plan to accommodate government (social) needs or to moderate impacts.

3. RETURN TO THE PUBLIC

Rate of return is affected by the reaction of bidders to the reduction of uncertainty of resource existence and size, which is discounted by probability of the existence of the resource. Existence, and to some extent size, of the resource is established through exploration thus reducing or eliminating the discounting of bids made for production rights.

Quantifying the precise effects on government returns is very difficult; however Section IV-E contains a discussion of the factors associated with changes in uncertainty.

² Platforms cannot be inventoried because they must be tailor made for water depth, bottom conditions, sea conditions and number of wells.

* A work program is an agreement to perform a stated amount of exploration as part (or all) of the bid for lease, and may be in lieu of some or all of the cash otherwise offered.

4. EFFICIENCY OF EXPLORATION

Separation System

The proposed new system which is designed to explore on a full trap instead of a 5,670 acre tract basis, and utilizes a priority selection of best target first, is the most efficient method. However, uncertainties are introduced in: (a) the government case, in terms of lack of government experience and equipment availability; and (b) the industry case in terms of the adequacy of an incentive system, either of which could affect the speed of exploration. This is addressed more fully in Section IV-D (below) which compares industry and government exploration programs.

Present Practice

As long as BLM continues to sell marginal tracts for exploration, sells by tract instead of trap, or does not require exploration by utilization, the existing system will be less efficient. At present, drilling equipment is used on marginal areas and several units are frequently used on the same traps, both of which contribute to inefficiency. The present system benefits from government and industry personnel experienced in administering and carrying out exploration programs. Equipment under contract by industry can be moved from marginal areas to new, high-priority leases acquired in a sale, thereby contributing to rapid exploration. Uncertainty in the present system derives from the threat of delays by states and environmental interest groups.

Other Possibilities

If traps instead of tracts were leased, and marginal land held for later years, with only the best traps offered in the next few years by BLM, then efficiency would be substantially increased. At present, an Environmental Impact Statement (EIS) is required prior to leasing. That EIS must cover exploration and possible production which may result from leasing. The statement must of necessity be very vague since the time, location, and size of the discovery, if any, is unknown. Therefore, the location, magnitude and rate of impacts can only be generalized.

If an EIS were to be made on exploration only, which has a far smaller impact than production, and a subsequent EIS were made after discovery, it would be possible to achieve far greater precision in estimating production impacts. The results could be a reduction in the criticism and delays caused by fears of the unknown consequences of leasing.

D. Comparison of Government vs. Industry Alternatives

This section will compare the government vs. industry alternatives within the proposed new systems for separating exploration from production that have been described in Chapter III.

Since we have eliminated further consideration of intermediate or full scale exploration programs, this discussion is confined to a comparison of a limited government program with a limited industry pro-

gram. Both of these alternatives provide for the same degree of separation of exploration from production and follow the same procedures for exploration. In the government case, however, the government would conduct all operations and contract for services, while in the industry case, industry would conduct exploration by the means of a lease or license with incentives to explore.

This comparison is made relative to the same issues used in the previous comparison. The effects of the alternative systems will be discussed for each issue.

1. PUBLIC AVAILABILITY OF RESOURCE INFORMATION

a. Government

So long as it is practical to carry out a limited exploration program prior to a leasing decision for production in accordance with our treatment in this report, it may appear that resource levels could be determined, and the information made available to the public with comparable accuracy, regardless of who (industry or government) conducts the program. There is, however, a major uncertainty associated with government determination of oil and gas reserves, stemming from the fact that the exploration process is more of an art than a science. It is generally agreed, as well, that the experts in this art are now concentrated within industry, not within government. The government alternative thus tends to offer a lower probability of success in determining the extent of a resource.

b. Industry

The industry alternative would tend to produce resource information more rapidly if an adequate incentive were provided for exploration. The incentive system would also need to provide for public availability of this information. The time it would take to transfer information to the public within a structured industry exploration arrangement could modify the initial time advantage.

2. PUBLIC CONTROL OF RESOURCE DEVELOPMENT

The extent to which the development of whatever resources are discovered on the OCS can be controlled has been considered in the structuring of alternatives for separating exploration from production.

In the structuring of government and industry alternatives, we have made certain assumptions that provide the same choices for production of any discoveries made—regardless of whether government or industry conducts the exploration. That is, in either case, the same level of control could be exercised over development and production. This assumes that appropriate incentives for exploration could be given industry without reducing control over production.

a. Government

If the government alternative described were implemented, it is estimated that the earliest years by which one could expect production from the OCS areas studied are 1983 in the Mid-Atlantic and 1985 in

the Gulf of Alaska. Variations in these estimates could be expected if exploration were much more or much less successful than anticipated; the estimates reflect principally both the normal lead times necessary to obtain personnel and equipment and the time required to carry out the work efforts. Normal government procurement and contracting procedures are also assumed for the government exploration case. If lags inherent in government contracting (at each stage of major equipment purchases) could be reduced for this program, the time could be reduced.

b. *Industry*

Our estimates of earliest production from the OCS under the industry alternative range from 1981 for the Mid Atlantic to 1983 for the Gulf of Alaska. The same normal equipment lead times were assumed, but allowance was made for earlier start-up by industry because staff and equipment are assumed to be available at once. It was also assumed that industry would follow its normal practice of very rapid contracting and commitment of exploration resources.

3. RETURN TO THE PUBLIC

a. *Government*

Whether a discovery is made under either an industry- or government-conducted exploration program, the question of fair return to the public relates principally to possible mechanisms for leasing that discovery for production.

The government exploration alternative and subsequent production leasing would increase the assurance of a fair—not necessarily larger—return to the public. As discussed in Section E, below, the process of leasing after exploration, and the consequent reduction of uncertainty, would tend to bring any production bid much closer to expected value of the resource.

b. *Industry*

In the case of industry exploration, one of the major problems is to devise a system which will provide industry with adequate incentives to explore when discoveries either might not be produced at all or delayed for some unpredictable time. This in turn makes the issue of return to the public difficult to judge until a precise industry exploration mechanism, with incentives, has been developed. We have not developed such a system, but several have been proposed that offer certain advantages.³ Mechanisms to be considered in developing such a system are identified below as they relate to two categories of bidding systems that can be envisioned.

(1) LEASE INCLUDES EXPLORATION AND PRODUCTION RIGHTS

In this category of alternatives, the incentive to explore is provided by giving the willing bidder preference in the right to develop. Of course, the difficulty posed by the concept of separation is how to make a lease award that is not also an *a priori* commitment to development. One possible way around this is to give the exploring lessee the right to develop *if* de-

See Appendix 3.

velopment is to take place at all. If, on the other hand, the government decides not to develop a field, then the company could be reimbursed for its exploration and other costs.

Of course, systems in this category do not get at the entire problem of assuring fair return to the public, since bidding still takes place under great uncertainty (i.e., prior to exploration). In fact, there would be even more uncertainty introduced because of possible production delays or no-production decisions. Any or all of the proposed systems normally considered in attempts to improve fair return (e.g., royalty bidding, profit-share bidding, etc.) could be utilized, but each has some difficulties. Alternatives falling within the category of lease-with-production-rights are most viable under a profit-sharing system or work program.

(2) EXPLORATION LEASE FOLLOWED BY PRODUCTION LEASE

In this category of alternatives, some systems could be devised to provide an incentive for the industry to only discover oil, with no production preference. With any discovery the government would then decide when (or whether) the oil should be produced, at which time it would put a production lease up for competitive bidding, just as in the government exploration case.

The basic difficulty is whether a system can be developed which will provide the industry with sufficient incentive to perform adequate exploration, carry with it no preferred right to develop, and at the same time not seriously affect other issues, such as fair return to the public. A competitive exploration lease sale could be held which would grant rights to the bidder offering to find oil at the lowest per barrel cost to the government, or a lease could be granted based on a work program plan which would include a fixed return to government for oil discovered. Many other systems could be proposed, but whether an adequate system can be designed will require study beyond the scope of the present effort.

4. EFFICIENCY OF EXPLORATION

a. Government

Chapter III presented estimates, based on both existing data and present practice, of the time and costs that would be involved for both government and industry exploration. In terms of cost per barrel of oil discovered, assuming most optimistic discoveries in each case, the government alternative would cost only slightly more than the industry alternative. In the government case, the cost is naturally assumed to be a direct, appropriated expenditure which would be offset only if adequate discoveries were made and subsequently leased under a system assuring a fair rate of return. Estimated government exploration costs for a limited program range from approximately \$595 million in the Mid-Atlantic to \$1,680 million in the Gulf of Alaska.

The time efficiency of a government program is more difficult to assess. It appears that the start-up time and the early phases of exploration would be longer for government than for industry. This would be principally due to the government's need to obtain personnel and equipment resources for the government option comparable to those already existing within industry. Our estimates indicate that this would tend to delay early exploration, if conducted by the government, by ranges of 1 to 2 years. However, in a well-designed program, it is not possible to discern any difference after several years between government and industry options. The possibility remains that government would be less efficient than industry due to lack of competitive pressure, but such risk cannot be quantified.

b. Industry

Compared to the government case, exploration by industry would probably be more efficient on a cost basis, but when related to the incremental cost per barrel of oil discovered, the difference appears to be small. It should be noted that with industry exploration, all costs would be incurred by industry. Industry's return, however, would be expected to be obtained from either discount reductions of bids, direct payment by government, or subsequent shares of future production. How such a return would be implemented depends on the exploration licensing system devised.

The delays in the government exploration option noted above would indicate industry exploration would be more efficient. This perceived greater efficiency, however, could also be affected by methods selected for licensing, leasing, and providing incentives. In this case a maximum incentive would be needed.

E. Factors Affecting Return to the Public

The major impact of separation of exploration from production on the return to the public would result from the expected large reduction in the financial risks that are involved in the current leasing system.

Under the present system, the firm interested in bidding for an OCS lease is faced with major uncertainties about three basic factors: (1) the actual level of resources that will be found in the tracts under consideration; (2) the costs of finding and producing those resources; and (3) the price for which those resources can be sold when they are produced. Exploration prior to leasing for production can be expected to significantly reduce the uncertainties about both (1) and (2); whereas the long-run uncertainty about price (3) will not be affected by any of the alternatives under consideration.

Those reductions in uncertainty should affect the return to the public by affecting the amount that interested firms are willing to bid for the resources being offered for lease. Three general areas of effects will be considered: (1) improvement of the firm's estimate of the expected present value of the discoverable resources; (2) reduction of any discount of the bid resulting from aversion to risk; and (3) increase in competition in the bidding process.

1. Improved estimates of expected value of resources

One of the major determinants of the amount that a firm would be willing to bid on an OCS tract is the firm's estimate of the expected present value of the resources that maybe discovered in the tract. This estimate will be based on the firm's expectations about the amount of discoverable resources, the costs of exploration and production, and the price the resource will bring in the market. If these values were known with certainty, the firm could simply project the time streams of revenues and expenditures and calculate a net present value using the firm's minimum acceptable rate of return on investment as the discount rate.⁴ The net present value calculated in this way represents the return to the firm at the normal return to capital that would be needed to induce the firm to produce the resource at all, and is sometimes referred to as economic *rent* or *excess profit*. The firm's estimate of this economic rent is the upper limit to the amount it would be willing to bid for the right to explore and develop an OCS tract. High competition in the bidding recess would lead the firm to offer all of the economic rent, as a bid, leaving it with a normal return on its investment.

Because the firm is in fact very uncertain about the actual values of the basic factors entering the calculations, it must make subjective estimates of the various values that those factors might take on and of the probabilities associated with each of these values. It then can calculate an *expected* present value of economic rent by calculating the present value for each of the possible combinations of values of the basic factors, weighting each calculated value by the probability that it will be the true value, and summing these weighted quantities. The resulting expected present value would be the upper limit to the amount the firm would be willing to bid for a tract.

In the past lease sales, the bidding firms' estimates of the expected present value of OCS tracts may not have been near the values they would have calculated if they had had no uncertainty about the basic variables, but there are no strong *a priori* grounds for determining whether the firms have been on the average either under- or over-optimistic in their expectations. In either case, the reduction of the uncertainty about both discoverable resources and the costs of exploration that would result from exploratory drilling prior to leasing should move the bidders' estimates of the expected present value toward the true resource value.

On individual tracts, the change could be in either direction. If the exploration reveals the presence of hydrocarbons, the calculated expected value would go up significantly; if all of the exploratory holes were dry, it would drop significantly. However, while exploration prior to leasing would clearly have a major impact on the amount bid on individual tracts, reducing it on some and raising it on others, it is not clear what the net effect would be when these changes are aggregated over the total area offered for lease. If the industry has, on the average, been conservative in its estimates of expected present value of economic rent, as could be the case if firms make conservative probability estimates as a means of hedging against risk, then reduc-

⁴See Appendix 4 for a more detailed discussion of the points raised in this paragraph.

tion of uncertainty by exploration prior to leasing should on the average increase the bidders' estimates of tract values. If competition for tracts is high, this should in turn lead to an increase in the average level of bids, other things being equal. On the other hand, if bidders have on the average been over-optimistic in their expectations, a reduction in uncertainty would by the same token lead to a downward shift in the average level of bids toward the true resource value of the tracts being offered.

It is difficult to predict the direction of the shift in the bidders' average estimates of expected tract values and the resulting effects on bids that would be produced by exploration prior to leasing. This would depend upon whether current industry tract evaluation procedures tend to overestimate or underestimate resource values. Of course, the competitive bonus bidding system tends to award tracts to the bidder with the most optimistic estimate of resource potential, but one cannot simply conclude *a priori* that the winning bids have therefore necessarily been above the true resource values on the average, since other factors—such as the bidders' assessment of the competitive environment—also affect the levels of bids. However, analysis of past performance suggests that on the average the high bidders may have in fact been over optimistic.

Several studies of the results of lease sales up to 1972 conclude that industry returns on OCS investments have not in general been above a normal return on capital, and may indeed have been below normals. If this conclusion is correct, it would imply that the industry has not on the average underestimated resource values, and may in fact have overestimated them. In this case, reduction of uncertainty by exploration prior to leasing would tend to move bids downward on the average, ignoring for the moment the other effects discussed below.

One potential limitation of these historical analyses is the fact that the most reliable estimates of return on investment are those made on relatively old, mature tracts which have been thoroughly explored and are well into the production phase, which in general are tracts leased ten or more years ago. If there have been significant improvements in the oil and gas companies' techniques for estimating resource values during the past ten years, it would be necessary to exercise some caution in using the results of these historical studies to project the direction of the effects of reduction of uncertainty in future bidding. However, whether the effect of reduced uncertainty is to raise or lower the bidders' estimates of resource values on the average, it is clear that in either case these estimates will move towards the true value of the resources.

2. Reduction of risk discounts

Under the present system, investment in an OCS tract is an extremely risky proposition, because of the large bonuses required and the great uncertainty about amount of resources that will ultimately be recovered. This high level of risk can be expected to have two effects on the amount a firm is willing to bid on any particular tract. First, it may raise the cost of capital to the firm above the level

⁵ See Appendix 4, J. W. Devaney, III, *The OCS Petroleum Pte.*, MIT Report SG 7510, Feb. 28, 1975, p. 71.

required for more secure investments. This would have the effect of reducing the expected present value of the tract to the firm.; consequently, reduction of the uncertainty by determining the existence of hydrocarbon deposits prior to leasing could be expected to raise the expected present value by reducing the cost of capital used to bid on and explore the tract.

The second way in which aversion to risk affects the return to the public is its effect on the fraction of the net expected present value of a tract that the firm is willing to bid for the tract. As discussed above, under conditions of certainty, high competition would tend to force a bidder to offer the entire present value of the economic rent calculated for a tract as a bid, leaving the firm with nothing in excess of the normal return to capital. Similarly, under conditions of uncertainty, a firm that is completely neutral about risk would tend to bid the entire expected present value of the economic rent. However, if the firm is averse to risk, it would be willing to bid only some smaller amount, since uncertainty reduces the value to the firm of the expected income stream.

In fact, the increasing occurrence of joint bidding ventures for the purpose of spreading risk over a large number of investments indicates that even the major oil companies are risk averse at the levels of bids required to win the more valuable OCS tracts. Yet one can argue that the public, like an insurance company, can aggregate risks over such a large number of investments that it should be completely risk neutral, and thus should value an OCS tract at its true expected value, with no risk discount. Under these circumstances, the present leasing system would lead to winning bids that are lower than the value to the public of the tracts being sold, even if competition is high and the bidders do not on the average underestimate the expected value of the resources being offered.

It should be emphasized that this conclusion would in no way imply that OCS bidders somehow benefit at the public's expense because of any risk discount. A risk averse firm would only be willing to offer a maximum bid below the expected present value of a tract because a tract with highly uncertain production potential simply is not worth the expected present value to the firm; and no bidder could be expected to offer more than it thinks a tract is worth, even though the more risk-neutral public might value the same tract more highly. The effect of reduction of uncertainty by exploration prior to leasing would simply be to reduce this divergence between the value of a tract to a risk-averse bidder and its value to the public.

.?. Effects of reduced uncertainty on competition

The high risk nature of OCS investments under the current leasing system appears to reduce competition in two ways. First, the great uncertainty about the actual amounts of oil or gas that will be found may make it difficult if not impossible for small firms to obtain the large amounts of capital needed to bid on and explore OCS tracts. In contrast, identification and evaluation of hydrocarbon deposits prior to leasing should make financing much easier to obtain even for small firms, since the relatively well-defined value of the resource in

the ground would provide substantial security for the investment. This should increase the number of firms participating in the bidding, and would thus increase the competitive pressure on each bidder to offer as a bid all of the expected present value of a tract beyond a normal return to capital.

The second way in which the high risk of the current leasing system tends to reduce competition is the pressure it places on even the largest oil companies to participate in joint bidding ventures in order to spread their total investment over a large number of tracts and thereby reduce the aggregate risk. Since one of the traditional requirements for competitive bidding is that there be no prebid communication among bidders, the communication that is necessary to arrive at joint bids may have some negative effect on the level of competition. Reduction of risk through exploration prior to leasing would reduce or eliminate the need for joint bidding as a means of spreading risk, which should in turn reduce prebid communication.

It is beyond the scope of this analysis to determine the current level of competition in OCS bidding. The studies of previous sales cited above suggest that competition for OCS tracts was high through 1972. However, several studies have argued that there has been a decline in competition since then, partly as a result of an acceleration of leasing.⁹ To the extent that competition has in fact declined, a reduction of uncertainty by leasing only after exploration should increase competitive pressures by increasing the number of firms able to participate in the bidding. This would in turn tend to move the average level of bids towards the expected values of the tracts.

4. *Summary*

The foregoing discussion has considered three distinct effects of reduction of uncertainty by exploration prior to leasing: (1) improvement of bidders' estimates of the expected value of resources; (2) reduction of risk discounts; and (3) a potential increase in competition. The latter two effects would clearly tend to move a firm's bids upwards toward its estimates of expected tract values. However, the direction of the net impact of reduced uncertainty on the average level of bids would depend upon the first effect, namely the expected improvement in the bidders' estimates of tract values. If current tract evaluation techniques are generally over-optimistic, as appears to have been the case prior to 1972, better information prior to leasing could lead to a net reduction in the average level of bids. This would occur if the increases resulting from risk reduction and higher competition are more than offset by declines in the average of expected tract values. On the other hand, if current procedures do not lead to over-optimistic bids on the average, then the net direction of the change produced by the three effects we have discussed would clearly be upward. In either case, reduction of uncertainty would move the expected return to the public toward the true value of the resources being offered for sale.

⁹ Attachment F, "An Analysis of the Department of the Interior's Proposed Acceleration of Development of Oil and Gas on the Outer Continental Shelf," National Ocean Policy Study, March 5, 1975, pp. 17-25; and Devanney, *op. cit.*, pp. 68-79.