512 HRES HB 834 (NOTEBOOK)

A significant result of this study is that State income can be increased for all leasing methods studied by using a percent of acreage option. This option consists of acquiring sufficient knowledge to intelligently withhold some of a structure when leasing.

As is shown in Tables II - 1 and II - 2 pages II - 27C and 27B, bonus income to the State was increased from 48.1 to 174.9 million dollars for our field model with 600 million barrels recoverable oil. This is an increase of 131.1 million dollars.

INTRODUCTION TO THE SENSITIVITY ANALYSIS

Petroleum Development and Past Leasing Policy. In the 74 years that have elapsed since the first commercial oil was found in Alaska at Katalla, the State has seen wave after wave of explosive development crash upon its shores, followed by the inevitable receding wave of bust and recession. After petroleum was found at Swanson River in 1957 (a major oil field of 218 million barrels of recoverable reserves), Alaska was catapulted into the petroleum era and the resulting series of petroleum lease sales have changed Alaska's economic emphasis from hard minerals to oil.

As Alaska moved into the petroleum scene, it found itself in the unique position of being the late comer to the party and winning the door prize. Alaska found that it possessed a great wealth of petroleum at a time when the other states and the Federal government were closing the curtain on the final act of their petroleum resources. The nation has managed to use the majority of its oil and gas resources in seventy years and now finds production falling with demand increasing - a grim situation, to say the least.

Alaska is therefore in a crucial position concerning the national and world energy crisis. The State has over 50% of the nation's remaining potential reserves, and the majority of these reserves lie on Alaska's Continental Shelves and uplands of the State. The nation is now moving to the OCS to develop the last oil resources, and Alaska with 560,000 square miles of shelf has more oil potential area (70%) than all of the other OCS areas

combined. This means that world and Federal actions, native development and state needs will be key factors in the State's future petroleum policies.

Political, economic, environmental and social requirements are now being considered as part of the State's needs, a much more complicated situation than earlier years and certainly more controversial. This report will concentrate on various methods of leasing petroleum lands. The decision of whether to lease or not, and when to lease, are basic policy decisions beyond this report. HOW to lease in light of the changes of recent years is a difficult and complex problem. This study will attempt to analyze some options and insight into this aspect of our natural resource management.

The present state leasing system was initiated in an earlier era when the major leasing consideration was in maximizing the current revenues to the State. Petroleum was leased upon a single variable - the initial cash bonus. In general, this system was effective and workable. It provided the State with the necessary revenue to move from dependence upon the Federal government to true statehood and provided impetus to establish an oil industry in Alaska.

With the 1969 Prudhoe Bay lease sale, the construction of the Alyeska Pipeline, and other changing economic and social circumstances, the public is becoming more interested in future leasing methods.

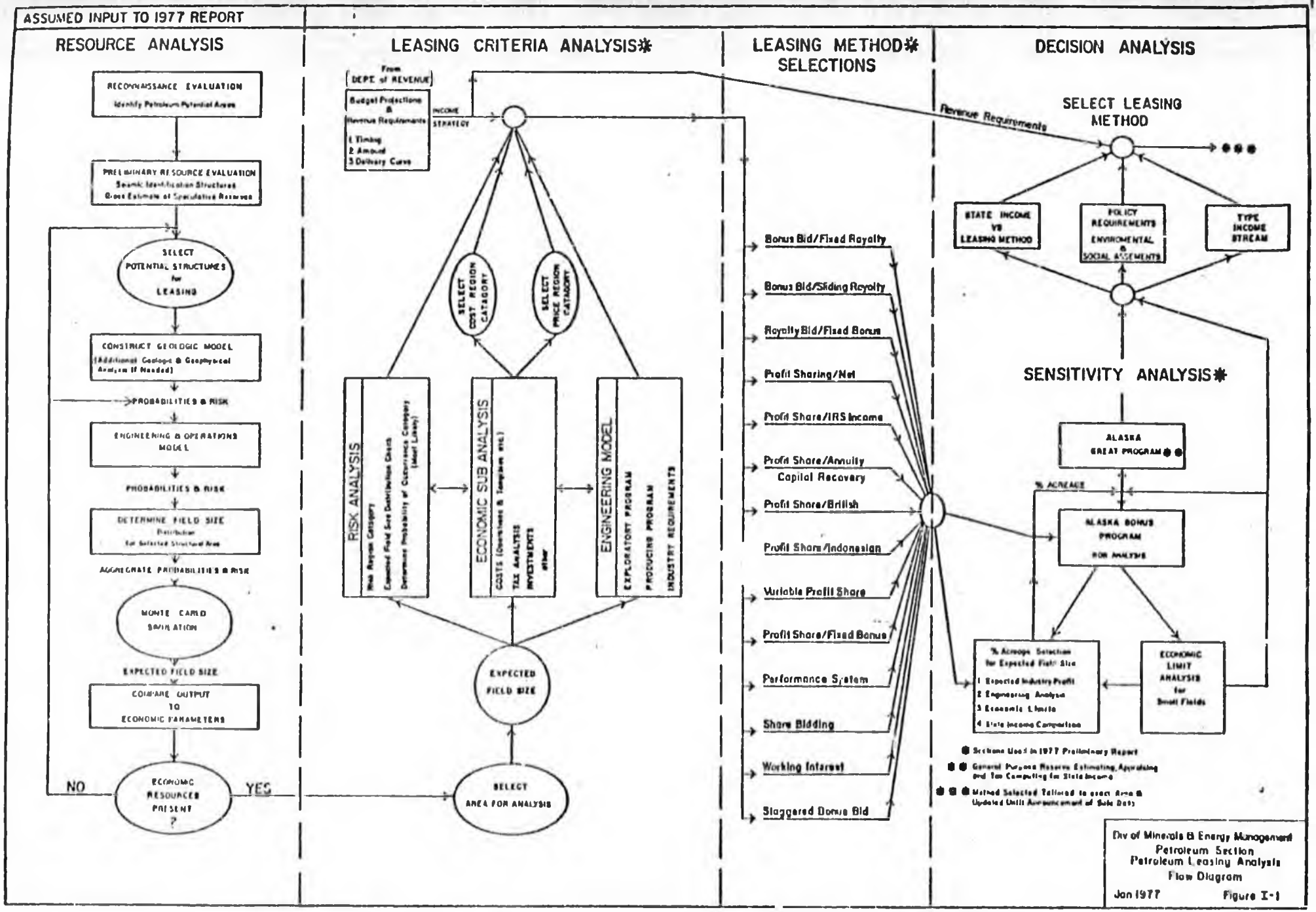
Management implies benefits, but it requires knowledge, and it assumes risks. This leasing study indicates that the State may achieve greater economic benefits and the ability to take these benefits when the State needs them if we undertake a managed leasing system. But what is a managed leasing system? If we ACQUIRE KNOWLEDGE of the key factors needed for leasing, ESTIMATE THE RISK in making a decision based on this knowledge, then MAKE THE DECISION THAT WILL GIVE US THE BEST CHANCE OF ULTIMATE GAIN we are "managing".

In our specific case of leasing petroleum we have found that we will need, (1) knowledge of the resource (gained from geologic, engineering and economic research), (2) Understanding of the risk of finding oil and of finding a certain amount of oil, and (3) the ability to choose the best method for capitalizing on knowledge and risk (right time, area and method to lease; in other words a flexible leasing method).

Our Leasing Analysis has shown that income to the State is extremely dependent upon risk and the type of risk we're dealing with is partially a function of knowledge. We have found that if we can quantify the risk, we will be able to lease to our advantage and a leasing program can be tailored to accomplish this.

Leasing Policy Problem. We have approached the leasing problem in the following manner. KNOWING where the potential petroleum may be located and estimating the amount of petroleum is fundamental to the determination of risk. This information is also essential for long range planning, economic projections, budgeting, and many other natural resource development issues. The Resource Analysis section of Figure I-1 indicates the steps involved in obtaining the resource knowledge needed for a State Resource Management analysis.

THE ALASKA RESOURCE EVALUATION & LEASING SYSTEM



The resource analysis steps shown, comprise a broad based statistical - analytical approach. The amount of exploration information used would be kept to a minimum. Only enough data would be gathered to determine the distribution of the large potential oil and gas fields, the gross expected value reserves of the fields and to ascertain the probabilities of finding petroleum.

The Division of Minerals and Energy Management is tasked with the "Resource Analysis" and would provide the "Expected Field Size" needed for a Resource Management Analysis. This study begins with an expected field size and assumes that adequate knowledge is available for the basic pre-leasing management decisions.

Since we cannot manage without knowledge, our only other option is to lease by an open bidding system that permits anyone to bid at competitive auction and establish a true value between the parties on that day. In retrospect this may prove to be either beneficial or detrimental to the best interests of the State.

Determination of Risk. The need to recognize the effects of uncertainty associated with oil and gas leasing, exploration, and production, especially in frontier areas, lead to the use of expected value as the method of accounting for risk and uncertainty. The probabilities of finding a certain amount of petroleum are determined using modern computer technology. This "Risk" oil field is then fed into a RISK determination analysis that accounts for the uncertainties that affect income such as costs and prices. Finally Risk is again considered in the economic computer program, so that the final output is the EXPECTED dollar income to the State from a chosen leasing procedure.

Decision Analysis. The final step in a resource management analysis would be to compare the economic results of the resource analysis with budgetary requirements, environmental and service needs, and policy guidelines. A decision on when, how, where, and how much of the resource to lease would then be made.

With the formation of the Division of Minerals and Energy Management, the State now has the technical ability to undertake a resource management analysis.

The Leasing Sensitivity Study. The questions naturally arise, should we manage? Is it worth it? To find the answers we have used models to determine the sensitivity of state income to various leasing factors. Since the leasing method is the factor over which the state government can have the greatest possible control, we have compared various leasing methods against the key income variables of RISK, FIELD SIZE, COST, AMOUNT OF ACREAGE and PRICE OF OIL.

Five potential oil field sizes, small, medium, large, subgiant, and giant, were selected as being representative of the range of potential hydrocarbon fields remaining in Alaska. Cost regions and price regions were selected as were various probabilities of success. (Details of these key factors are given in Appendix A, C & D).

Each combination of oil field size, cost region, and probability of success was analyzed using an appropriate computer model. Likely bid variables (bonus, royalty or profit share) were estimated by performing a discounted cash flow analysis of the exploration, development, and production of a field

from an oil company's point of view. Sensitivity analysis procedures were used to determine a profile of bid variable versus expected rate-of-return. Using the value for the bid variable which yields the target rate-of-return, the cash flow to the State was projected via computer simulation for various size fields, cost regions, risk conditions and State income. All of these variables fluctuate with each bidding method. Bidding methods are described in Section VI. Special versions of GREAT, a widely used petroleum economics system developed and supported by Garrett Computing Systems, Inc. of Dallas, Texas, were prepared to fit the specific needs of the State.

Natural Gas Fields. The exploration and discovery of natural gas fields has been considered and our decision was to evaluate the sensitivity of natural gas fields to leasing at a later date. The uncertainties at this time of prices, markets, transportation systems and many other factors would have called for a risk analysis -- sensitivity study even greater than the one we have used for oil.

If we are to have flexibility in leasing, the oil sensitivity analysis has plainly demonstrated a need. The evidence being what it is for chance, we prefer to undertake the gas study as a direct consequence of our lease planning system and will begin work on this project in the near future.

The results of the oil field sensitivity study are very conclusive. Proper management in leasing will lead to higher income for the State at the risk we assumed. If the probability of occurrence is higher than we have assumed the resulting income to the State in all cases will be higher. If it turns out to be lower than we have assumed, the income will be lower in all cases.

Since evaluation of the produced gas depends on several variables the effects of solution gas are not handled separate from oil in this analysis. The effects on the study are in the order of less than 1%.

SENSITIVITY ANALYSIS OF SELECTED LEASING METHODS

Various specific parameters are important to an analytical study of income from various leasing methods. These parameters are discussed in the following sections and are briefly identified here.

A sensitivity analysis of leasing methods must include all income to the State from the leasing and production of petroleum properties. These include bonuses, royalties, various production and property taxes and state income tax. These income sources are explained more completely in the section titled "State Petroleur Income Sources".

A discussion of leasing methods must include an analysis of the oil field models used in the study. As was done in this study, the models used should be based on existing Alaska oil fields. Parameters of field size (reserves), investments, operating costs and production rates were based on actual Alaska fields. The models used in this study are described in the section "Expected Petroleum Field Models".

The Chance of Finding The Expected Field Size (a following section) is important to the validity of any study which is based on analytical comparisons. National field discovery statistics, modified by Alaska data, is used to develop field sizes and probability of finding the expected size field.

Income from any venture is dependent on the risks involved. State petroleum income varies directly with the risks involved. The concepts of risk and how it affects income is discussed in the following sections titled "The Risk Factor" and "Importance of the Risk Factor".

STATE PETROLEUM INCOME SOURCES

Since statehood, at the present, and for the forseeable future, petroleum revenues have constituted a major portion of the State's income. These revenues accrue from leasing bonuses, royalty interest, severance tax, conservation tax, advalorem tax rentals, and from State income tax.

The State has been leasing potential petroleum lands at 12.5% royalty by soliciting sealed cash bonus bids (the State's last lease sale was at 16 2/3% royalty but that sale in "Katchemak Bay" sale has been environmentally questioned, and the State is now negotiating a buy-back of the leases. The royalty represents the State's retained interest in the oil and gas. The bonus constitutes the amount of money a bidder is willing to pay for the privilege of exploring for petroleum and for the privilege of developing and producing the oil and gas which may be found.

The State commonly collects four different types of taxes from the oil companies which are actively engaged in the production of oil and gas in Alaska. The severance tax is based on gross value of production, the conservation tax is based on the amount of oil and gas produced, the advalorem tax is based on the value of oil and gas property, and the state income tax is based on taxable income.

Tax rates are set by the legislature, therefore, State income from the severance tax, conservation tax and the advalorem tax is essentially fixed, dependent on the amount and value of production and the valuation of the producing properties. The State income tax is based on taxable income

of the particular company. The company is able to manipulate taxable income and therefore the amount of State income tax actually paid. As will be discussed later in this report, the State also has the capability of influencing the taxable income of companies producing oil and gas from State lands. The royalty represents the State's ownership of the oil and gas. Therefore, the State has the perogative of specifying the ownership percent, or utilizing it as a bid parameter. That is, the amount of ownership the State would have in its resources could be a bid item.

Of course, the size of the bonuses bid are determined by the oil companies. From an engineering and geologic model, they determine the probable size of the oil field and the probability of occurrence. The cost of development, cost of production, expected value of the production and required return on investment are input into a computer program which calculates the return of investment at different discount rates. From these data, the oil company determines the maximum bonus it would be willing to pay to acquire the right to explore and to develop and produce the oil and gas property. The final selection of the bonus is based on what the company believes it will have to bid to acquire the property. That is, if only one company is interested in a lease, their actual bonus bid would be less than the maximum they would be willing to pay. On the other hand in a highly competitive bidding case, one of the bidders will overbid.

EXPECTED PETROLEUM FIELD MODELS

As shown on the Resource Evaluation and Leasing System flow sheet (Figure I-1), the input to our leasing criteria and Sensitivity Analysis is the EXPECTED PETROLEUM FIELD SIZE. In order to show the sensitivity of various leasing methods to State income, we have modeled five expected field sizes. A detailed discussion of the field models is given in Appendix A. The models range from a small field with an expected value of 50 million barrels of oil recoverable (Mercury) to a super giant field with an expected value of 5 billion barrels of oil recoverable (Jupiter). These models are assumed in each case to be the expected recoverable quantities resulting from an analysis of the field size distribution considered. The expected value concept will only briefly be covered since this approach has been discussed in other papers and is used in our study as a routine application of the probability theory.

Figure II-2 taken from the Cornell University study shows the field size distribution of all the oil fields discovered in the United States between 1943 and 1968. It is important to note the rapid decrease in field size as the number of fields discovered increases. The field size distribution for each petroleum province, although log normal in nature, would differ from this aggregated United States field size distribution, but some important observations can be used for concentrating our attention on optimum leasing strategies. Because field sizes within a province follow a log normal distribution, it is important to know the approximate location on this curve of the state owned fields. Since it

THE ALASKA RESOURCE EVALUATION & LEASING SYSTEM

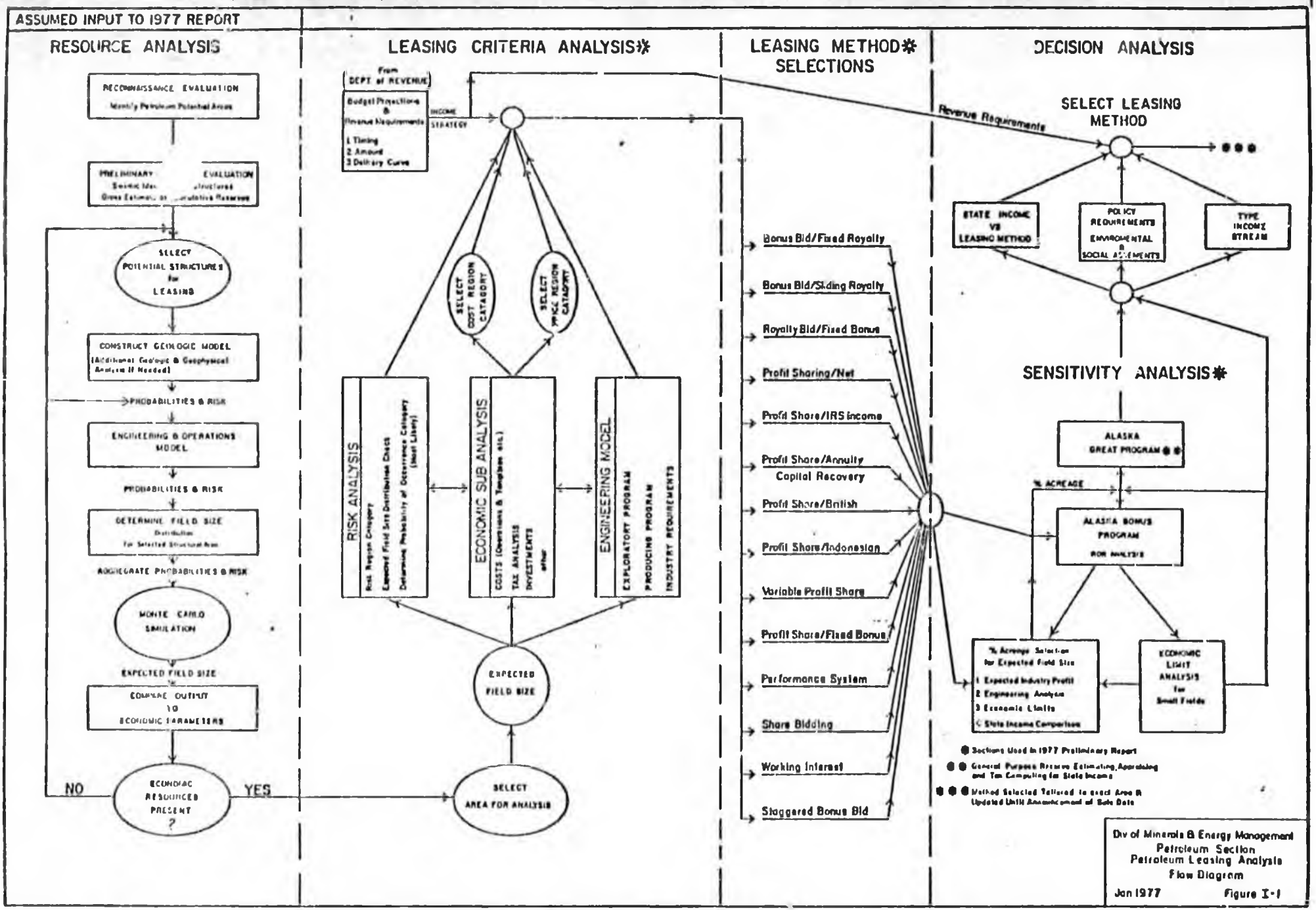
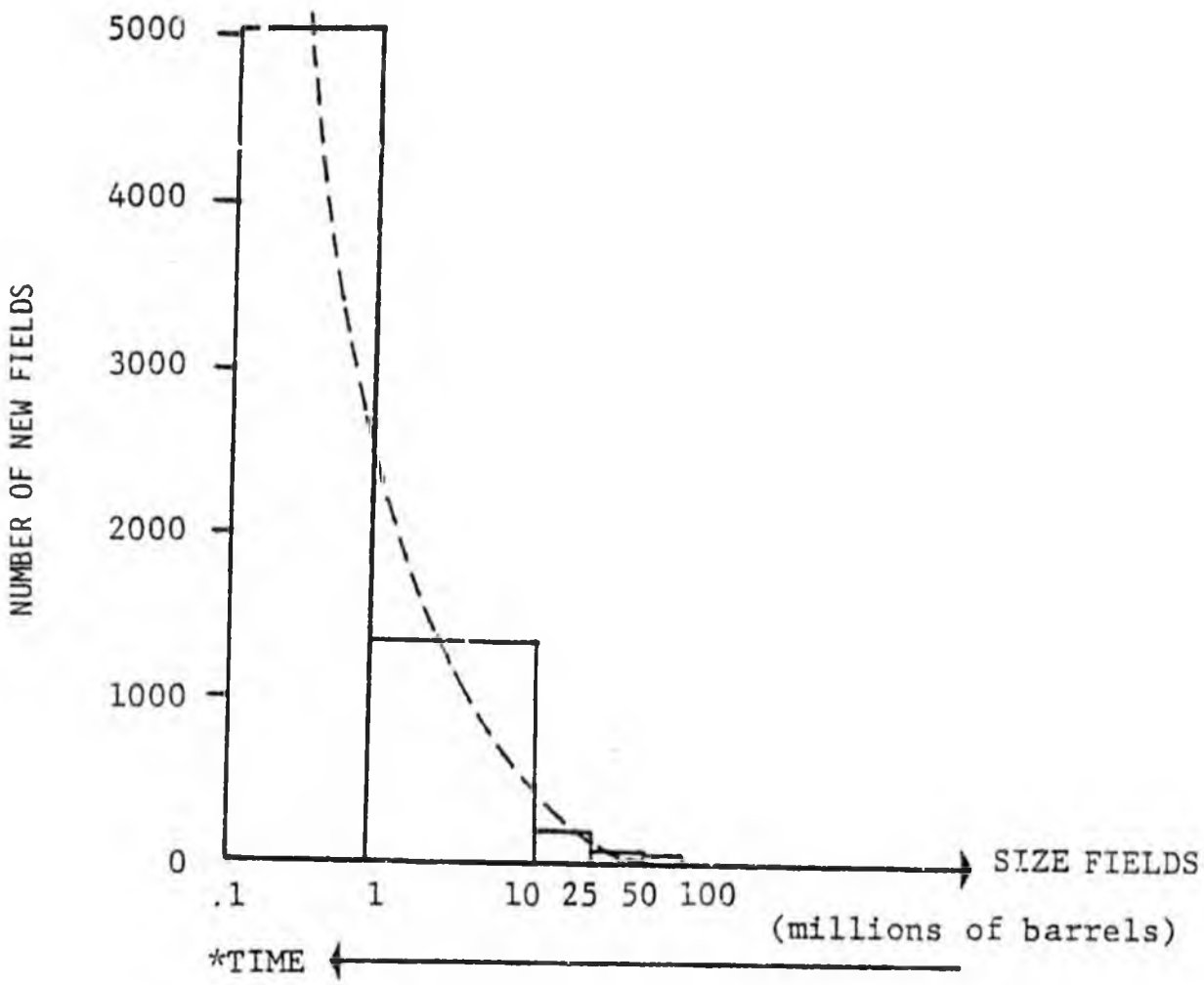


Figure II-1

--NUMBERS OF NEW OIL FIELD DISCOVERIES OF VARIOUS SIZES (1946-1968)

Modified from Alternative Leasing Strategies and Schedules for the Outer Continental Shelf Kalter, Tyner & Hughes



*Since larger fields are statistically found first, the size of new fields found will generally decrease with time.

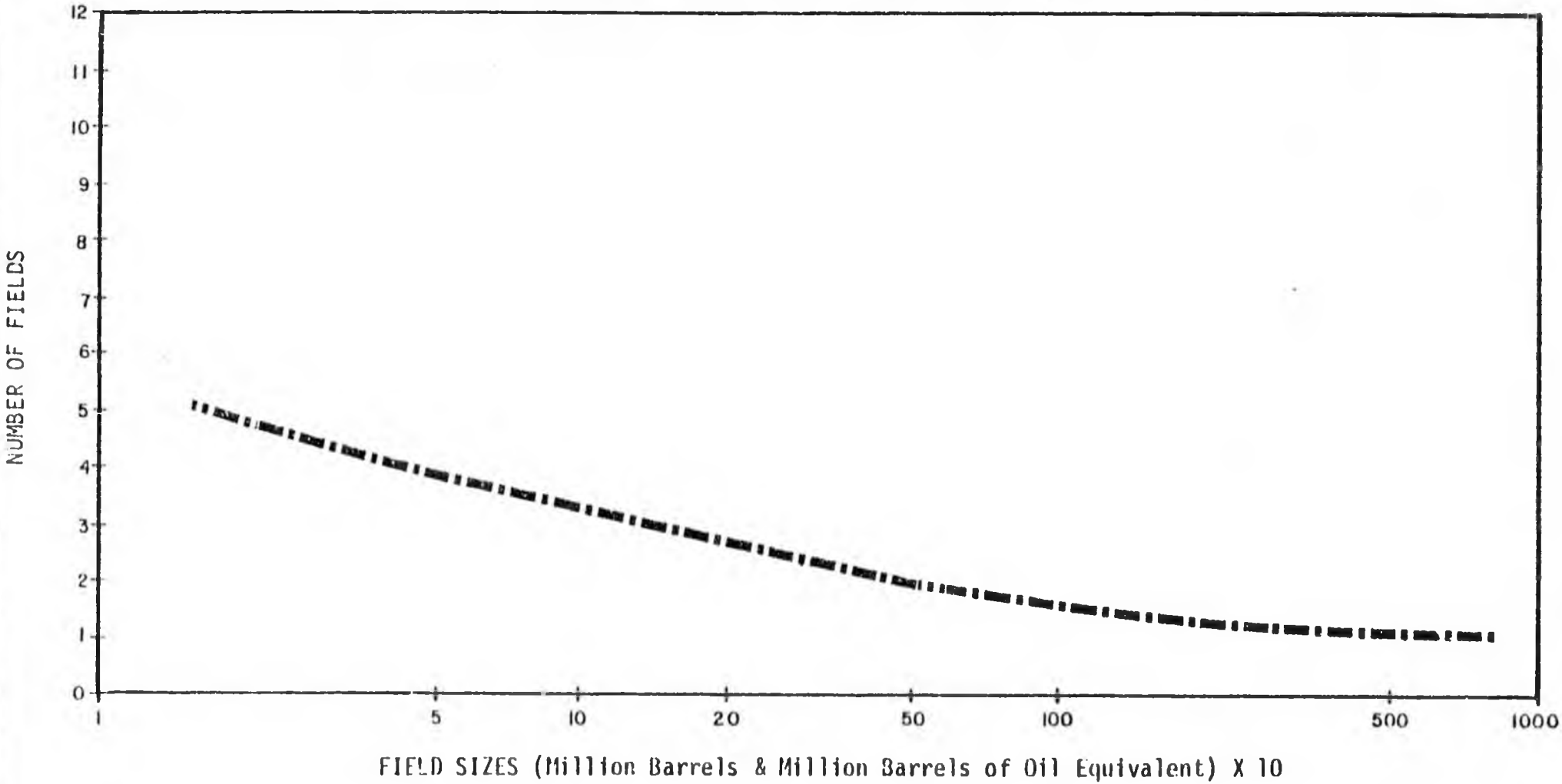
Figure II-2

is expected that large fields generally will be discovered early in the exploration time horizon (Cornell Study). Figure II-2 can also be used as a rough time versus discovery plot.

As expected, when Alaskan fields are plotted on a semilog graph (Figure II-3) the field distribution is on the flat far right portion of the United States (province) log normal distribution curve. This is illustrated on Figure II-4 which shows that Alaska's petroleum development stage is in the early time distribution zone and the expected value field distribution is on the flat or larger field portion of the curve.

What is the significance of this to the State? It means that with fairly inexpensive geologic/geophysical analysis and the use of probability theory we should be able to determine the expected risk field sizes to be found before a sale. It will be important for us to understand that as provinces in the State change in maturity, we will see the expected field sizes decrease with time and move along the distribution curve. A flexible leasing system will be necessary to take advantage of this knowledge.

*APPROXIMATE ALASKA FIELD SIZE DISTRIBUTION TO 1977

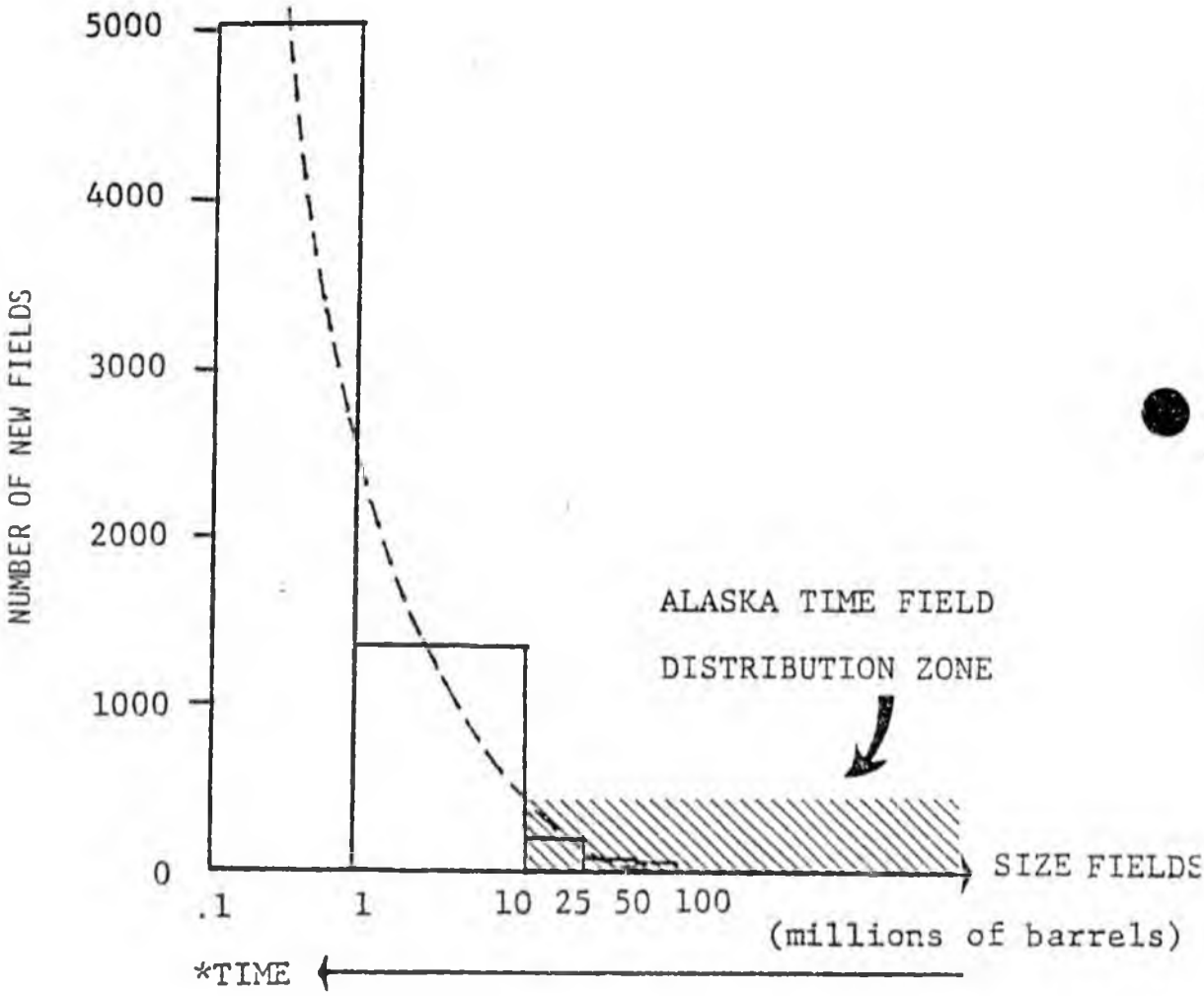


*Because of the immaturity of Alaskan development, field discoveries are larger and, as expected, the distribution curve resembles the flat portion or early time zone of the national curve.

FIGURE II-3

--NUMBERS OF NEW OIL FIELD DISCOVERIES OF VARIOUS SIZES (1946-1968)

Modified from Alternative Leasing Strategies and Schedules for the Outer Continental Shelf Kalter, Tyner & Hughes



*Since larger fields are statistically found first, the size of new fields found will generally decrease with time.

Figure II-4

CHANCES OF FINDING THE EXPECTED FIELD

A discussion of the risk factor follows this section but before defining risk with relation to income, we must understand the relationship of expected field size to possible discovery.

Once we have determined through analysis what the expected field size will be, the chances of finding that amount of oil or gas in the structure will follow the normal rules of probability for the structure. In other words, the chances of finding more or less petroleum than expected are a function of the accuracy of information available and the assumptions made for THE SIZE STRUCTURE WE ARE CONSIDERING FOR LEASE. For this study we have assumed a normal distribution for the expected reserves in the structure. Based on this distribution, the odds are equal that we will have more oil in the structures rather than less oil. Therefore, whether we find any petroleum or not will be the significant variable and that will be a function of the risk parameters of discovery.

THE RISK FACTOR

The risk factor used in our sensitivity analysis for petroleum leasing is the percent chance of discovering the expected field in question. This percent chance can range from around 90% (a drainage situation) to 10%, the rough average used for wildcat ventures.

In general, to lease acreage when the risk would be below 10% would be unwise for government and in some cases uneconomical for Industry. This follows from the general rule that risk is a function of knowledge. For example, to lease acreage with a 1,000 to one chance of finding the expected field size would probably result in uneconomic overbids by Industry on small fields and very low bids for the State on large fields.

We have shown in our sensitivity analysis that income to the State increases as the uncertainty of finding petroleum decreases. It is better therefore for the State to ensure that as much knowledge as possible is available to the public and Industry before leasing.

What are some examples of chance of finding, or risk? In 1976 the success rate of new field wildcats finding oil or gas in the United States was 18% (Petroleum Information Corporation, reported in January 1977 Alaska Report). In Alaska on the North Slope after the initial discoveries, the expected chance of finding oil on the remaining Prudhoe Bay structure tracts was reflected by the high price bid in the 1969 lease sale.

IMPORTANCE OF THE RISK FACTOR

Income from oil and gas fields on State land is distributed as follows: for repayment of investment, for operating costs; to the State for royalty and various taxes, to the Federal government for income tax, and to the oil company as profit, (a distribution is shown on Figure II-8).

Income to the State is shown on Figure II-6 for a typical, medium size Alaskan oil field with an expected recovery of 600 million barrels. Income is for a bonus bid at 12.5% royalty case and is based on the expected field size, and the estimated parameters of cost, price, and recovery (the computer input parameters are explained in Appendix B). As shown on Figure II-6, at a risk factor of 10% (10% chance of finding the expected field) expected income to the State would be 0.34 billion dollars; at a risk factor of 90% (90% probability of occurrence) the State would expect to receive 3.0 billion dollars.

As the confidence level increase from 10% to 90%, income to the State increases. Most of the income at 10% risk results from non-bid sources of royalty and taxes. However, the cash bonus bid, at a risk factor of 10%, is 48.2 million dollars while at a risk factor of 90%, the cash bonus bid would be 377.5 million dollars. This is nearly an 8-fold increase.

It becomes immediately obvious that the State can increase it's income from petroleum properties by influencing the acquisition of data so that probability of success is increased. This is also concluded by Richard Norgaard on page 2 of his report titled "Uncertainty, Competition and Leasing Policy" prepared for the Department of Natural Resources.

GROSS INCOME FROM PRODUCTION VERSUS RISK

(Based on Expected Values)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

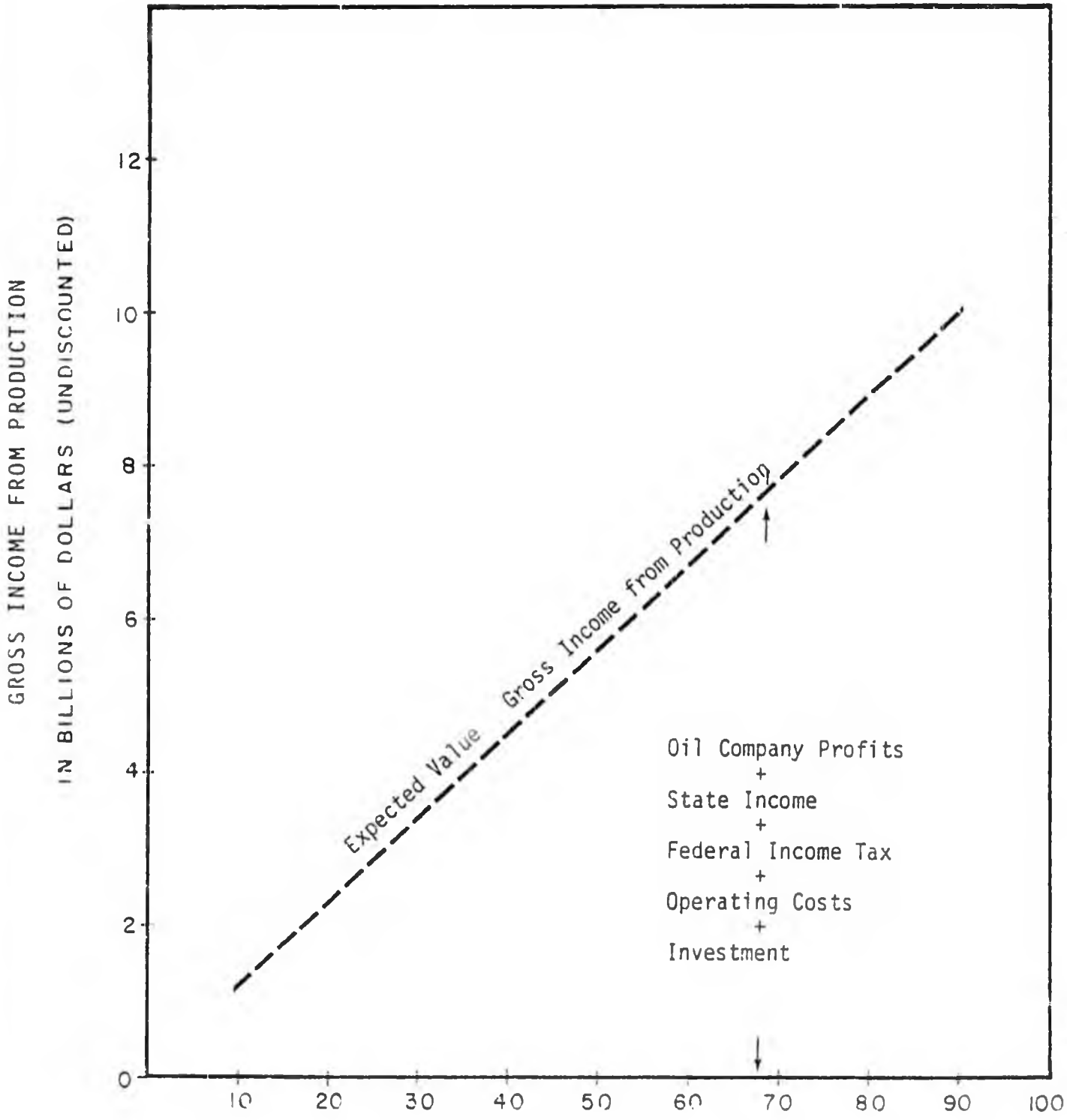


FIGURE II-5

STATE INCOME VERSUS RISK

(Based on Expected Values &
Current Leasing Method)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

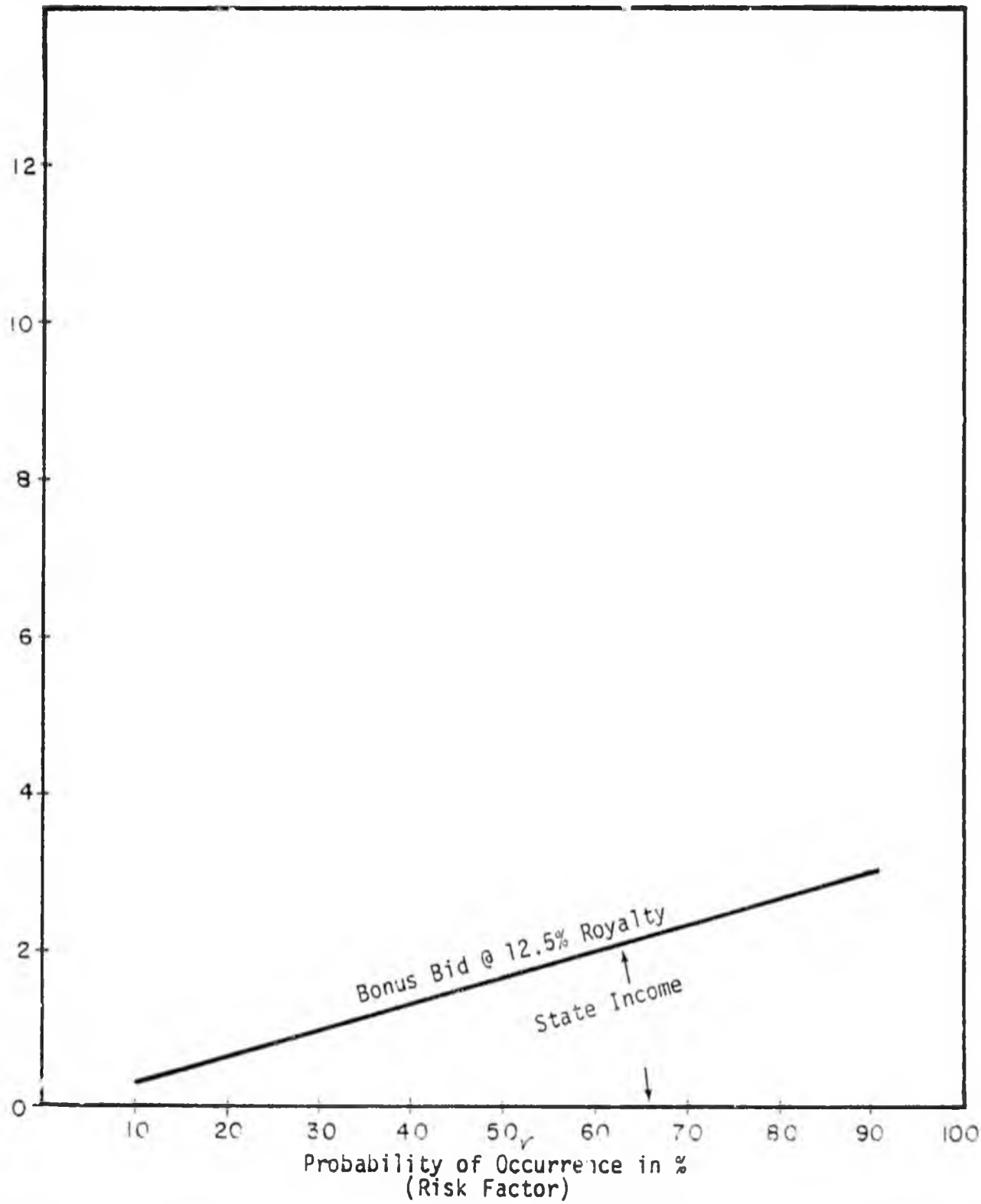


FIGURE II- 6

EXPECTED VALUE CONCEPT

Direct (and total) state income from leasing will increase as the probability of occurrence increases because the expected value of the leased structure also increases. It is the "expected value" amount of oil or gas in a structure upon which oil companies calculate their bids. The expected value is a direct function of probability of occurrence.

The expected value is the mean (or average) value of the dry structures plus the producing structures. For example, if 9 dry structures are drilled per each discovery, then the probability of a discovery for any specific structure is 1 in 10, or 10%. This means that the average oil recovery for each of the 10 structures drilled is 10% of the productive structure. If the field size is 600 million barrels of recoverable oil, the average amount per structure expected is 60 million barrels.

As additional information is obtained, it's possible that only 4 structures will be drilled for each discovery (some structures will not be drilled because of the extremely low probability of an economical field). With 4 dry structures drilled for each discovery drilled, the expected value (average amount) of recoverable oil for each structure will increase to 120 million barrels. Therefore, for each field leased, the income to the State should be increased. This increase should be in direct proportion to the increased probability of the expected event occurring, in this case a discovery.

The expected value of gross income from production also increases as the probability of occurrence (a discovery) increases. For the medium size expected oil field (600 million barrels of recoverable oil), as the probability of occurrence increases from 10% to 90%, the expected value of gross income increases from 1.1 billion dollars to 9.9 billion dollars--this is shown graphically on Figure 11-7.

STATE INCOME VERSUS GROSS INCOME

RISK SENSITIVE

(Based on Expected Values &
Current Leasing Method)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

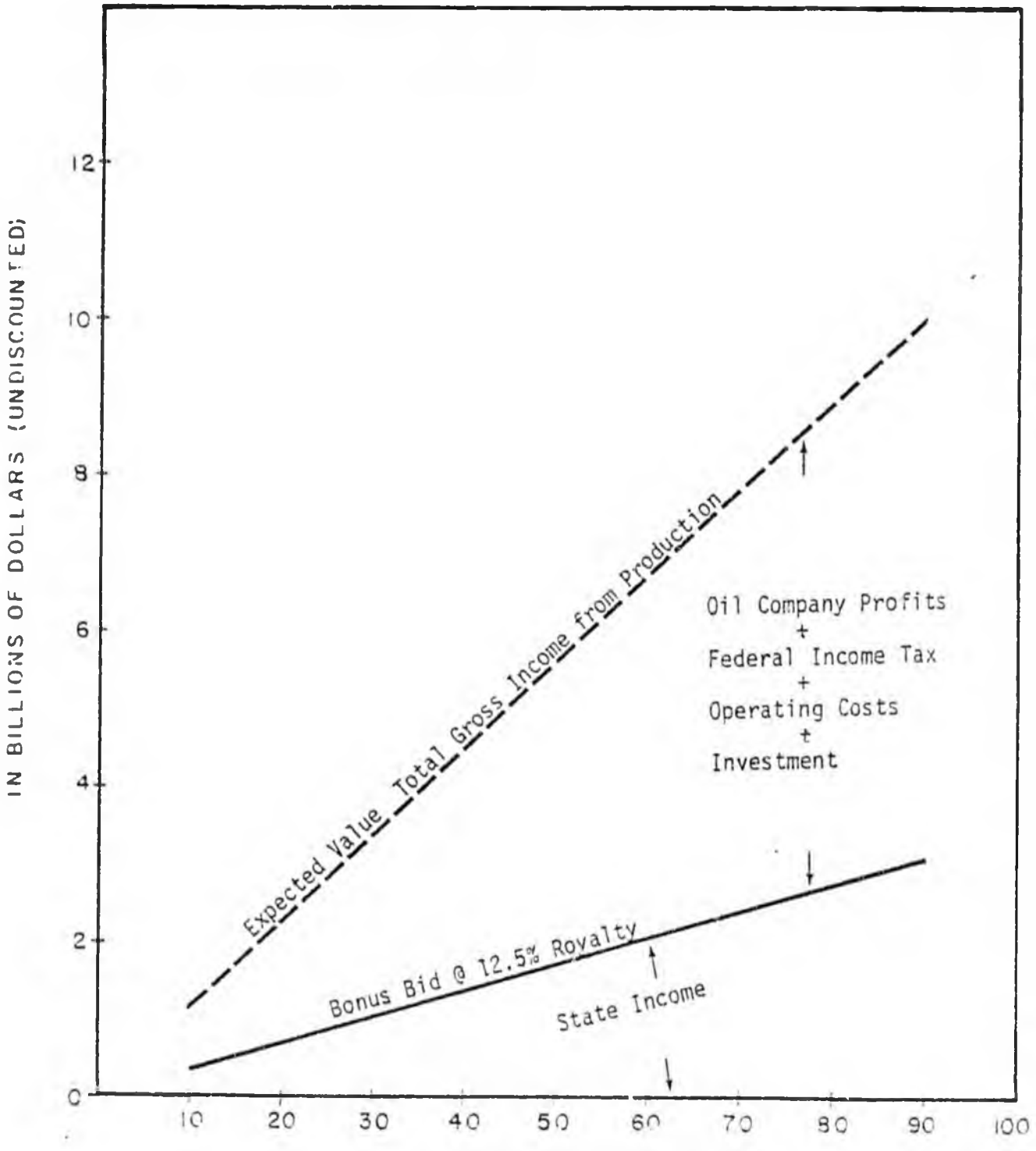


FIGURE II-7

THE SENSITIVITY OF STATE PETROLEUM INCOME TO VARIOUS LEASING METHODS

ANALYTICAL COMPARISON OF ALTERNATE LEASING METHODS

ANALYTICAL COMPARISON OF LEASING METHODS

There are a large number of possible leasing criteria. Some involve how much of the structure is leased at different times. Others involve which parameter of royalty or cash bonus are fixed by the owners and which ones are bid items. Five leasing methods based on different bidding parameters versus probability of occurrence at 1%, 10%, 50% and 90% are analyzed in this study. The method currently used by the State, cash bonus bid at 12.5% fixed royalty, is compared to 4 alternate methods: 1) cash bonus bid at 25% royalty; 2) cash bonus bid at sliding scale royalty; and 3) royalty bid at fixed cash bonus; 4) net profits bid at fixed bonus; and 5) percent of acreage.

State income from various leasing methods was determined by an economic analysis utilizing a special adaptation of a Garrett computer program. This program is explained in Appendix B. Input data included bonus payment, dry hole costs, investment schedules, production schedules, operating costs and crude oil prices. Output data combine the following sources for total state income: bonus, severance tax, royalty, conservation and advalorem tax, and state income tax. The output also includes operating costs and schedules for depreciation of investment and for amortization of the bonus. Total State income is given at various discount factors. The oil company income is discounted at 10%.

Gross income from production is distributed as follows: for repayment of investment; operating costs, State income such as cash bonus, royalty, income tax, and other state taxes, Federal income tax, and as oil company profit. For the cash bonus bid at 12.5% royalty leasing method, the percent distribution of the gross income is approximately the same at a risk factor of 10% as it is at a risk factor of 90%

DISTRIBUTION OF GROSS INCOME

Based on Current Method of Leasing
(Bonus Bid @ 12.5% Royalty)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

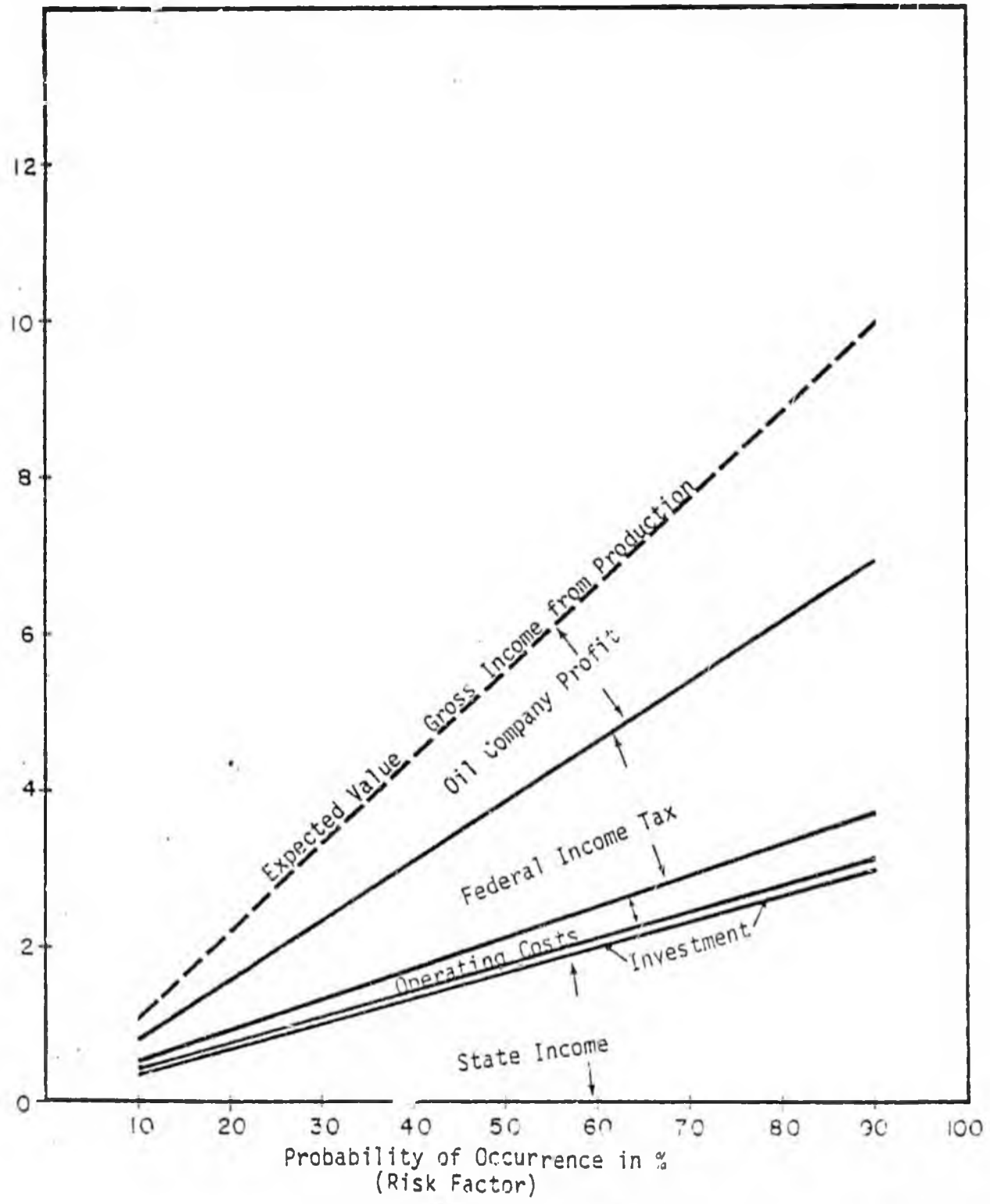


FIGURE II-8

(Figure II-8). Averages are as follows:

Operating cost and investment - 6%

State income - 31%

Federal income tax - 32%

Oil company profit - 31%

Note that State income, Federal income and oil company profits are about evenly divided. While the income distribution percentages remain approximately constant at probability of occurrence of 10% and 90%, the total income for distribution increases from 1.1 billion at 10% probability to 9.9 billion dollars at 90% probability.

Bonus Bid at 12.5% Royalty. This is the method currently used by the State. (All recent competitive leases have been issued with a 16-2/3% royalty requirement.) If there is little available knowledge about a structure, assumed probability of occurrence is low. At a low probability of occurrence, there is little difference between the various leasing or bidding methods. This can be seen in Figure II-9 at the 10% probability of occurrence where the plotted curves tend to converge.

In the past, not much has been known about the structures in Alaska prior to bidding, therefore cash bonus bids at 12.5% or 16.67% royalty were not too bad a method. For small field size (100 million barrels recoverable) with a 10% probability of success, income to the State is not significantly affected by the bidding methods. However, as can be seen from an inspection of Figure II-10, as the probability of occurrence increases there are methods of leasing which provide much higher income to the State. The percent probability of occurrence can be improved (some of the risk removed) by obtaining and analyzing specific structures.

COMPARISION OF STATE INCOME

Resulting From Various Leasing Methods

Shows Risk Sensitivity of All Methods

Medium Expected Oil Field
(600 Million Barrels Recoverable)

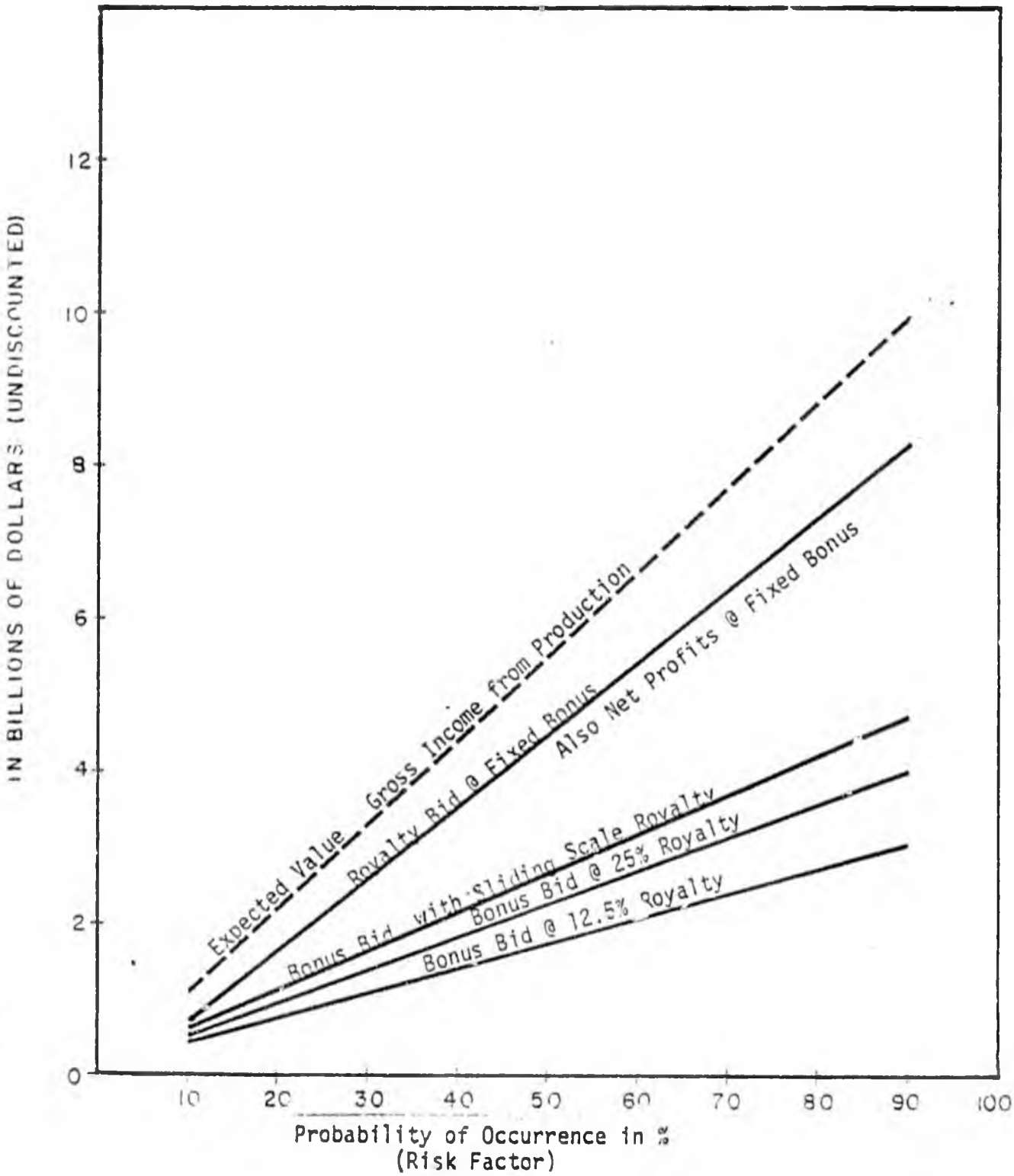
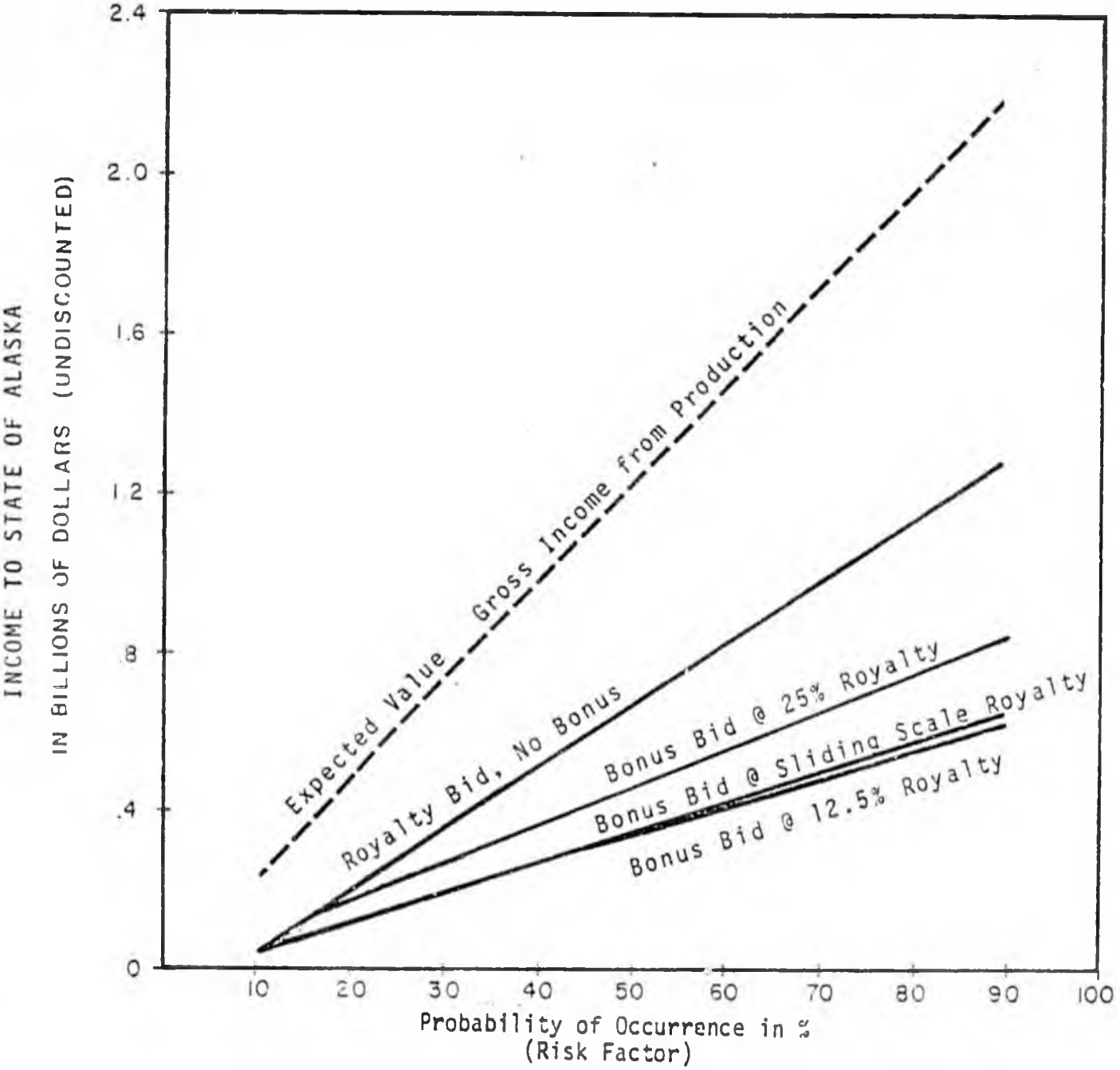


FIGURE II-9

COMPARISON OF STATE INCOME RESULTING FROM VARIOUS BIDDING METHODS

Shows Risk Sensitivity Of All Methods

Small Expected Oil Field
(100 Million Barrels Recoverable)



NOTE: For each bid case, the difference between Gross Income and state income includes
Operating Costs
Investment
Federal Income Tax
Oil Company Profit

FIGURE II-10

Bonus Bid @ 25% Royalty. This bid method does provide greater income to the State than does a bonus bid at 12.5% royalty. The bonus is approximately 25% less than at 12.5% royalty, but total income is approximately 25% to 30% greater, depending on the specific cases being compared - this is shown on Figure II-9 and II-10. At discount rates of 6% and 10% (Figures II-19 and II-20 bonus bid at 25% royalty provides more present worth income to the State than does the current leasing method (bonus bid at 12.5% royalty).

Sliding scale royalty with bonus bid. The royalty scale is set by the State prior to advertising leases for bid. When leasing small fields with low production rates, this method provides the same income to the State as does the cash bonus bid at 12.5% royalty. As field size increases, production rates increase and State income from a bonus bid with sliding scale royalty increases considerably over the income provided by a cash bonus bid with a fixed 12.5% royalty. Figure II-11 gives the income distribution in the sliding royalty case for a medium sized oil field. This leasing method allows the State to participate in the operators good fortune, if the operator finds a large field, the State's royalty increases. If the operator finds a field of lesser size than he expected, he is not burdened with a high royalty such as he would be with a royalty bid.

Another important aspect is that as a good field declines, the royalty percent will also decline, thus extending the economic life of the field. Of course, as the economic life of the field is extended, the ultimate recovery increases and the amount of oil left in the reservoir decreases. The aspect of encouraging more ultimate recovery so the oil or gas left in the reservoir is decreased is good for the conservation of a depletable natural resource.

DISTRIBUTION OF GROSS INCOME
FOR AN ALTERNATE LEASING METHOD

Sliding Scale Royalty With Bonus Bid

Medium Expected Oil Field
(600 Million Barrels Recoverable)

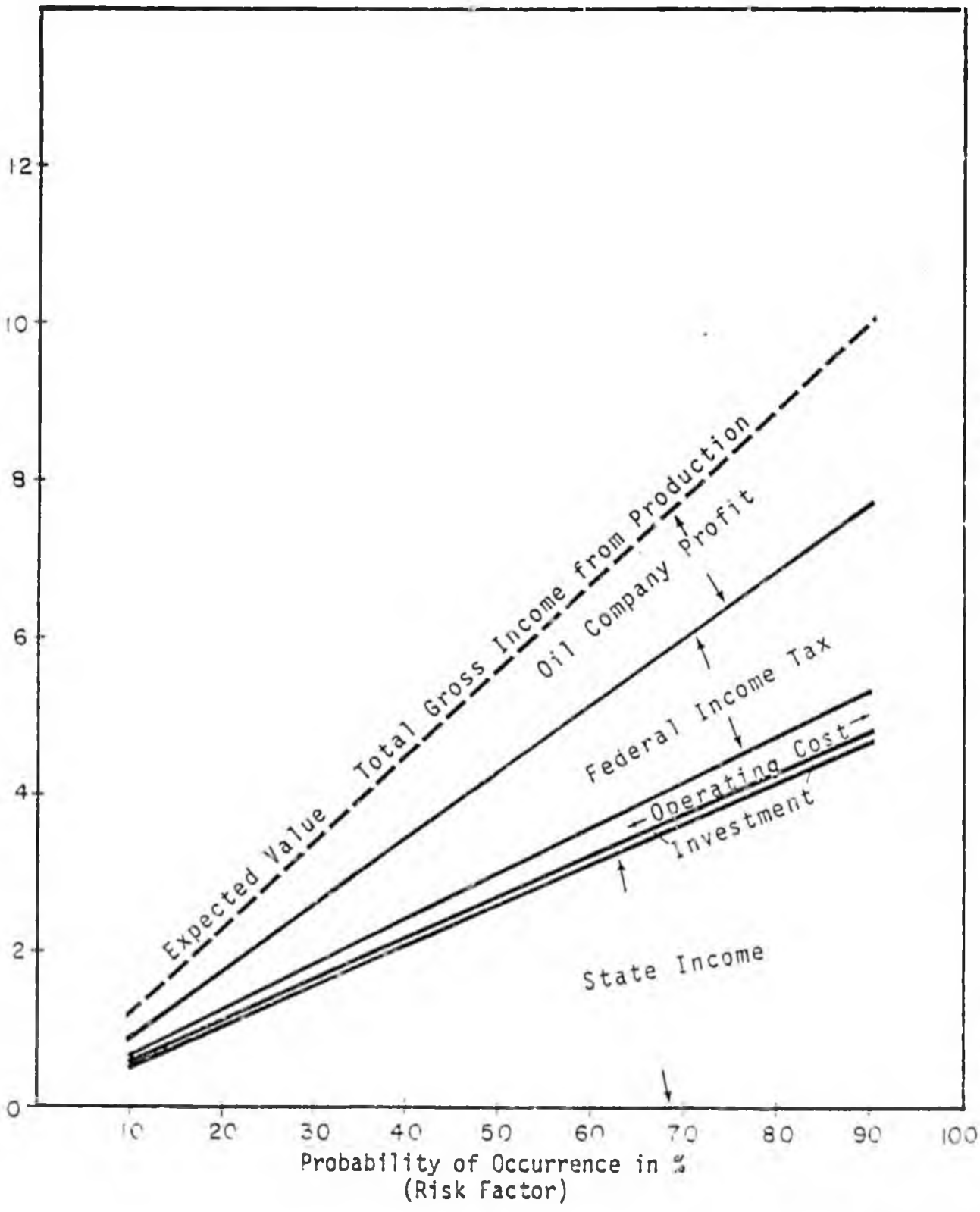


FIGURE II-11

Royalty Bid at a Fixed Cash Bonus. The fixed cash bonus is utilized to encourage only earnest bidders and is calculated at 2.5 cents per expected volume of recoverable oil. As with all of the leasing methods, the main data was based on the operator (oil company) earning an 18% rate-of-return. As is shown on Figure II-9, the royalty bid (and net profits bid) provide more income to the State than do any of the other analyzed methods except at small field sizes. At an oil field size of 100 million barrels recoverable oil, (Figure II-10), income to the State from the royalty bid (65.8 million) was essentially the same as for the cash bonus bid at 12.5% royalty (61.2 million) at 10% risk.

In our models the major economic advantage to the State from royalty bidding over the bonus bid case is from a reallocation of Federal income taxes. Figure II-12 showing the income distribution for an expected field size of 600 MM/bbls in the royalty bidding case should be compared with Figure II-8 in the bonus bid case (an overlay of the Federal income tax revenues from Figure II-8 has been provided for easy reference). As can be seen by the comparison, the State takes a much larger income in the royalty case at the expense of the Federal government. The absence of a large front end investment, the bonus, allows a company to have a smaller profit profile in the royalty case but still make the same rate-of-return on investment as the bonus bid case, 18%. The "Tax Break" illustrated here is an incentive for seeking higher royalties whenever, or however possible.

DISTRIBUTION OF GROSS INCOME

Based on an Alternate Leasing Method
(Royalty Bid at Fixed Bonus)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

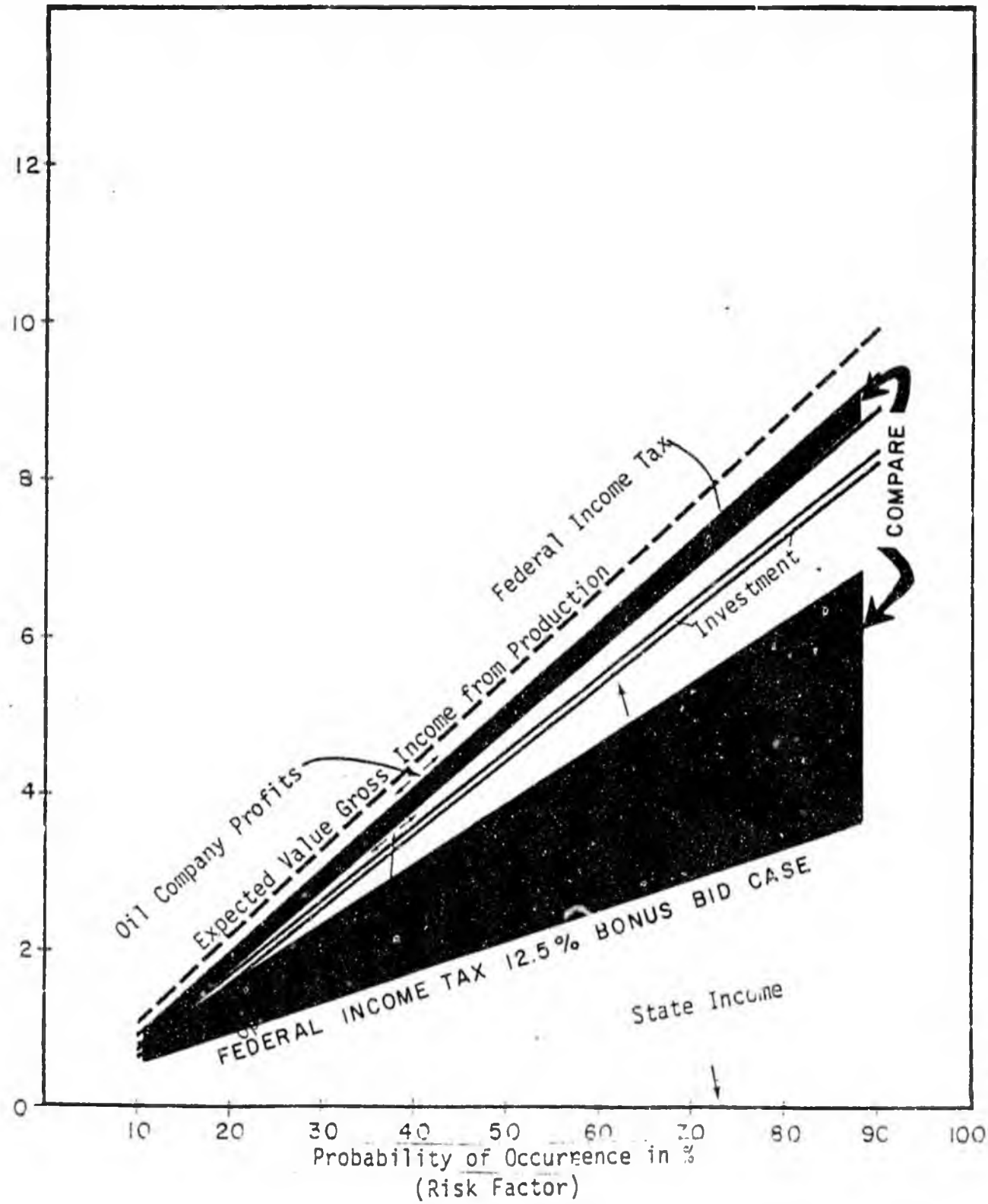


FIGURE II-12

Net Profits at a Fixed Cash Bonus. For this leasing method, a small fixed bonus is required as earnest money. The companies then bid on the percent of net profits they will return to the State after they have recovered their investment. Income to the State for the net profit cases is essentially similar to the income from royalty bidding, (Figures II-9 and II-10). For those examples where the two cases diverged, the net profit data is shown separately.

Listing of Leasing Model Results. The data listed in Tables II-1 and II-2 (pages 27b and 27c) constitute the major portion of the results of this leasing study. This data is the computer calculated results of the economic models for the leasing methods consedered. Most of the graphs in Section II of this report were plotted from data contained in these tables.

Data on Tables II-1 and II-2 show that at risk factors of 10% and 90% (% probability of finding the expected field size), the bonus bid at 12.5% royalty method provides the least expected value income to the State of all the methods analyzed in this report. The net profits bid method provides the largest expected value income to the State, being only slightly higher than the royalty bid method. The sliding scale royalty with bonus bid method provides an income stream which is between the net profits bid method and the bonus bid method. Section III of this report contains additional factors which must be considered when selecting a leasing method.

RESULTS OF LEASING MODEL SIMULATIONS @ 10% RISK AND LOW COST REGION

LEASING METHOD	OIL REC MM/BBLS	OIL CO. PROFIT		EXPECTED VALUE STATE INCOME STATE INCOME				
						BONUS, ROYALTY & TAXES		
		*TOTAL	*PW @ 10%	*BONUS	ROYALTY	*TOTAL	*PW @ 6%	*PW @ 10%
BONUS 12 1/2%								
Mercury								
Mars	137.6	72.6	14.7	.5	27.6	61.2	24.9	14.6
Venus	633.8	376.3	93.2	48.1	127.0	338.9	171.6	118.7
Neptune								
Jupiter	5238.1	3189.1	697.2	385.3	1048.1	2807.0	1347.8	917.1
BONUS 12 1/2%								
Acreage Withheld (initial sale)								
Mars								
Venus 40%	633.8	1524.8	289.9	179.9	533.5	1408.3	711.0	490.4
Neptune								
Jupiter 60%	5238.1	17905.3	2950.6	1780.0	6079.1	15900.8	7510.1	5035.4
BONUS 25%								
Mercury								
Mars	uneconomic							
Venus	633.6	316.9	77.9	38.5	292.5	445.1	214.3	141.8
Neptune								
Jupiter	5236.9	2698.2	582.8	316.3	2095.7	3693.4	1681.2	1091.1
SLIDING ROYALTY								
Mercury								
Mars	137.6	71.1	14.2	.1	31.0	63.9	26.2	15.4
Venus	633.9	274.6	64.7	30.0	344.8	519.8	249.0	161.3
Neptune								
Jupiter	5238.5	1388.6	265.1	117.1	4891.8	6046.5	2591.7	1568.3
ROYALTY								
Mercury								
Mars	137.5	70.0	14.1	0.0	33.1	65.7	26.6	15.5
Venus	632.6	178.9	42.4	15.0	547.9	688.9	311.4	193.4
Neptune								
Jupiter	5230.1	1400.5	281.0	125.0	4861.2	6024.1	2555.6	1544.1
NET PROFITS								
Mercury								
Mars								
Venus	634.0	169.8	40.4	15.0	567.0	705.6	318.6	197.1
Jupiter								

* In millions of dollars

Table II-

RESULTS OF LEASING MODEL SIMULATIONS @ 90% RISK AND LOW COST REGION

EXPECTED VALUE STATE INCOME

LEASING METHOD	OIL REC MM/BBLS	OIL CO. PROFIT		STATE INCOME				
						BONUS, ROYALTY & TAXES		
		*TOTAL	*PW @ 10%	*BONUS	ROYALTY	*TOTAL	*PW @ 6%	*PW @ 10%
BONUS 12 1/2%								
Mercury								
Mars	137.6	635.0	98.6	44.5	249.0	603.4	275.2	180.8
Venus	633.8	3247.7	585.0	377.5	1143.3	3012.2	1520.2	1048.0
Neptune								
Jupiter	5238.1	27716.2	4452.9	2709.9	9433.1	24630.1	11618.3	7780.9
BONUS 16 2/3%								
Mercury								
Mars								
Venus	633.7							
Neptune								
Jupiter								
BONUS 25%								
Mercury								
Mars	137.4	523.1	79.2	30.6	49.7	815.5	358.0	226.8
Venus	633.6	2737.5	492.6	308 9	2285.9	3984.8	1917.6	1267.6
Neptune								
Jupiter	5236.9	23473.1	3745.7	2228.6	18861.8	32734.2	14723.2	9443.5
SLIDING ROYALTY								
Mercury								
Mars	137.6	622.1	95.5	42.1	279.0	628 4	287.2	188.1
Venus	633.9	2376.0	407.6	256.1	3103.4	4678.2	2249.0	1461.2
Neptune								
Jupiter	5238.5	12200.0	1832.0	820.6	44026.2	54260.4	23201.8	14001.0
ROYALTY								
Mercury								
Mars	136.8	308.4	42.9	2.5	972.7	1219.5	516.4	314.2
Venus	629.2	495.3	80.5	15.0	7261.1	8216.0	3665.7	2238.2
Neptune								
Jupiter	5216.7	5666.5	836.4	125.0	58312.9	66525.9	27704.6	16370.0
NET PROFITS								
Mercury								
Mars	137.7	271.6	38.6	2.5	1054.8	1295.5	538.8	323.7
Venus	634.0	433.8	71.6	15.0	7419.0	8369.7	3712.6	2255.9
Neptune								
Jupiter								

* In Millions of Dollars

TABLE II-3

RESULTS OF SIMULATIONS ON AN EXPECTED 600 MILLION BARREL OIL FIELD

HIGH RISK

LEASING METHOD (18% rate of return for industry)	UNDISCOUNTED EXPECTED STATE INCOME (MILLION DOLLARS)
Bonus + 12 1/2%	338.9
Bonus + 25%	445.1
Sliding Royalty	519.8
Royalty Bid	688.9
Net Profits	706.6
% Acreage	1408.3

LOW RISK

LEASING METHOD (18% rate of return for industry)	UNDISCOUNTED EXPECTED STATE INCOME (MILLION DOLLARS)
Bonus + 12 1/2%	3012.2
Bonus + 25%	3984.8
Sliding Royalty	4678.2
Royalty Bid	8216.0
Net Profits	8369.7

EXTREME HIGH RISK CASE

(1% Chance of Success)

LEASING METHOD (16% rate of return for industry)	UNDISCOUNTED EXPECTED STATE INCOME (MILLION DOLLARS)
Bonus Bid 12 1/2%	71.7
Royalty Bid	79.7
	DISCOUNTED 6%
Royalty Bid	41.5
Bonus Bid 12 1/2%	53.2

1E PERCENT OF ACREAGE OPTION

This option has the capability of significantly increasing State income from petroleum leases. The main elements of this option are that only a part of the structure is leased initially; the remaining acreage is leased after a discovery has been made. The remaining acreage leased will be "probable reserves," and will therefore bring a much higher price than will wildcat acreage. Leasing of the Prudhoe Bay structure is a good example of the percent of acreage option. The initial leases were auctioned off for about 12 million dollars. After oil was discovered the remaining acreage (generally marginal tracts near the oil water contract) were leased in 1969 for 900 million dollars.

For comparison purposes, the income to the State from leasing a whole structure at the initial auction was compared to leasing only 60% of the structure at the initial auction (See Figure II-13). Bidding method for both cases is the "Cash Bonus Bid at 12.5% Royalty" method. Comparisons were made for a medium size field; calculations for both cases were at 10% and at 90% probability of success.

For the base case at 10% probability, each of the ten structures (9 dry and 1 productive) were leased in total at the auction, but all of the structures were not necessarily leased at the same auction. For the percent of acreage option, only 60% of each tract was leased initially; out of 10 structures leased in this manner, statistically, 9 would be barren and the remaining 40% of the structure acreage could not be leased. However, after discovering oil in the one good structure, the remaining 40% of the acreage in that

structure could be leased with an expected confidence level of 90% probability of success. The remaining 40% of the acreage in the discovery structure was leased as before - 12.5% royalty, cash bonus bid. Since the expected probability is now 90%, the cash bonus bid would be increased, resulting in increased income to the State.

At a risk factor of 10%; expected value income from the base method was 0.34 billion dollars versus 1.4 billion dollars from the percent of acreage option. (Some of the increased expected value is due to taxes which would also be received by the base method; however, there is an actual increase due to the difference in the bonuses). The bonus for the base method was 48.2 million dollars as compared to 179.9 million dollars for the percent of acreage option, this represents an actual value increase of 131.7 million dollars.

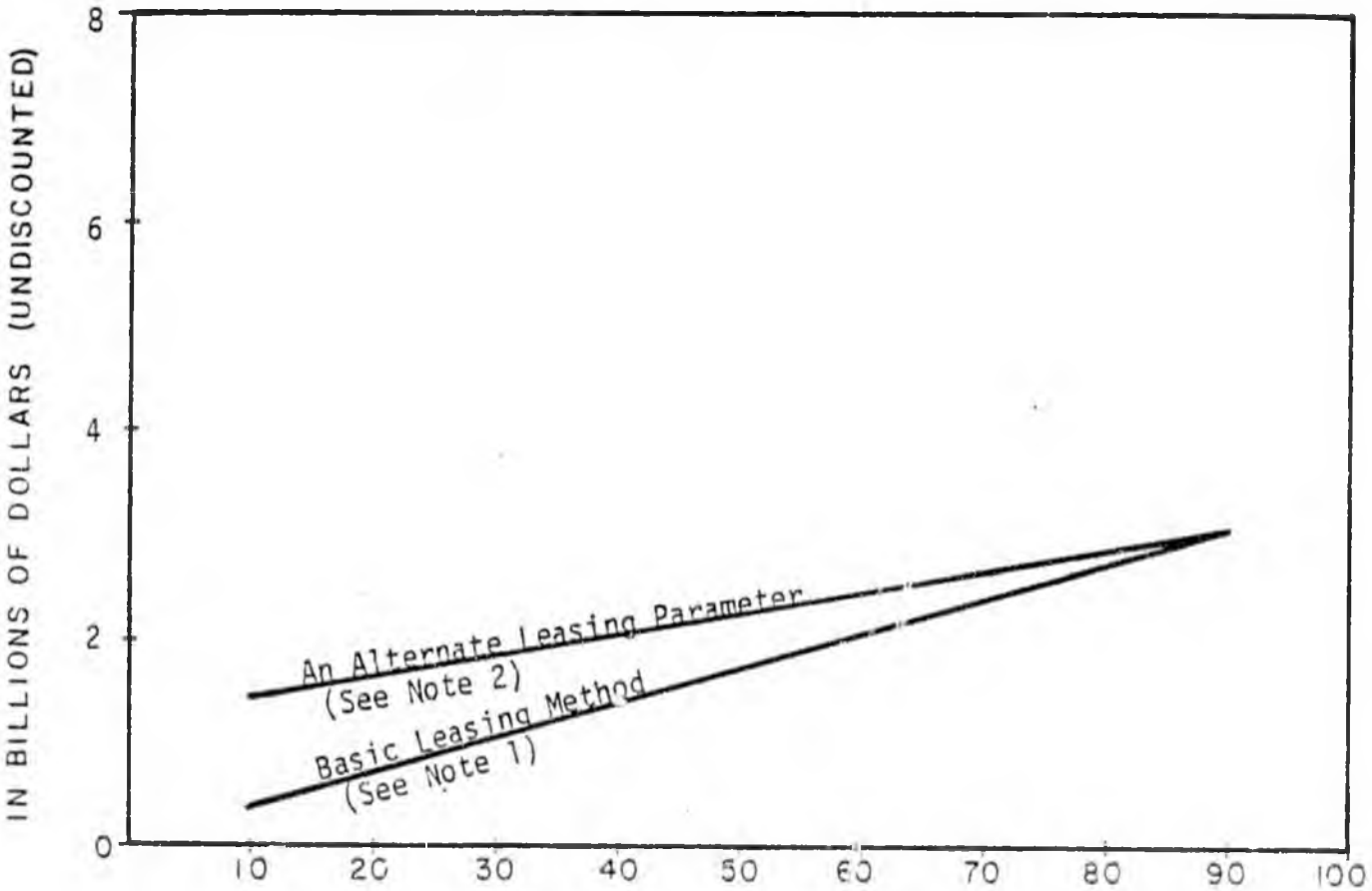
If at the time of initial leasing, enough data is available so that the bidders consider the probability of occurrence to be 90%, then there is no gain in state income by withholding acreage, this is shown on Figure II-13. However, it would be very rare for any group to consider any undrilled structure as having a 90% probability of occurrence (90% chance the expected amount of oil is present).

While for this example, the calculations and discussions were based on an oil field having an expected recovery value of 600 million barrels, income to the State can also be increased for other field sizes. Figure II-14 shows a similar comparison for a giant field where 60% of the acreage was held back. However, as the field size decreases, there becomes a size whereby it's not feasible to have the oil companies bid on only a part of the field. Since this is a somewhat subjective factor, calculations

INCOME TO STATE OF ALASKA

Comparison of an Alternate Leasing Parameter

Medium Expected Oil Field
(600 Million Barrels Recoverable)



NOTE 1: Basic Leasing Method
All Acreage Leased at the Same Time
Bonus Bid @ 12.5% Royalty

NOTE 2: Percent of Acreage - An Alternate Parameter
60% Leased Initially by Bonus Bid @ 12.5% Royalty
Expected Value Based on Risk: 10%
40% Leased 2 Years Later by Bonus Bid @ 12.5%
Expected Value Based on Risk: 90%

FIGURE II-13

and analysis as used on larger structures will not necessarily delineate the minimum size structure on which acreage can be withheld at the time of initial leasing. However, it will be possible for the DMEM to determine, depending on location and other conditions, the minimum field size on which acreage can be advantageously withheld.

For this comparison, the data for both the base case and the percent of acreage option were obtained from a bonus bid at 12.5% royalty method. If other methods considered in this report were used with the percent of acreage option, (royalty bid, net profits, or sliding scale royalty) equivalent or even greater income gains would be realized.

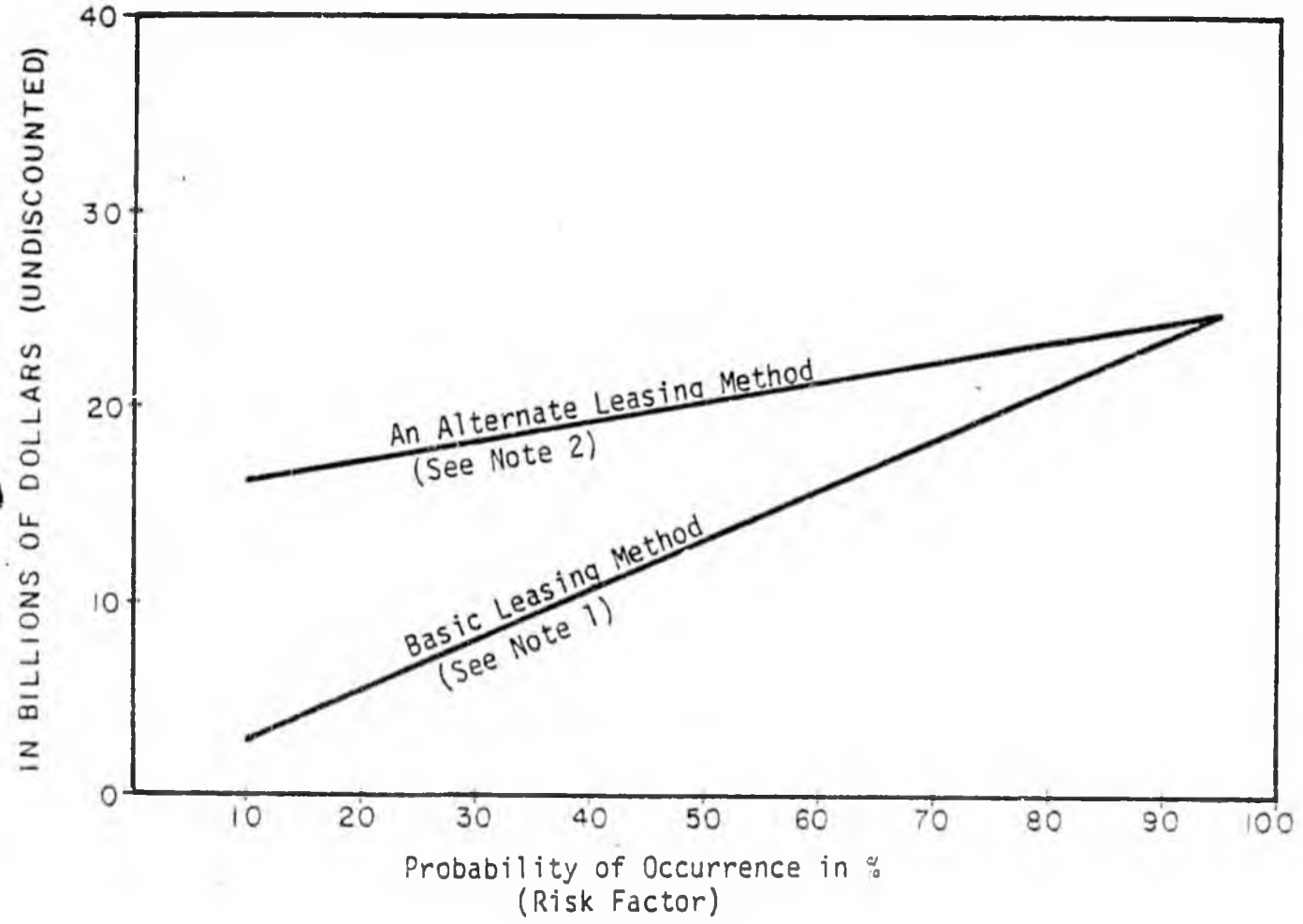
Of course, there are other possibilities under the percent of acreage option. For example, after oil has been discovered in the portion initially leased, the remaining acreage need not be leased but could be held by the resource owner (State of Alaska) for direct participation in the unit. The value of this alternative or any alternate depends on the State's income needs and their willingness to share risks.

This model study indicates that State income can be greatly increased over the long run by mapping structures, analyzing the potential petroleum reserves and then on the basis of resource econometric calculations, finding the optimum percent of acreage to lease.

INCOME TO STATE OF ALASKA

Comparison of an Alternate Leasing Method

Giant Expected Oil Field
(5 Billion Barrels Recoverable)



NOTE 1: Basic Leasing Method
All Acreage Leased at the Same Time
Bonus Bid @ 12.5% Royalty

NOTE 2: Percent of Acreage - An Alternate Method
40% Lease Initially by Bonus Bid @ 12.5% Royalty
Expected Value Based on Risk: 10%
60% Leased 2 Years Later by Bonus Bid @ 12.5%
Expected Value Based on Risk: 90%

FIGURE II-14

MARGINAL FIELDS REQUIRE FLEXIBILITY IN LEASING

Minimum economical field size in Alaska is much larger than in the lower 48 states. Considering the Cook Inlet area where development and production costs are high, the minimum field size is very dependent on the price of crude oil. As shown by Figures II-15 and II-16, for 12.5% royalty and 18% rate-of-return, at a crude oil price of $10.50/Bbl, the minimum field size is about 54.8 million barrels recoverable. However, at an average crude price of $17.40/Bbl the minimum field size (reserves) is only about 13 million barrels recoverable.

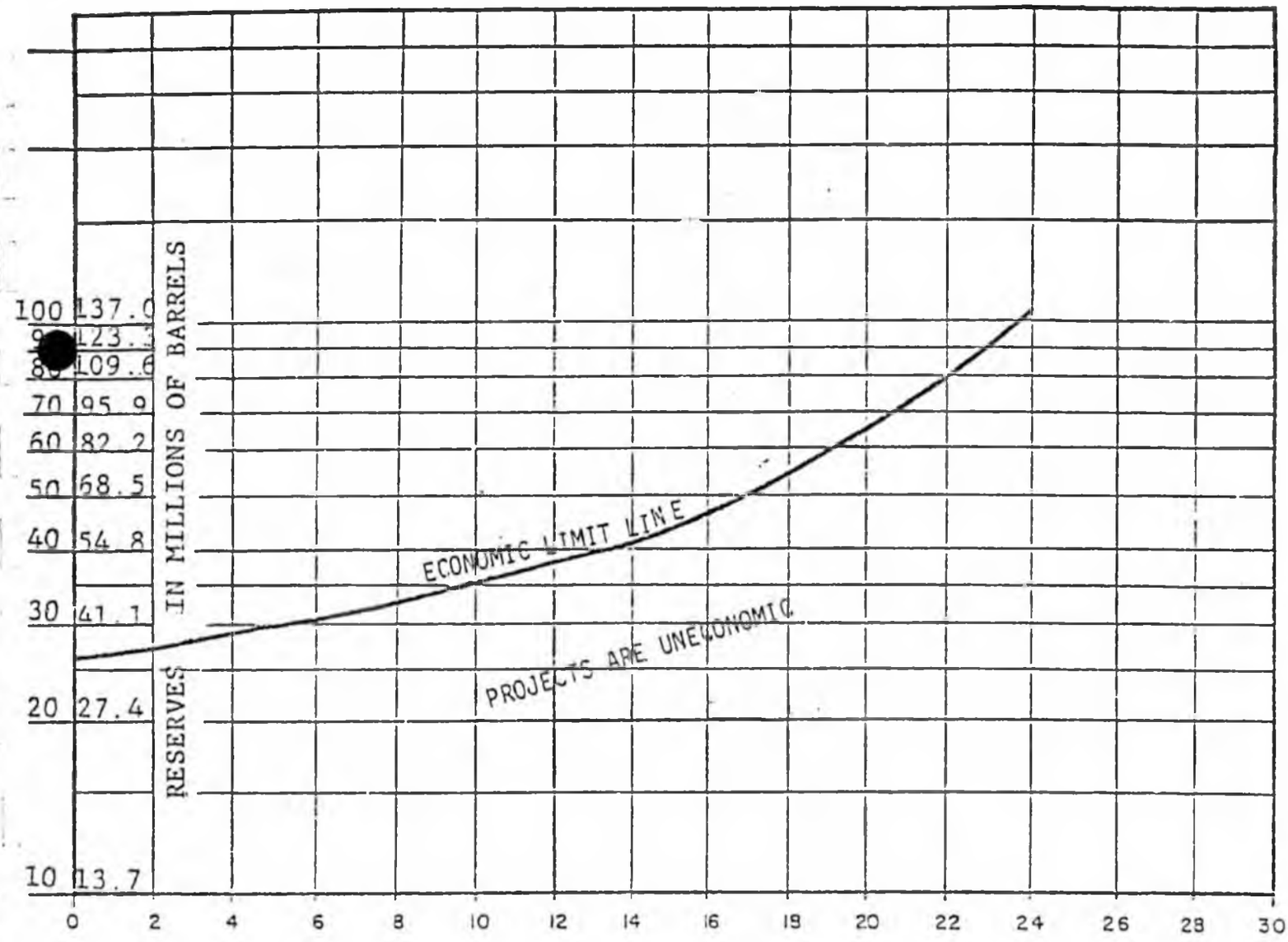
Small fields which are uneconomic at specific values of crude oil price, royalty, and rate-of-return can be made economical if any one or a combination of these three factors are appropriately changed. The preceding paragraph explained that as crude oil prices increase, the minimum field size decreases. The same Figures (II-15 and II-16), also show that for a given oil price and a fixed rate-of-return, as the royalty is decreased, minimum economical field size is also decreased. This means that small fields which would not be economical to produce at a 12.5% royalty, could be economical if the royalty percent was decreased.

Minimum economical field size can also be decreased if industry is willing to accept rate-of-returns lower than the 18% used in this report. This is unlikely however, because the anticipated rate-of-return from a high risk venture must be much higher than for a low risk venture. Where one would be willing to buy secure bonds at a 10% rate-of-return, he would not be willing to invest in a risk venture if the best possible rate-of-return was only 10%. In business, as the amount of risk increases, the anticipated rate-of-return from a successful

ECONOMIC LIMIT DEFINED BY

ROYALTY VERSUS RISK
FOR OIL WITH AVERAGE VALUE OF 10.5 DOLLARS/BARREL

Also Shows Royalty Versus Reserves
At The Economic Limit



Probability of Occurrence in %
(Risk Factor)

ECONOMIC LIMIT DEFINED BY ROYALTY VERSUS RISK

For Oil With Average Value
Of 17.40 Dollars/Barrel

Also Shows Royalty Versus Reserves at Economic Limit

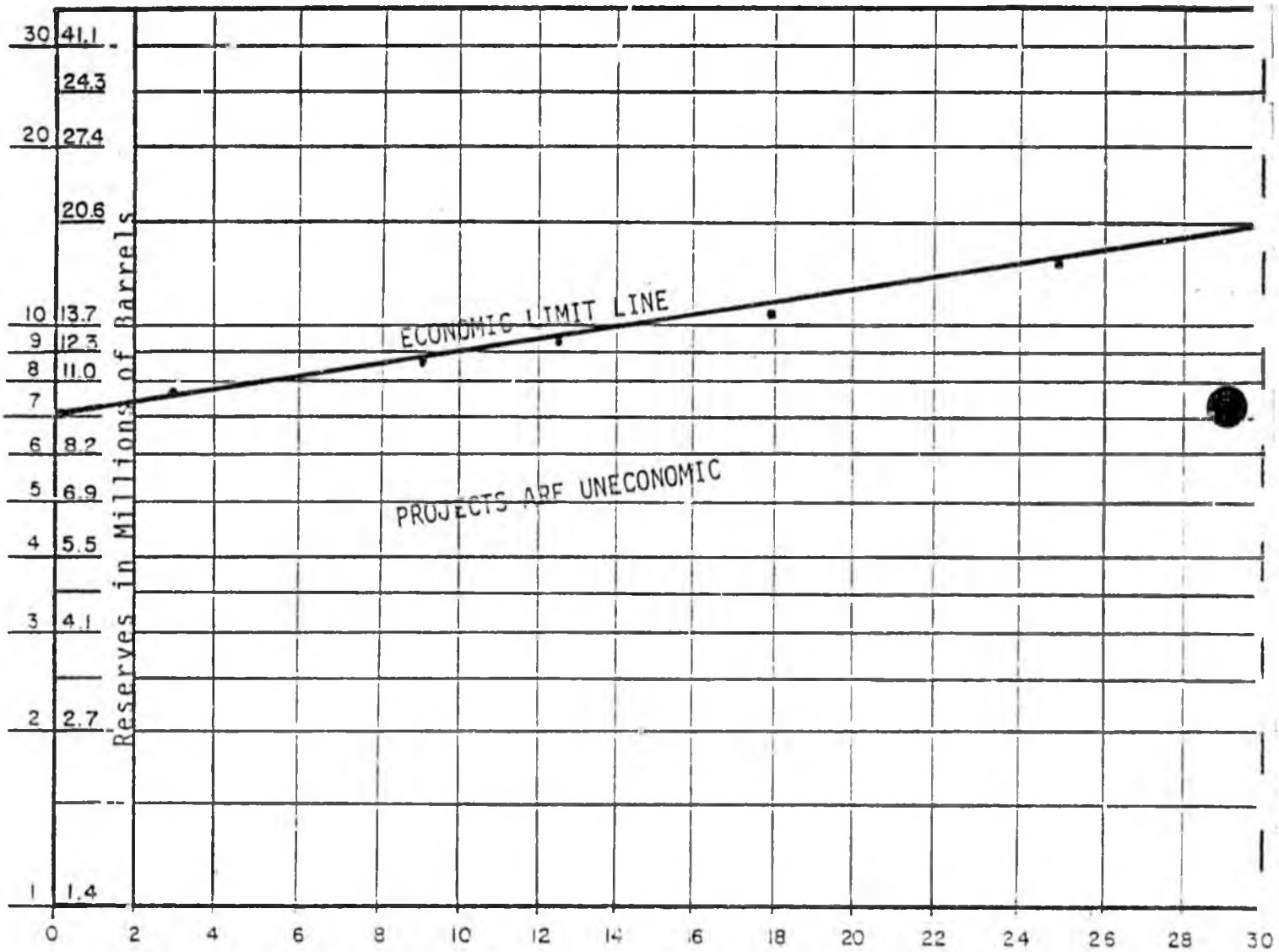


FIGURE II-16

venture must also increase to compensate for the losses from the unsuccessful ventures. Because of the high risks involved with finding and developing an oil field, it is entirely probable that the 18% rate-of-return used in this repor[illegible] low, depending on the specific structures being leased and on the bid[illegible]hods being used to auction off the leases.

The State [illegible]he capability, and perhaps the obligation to influence the timely develo[illegible]nt and production of small fields. Of the three parameters which most influence the minimum economical field size, the State has the capability of adjusting only one of the parameters - the royalty percent. Even if the royalty were reduced to zero, the State would realize income from severance tax, conservation tax, advalorem tax and from income tax. These tax revenues would not be realized unless the field were produced. The oil company makes some profit and derives benefits from supplying refineries with feed stock. The nation benefits from an increased supply of crude oil.

Marginal fields must be developed and produced on a timely basis. For a specific set of conditions of field size, oil price, royalty, and rate-of-return, the location and development timing are related and are critical. For example, any oil field which is near already producing fields is more economical to develop and to produce than if it is remotely located. This is because the facilities, equipment and personnel required for the operating field can be utilized in the operation of a small, nearby field. While some additional direct labor may be required, the repair crews and supervisors could cover both fields; in other words, the fixed operating costs would not significantly increase. Thus, it is critical that the marginal fields be developed and produced while there are large producing fields in the area.

The State has the capability of encouraging the development of marginal fields. The State benefits [illegible] development as does industry and the nation. Therefore, if the [illegible] to encourage this development, a flexible leasing program will be necessary so the leasing system can be tailored to existing conditions.

SENSITIVITY OF THIS ANALYSIS TO CHANGES IN VARIOUS PARAMETERS

Extremely High Risk Cases. Two leasing methods were analyzed at a 1% probability of success to determine if the results obtained from this study would be valid for extremely high risk situations. The bonus bid @ 12.5% royalty case and the royalty bid at fixed bonus case were run at extremely high risk.

The major elements of these extremely high risk cases were that 100 bonuses would be received and 100 structures would be drilled. The bonuses were appropriately factored to reflect the 1% probability assigned to this venture. Since our study assumes 3 wells are drilled per structure, there were a total of 297 dry holes drilled - 300 exploratory wells total. The cost of drilling these wells was included in both cases as dry hole exploratory costs. For a dry structure, the bonus and the well cost were expensed at significant tax loss to the State; as a matter of fact, the tax loss constitutes 42.3% of the bonus received.

The rate-of-return from high risk ventures must be adequate to compensate for the statistical losses. The bonus bid method requires relatively larger bonuses than does the royalty bid methods. The bonus is a leasehold investment item while royalty operates like a cost of production. Therefore, the investment risked on a bonus bid case is significantly higher than the investment risked on a royalty bid case.

In recognition of the relative risks, the bonus bid case was run at a higher rate-of-return than was the royalty bid case. A rate-of-return of 22.5% was deemed reasonable for the bonus bid case. From the oil company's viewpoint, the royalty bid case is much more secure; therefore, we assumed a 10.5% rate-of-return for this case. The results of the economic calculations are shown graphically on Figure II-17. For these conditions at all discount rates from 0% to 10%, the royalty bid method provides significantly more income to the State than does the bonus bid method.

Next, the cases were compared at equal rates-of-return (16%). At this rate-of-return, undiscounted income from the royalty bid case is higher than for the bonus bid case. But at a discount rate of 2%, the present worth income from both cases is equal - at discount rates above 2%, the bonus bid case provides more income to the State than does the royalty bid case.

Changes in Crude Oil Prices. Crude oil prices used in this report are the Tier II prices for Cook Inlet. These prices are then escalated at a rate of 5% per year to a maximum value of $18.00 per barrel. The maximum value of $18.00 per barrel is reached in the twelfth year after the lease sale, 7 years after production starts. The average price per barrel for the cases studied is $17.40 per barrel. The initial price is $10.86/Bbl.

The possibility exists that the Federal government will set crude oil prices for newly discovered fields. Therefore, we reran the computer programs, changing only the crude oil prices. The comparative effects on the selected leasing methods is shown in Figure II-18. This figure shows state

STATE INCOME VERSUS DISCOUNT RATE

FOR BONUS BID AND ROYALTY BID CASES

AT DIFFERENT INDUSTRY RATES OF RETURN

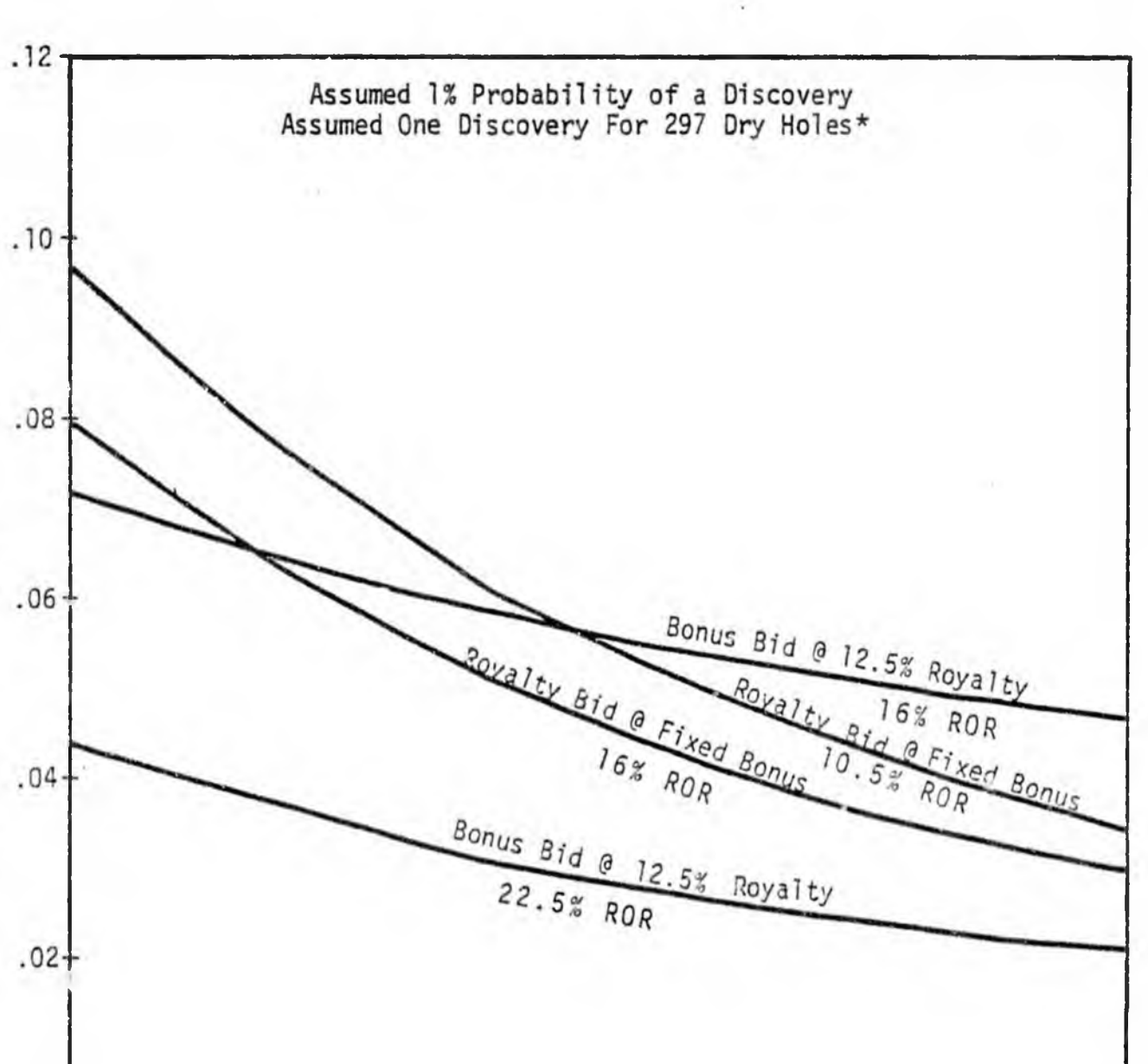


FIGURE II-17

DISCOUNTED STATE INCOME VERSUS RISK

Based On

Expected Value Oil Field, 600 Million Barrels Recoverable.

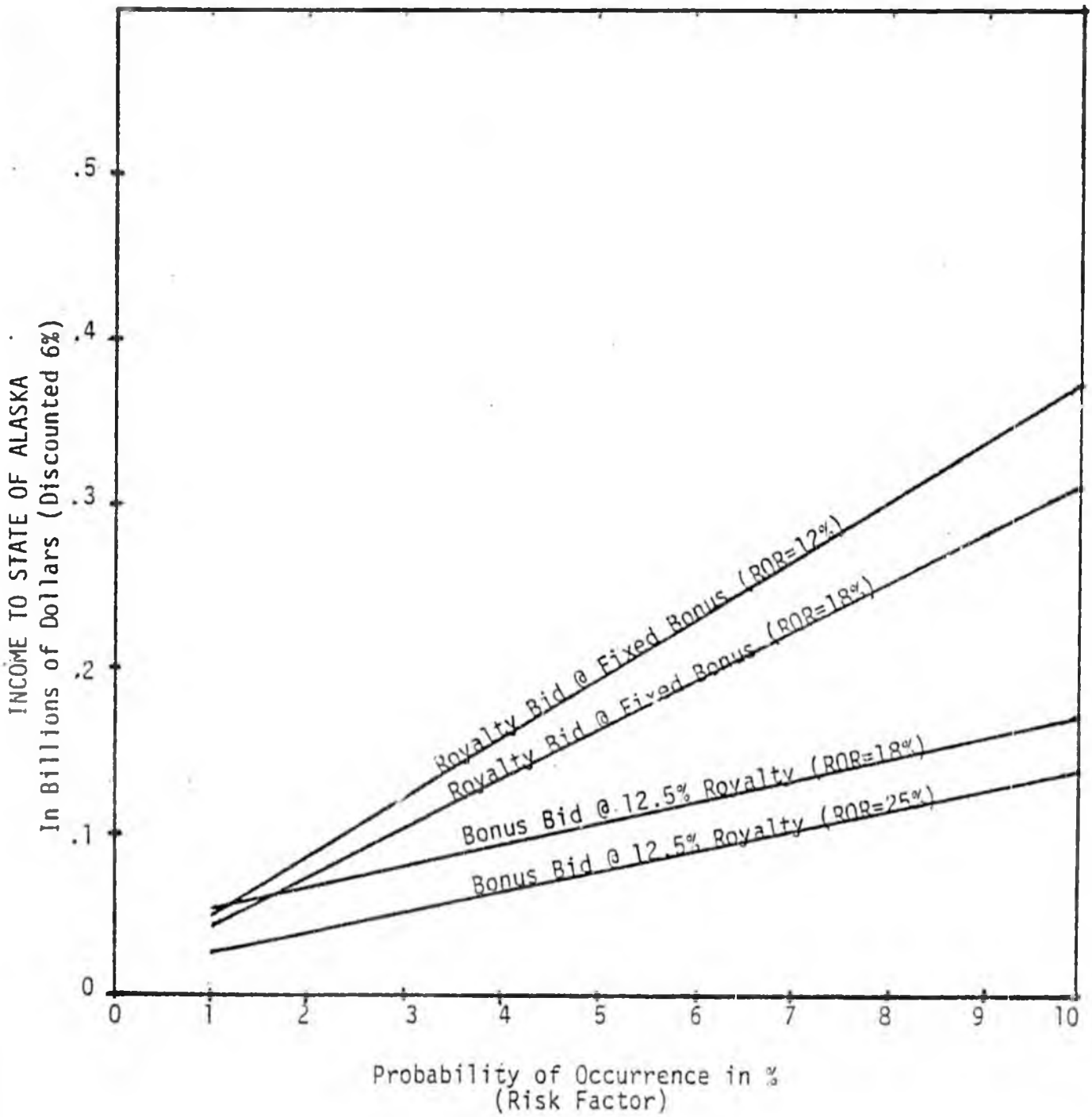


Figure II - 18

DISCOUNTED STATE INCOME VERSUS
CRUDE OIL PRICES
FOR VARIOUS BIDDING METHODS

Venus Field
(600 Million Barrel Recoverable)
All Cases At Risk Factor = 10%

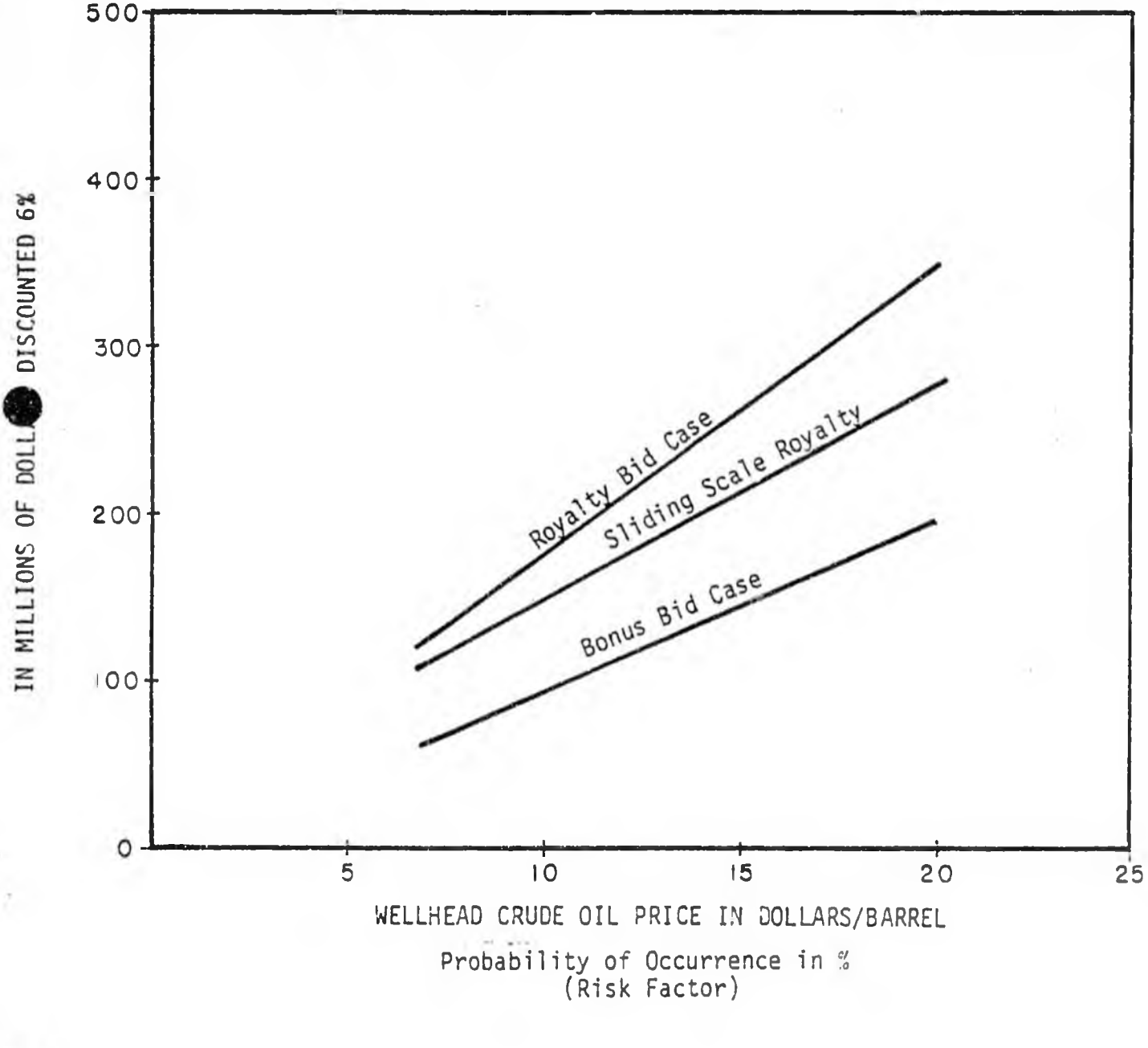


FIGURE II-19

income (discounted 6%) versus wellhead crude oil price.

For the range in crude oil values studied, the comparative relationship of the selected bidding methods did not significantly change. The range of crude oil prices considered was $7.00 to $20.00 per barrel. Over this range, the discounted income curves for the bonus bid case was always lowest, the royalty bid case the highest, and the sliding scale royalty case was in between; a net profit bid case would be similar to the royalty bid case. Thus a change of crude oil prices from a low of $7.00 per barrel to a high of $20.00 per barrel does not change the comparative results of this study.

Effects of Produced Gas. Wellhead gas production was considered in this study. There are many unknowns which effect the value of gas removed from oil. Some of these unknowns are:

1. First, how much gas is produced - what is the producing gas/oil ratio?

2. Next, how much of this gas will be required for lease fuel - fuel usage depends on the field location, availability of commercial electricity, gravity of the oil, water content, emulsion condition, temperature of the production, and distances from the gathering centers to the cleaning facilities and sale point.

3. Third, marketability of the gas - some Cook Inlet gas is handled at a loss, some is sold at various values from about 16¢/MCF to 64¢/MCF.

4. Lastly, what is the present worth of profits (PWP) resulting from reinjection of the produced gas?

Since evaluation of the produced gas depends on several variables the effects of solution gas are not handled separate from oil in this analysis. The effects on the study are in the order of less than 1%.

Government and Discount Rates. What discount rate should governments use? Discount rates are used by businesses to compare alternative investments. The Net Present Value (NPV) of future cash flows that would result from alternate investments is a uniform comparison base; it's about the only one available to business (governments use a "cost to benefit ratio").

Goals of businesses differ from those of governments. A business's only goal is to make money for their stockholders. A government's goal is to provide those services for the populace which they cannot provide for themselves. A business wants to continue making profit to pay monetary dividends in perpetuity while a government needs money to supply services in perpetuity. A business uses Present Worth of Profits (PWP) to compare investments; to be consistent, a government should use Present Worth of Services (PWS) to compare various options. PWP is not compable to PWS. Since a Discounted Cash Flow (DCF) is used to determine PWP, it cannot also be used to determine PWS, therefore, it may be wrong for governments to utilize a (DCF) as does business.

A government has a requirement for a sustained income in perpetuity. Money in a bank provides no services to the populace - at best, the interest earned is useful for future services. Since the value of oil and gas is increasing with time (a recent USGS prediction indicates crude oil prices of $80.00 per barrel by the year 2,000, if that's accurate or even 50% accurate), more State income may be gained by leaving it in the ground to mature than by "banking it" or spending it frivolously. Indeed, if the price escalation of crude oil is greater than the bank interest, a loss will result from early removal of crude oil. At this point in time, this is a real possibility. Perhaps current income over and above current requirements should be discounted to appropriately reflect the price loss resulting from early removal of crude oil.

While it is uncertain that governments should utilize discount rates to evaluate future cash flows, data is presented for discount rates of 6% and 10%. Shown on Figure II-19 and II-20 is discounted income to the State for the leasing methods analyzed. At these discount rates, (6% and 10%), the relative positions of the income curves for the various leasing methods do not change, they only shift downward.

DISCOUNTED INCOME TO STATE OF ALASKA

Risk Versus Income

Medium Expected Value Oil Field
(600 Million Barrels Recoverable)

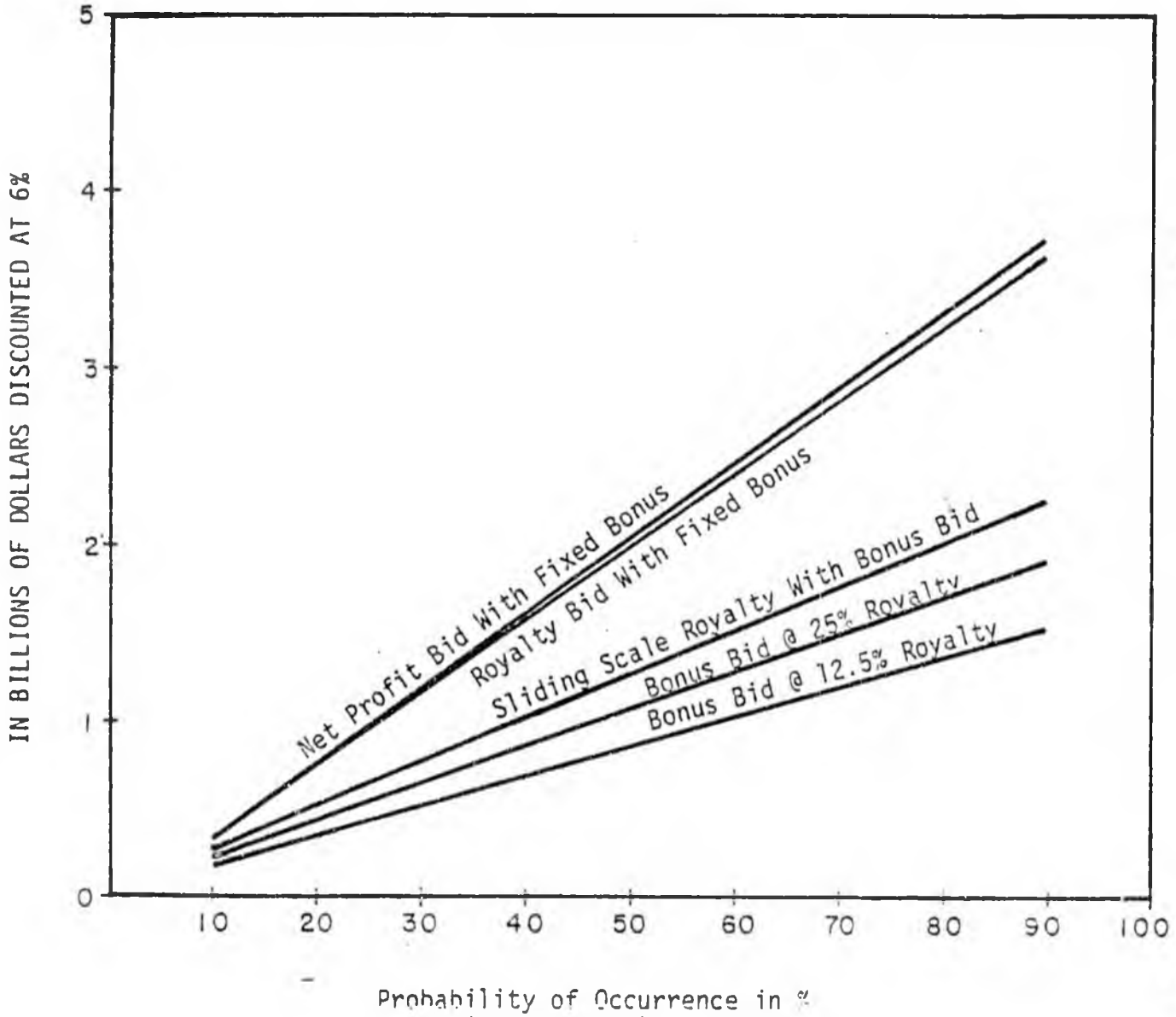


FIGURE II-20

DISCOUNTED INCOME TO STATE
VERSUS PERCENT RISK

For Various Leasing Methods

Medium Expected Oil Field
(600 Million Barrels Recoverable)

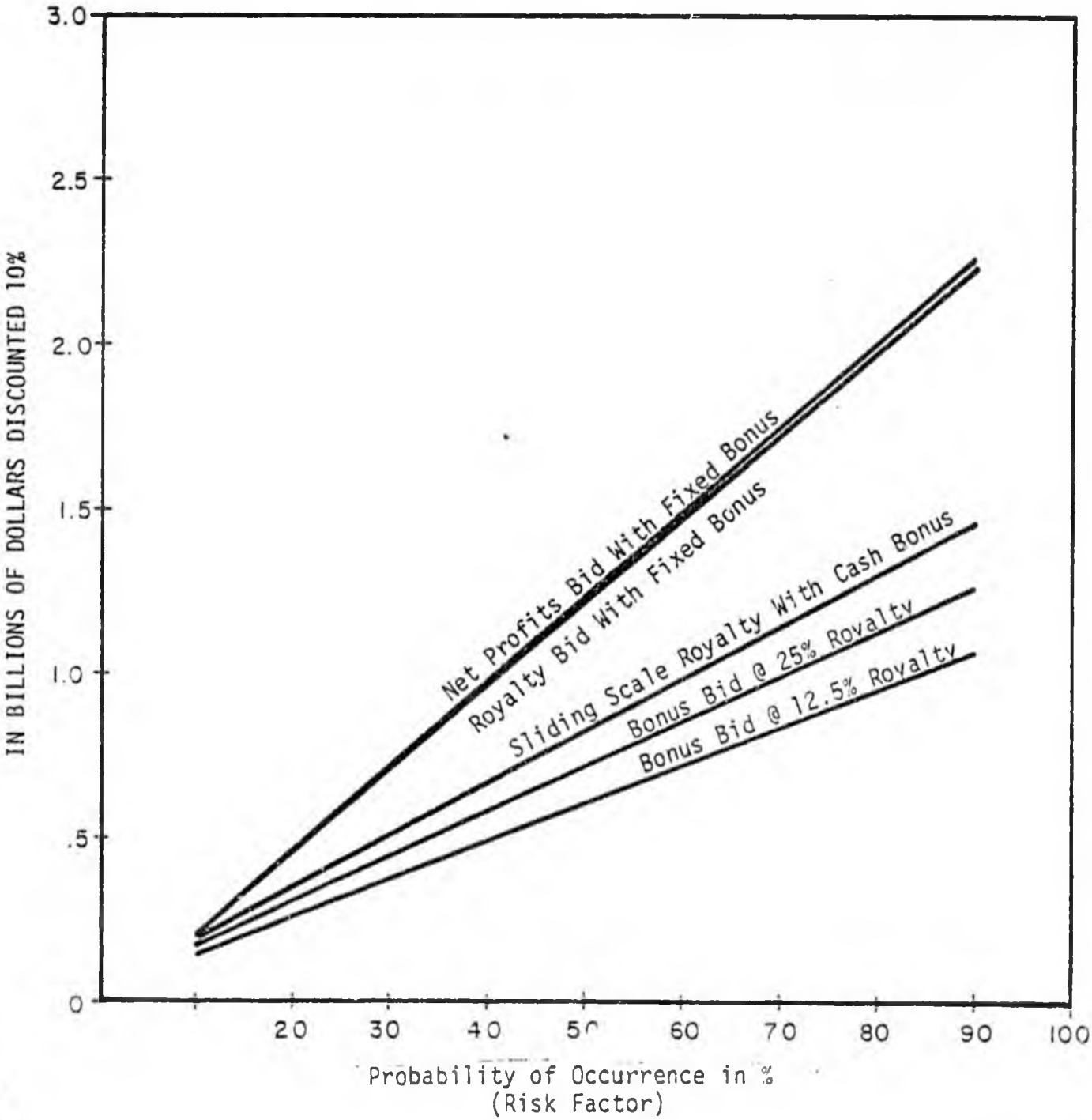


FIGURE II-21

EFFECTS OF VARIOUS LEASING METHODS

To obtain the amount of bonus to be bid under a cash bonus bid system, the interested companies make geological and engineering models of the field. This data is put into a computer program along with the rate-of-return the company requires. The computer output lists the present worth of profits at various rates-of-return and the bonus which can be paid for each complement of discount rate and rate-of-return. Company management then selects the bonus based on the historical success of the company in obtaining the reserves calculated by the engineers and geologists.

To determine the amount to be bid under the Royalty Bid system, the Net Profit system or the Bonus Bid for Sliding Scale Royalty system, input variables are changed to reflect the required output data. In all cases, the bid parameter is listed in the output for various rates-of-return at the company's discount rate of money. This data is frequently displayed on a normal distribution curve so management can readily perceive the bid value versus risk.

The geological and engineering risks are incorporated into the respective models. However, the final risk applied to the bid quote is done by top management based on the statistical success of the company in obtaining the reserves calculated by the geologists and the engineers.

Bonus Bid Method. This is the method currently used by the State of Alaska, the Federal government and various other state governments. The advantage to the State is that immediate income is maximized. The cash bonus can be utilized by the resource owner before any production is obtained. In the likely event of a dry structure, the resource owner still has obtained the bonus; the

implications of a resource owner obtaining large revenues for nothing is beyond the scope of this report. However, it does seem wasteful of capital resources. It should also be noted that tax deductions taken by industry in the unsuccessful ventures result in a reduction of the net bonus to the State of Alaska.

The State of Alaska's income needs have been great while the sources of income have been few. Generally, the cash bonus has been spent before the field is developed, and in many instances, the bonus has been spent even before a discovery has actually been made.

Compared to cash bonus bidding there is no other leasing method which maximizes the immediate income to the State of Alaska.

The disadvantages of the bonus bid, from the State's position, is that considerable future income may be sacrificed to obtain immediate cash income. The best example of this is that for all the State's petroleum leases on the North Slope bonus bids totaled 912 million dollars. Estimated reserves of the Prudhoe Bay Field are 9.6 billion barrels. Total State bonuses collected from all North Slope leases to date amount to only 9.5 cents per barrel of oil for the Prudhoe Bay Field. As additional reserves are developed on the already-leased North Slope acreage, the bonus value will drop below this 9.5 cents per barrel figure. Bonus wise, the State of Alaska virtually gave away the Prudhoe Bay oil.

In addition to the above considerations, the amount available for the bonus bid is based on the cost/price assumptions made at the time of bidding. If the costs or prices change after a lease has been awarded, the comparative value of the bonus changes. If costs decrease, the bonus was too low; if costs

increase, the bonus was too high. Similarly, if crude oil prices decrease, the bonus was comparatively high; however, in the more probable event that crude oil prices increase, the bonus would then be too low. The 1969 Prudhoe Bay lease sale occurred when Cook Inlet prices averaged 2.63 $/bbl.

From the producing companies consideration, they are making a considerable investment several years before they can possibly get any return for that investment. The cash bonus is wasted if the structures are dry. It has not purchased anything of value and does not assist in the exploration or development of resources. For small companies, this cash bonus or "Front End Money" imposes a large problem. For even large companies bidding on large structures, an equitable bid may be a significant part of the very high costs needed to bring the field to production. Here again the Prudhoe Bay Field is a good example. When the $0.9 billion bonus is added to the $8-10 billion for pipeline cost plus the field development costs of $5-6 billion, the aggregate cost strains the financial markets of even a group of large companies such as ARCO, BP, EXXON, and SOHIO.

In anticipation of the ability to finance a venture (bonus + development + transportation), a company would reduce their bonus bid based on the availability of capital and especially on the basis of their ability to obtain the needed capital.

Royalty Bid Method. On the other end of the bidding spectrum is the royalty bid. This is the bidding method most frequently compared to bonus bidding. Generally, a small fixed cash bonus is required to reduce speculation by those who have no intentions of exploring the leases. The winning bidder is the company which bids the highest fractional royalty to the resource owner.

The royalty bid is a means by which the resource owner can share in the benefits of a large field such as the Prudhoe Bay Field. However, the resource owner

must also share the risks in the dry structures, from which he would get nothing except the small fixed bonus.

Based on the same geologic, engineering and economic models, an operator would be more willing to promise large future payments contingent on the success of the exploration and development than he would be willing to pay an equivilent amount as a lump sum cash bonus at the lease sale when the first income from production is 4-6 or more years away; and when income from the investment may never be realized.

From the resource owner's consideration, a disadvantage of royalty bidding is that the owner shares the risk with the operator. For a dry structure, the owner would realize only the small fixed bonus whereas under the bonus bid, the owner would normally have received a larger bonus.

Royalty income to the State can be influenced by the crude oil prices set by the Federal government. The income gain to the State from royalty bidding as opposed to bonus bidding results in part from a reduction in Federal income tax (Figure III-1&2). This occurs because the royalty oil is not income to the operating company, therefore, it is not subject to Federal income tax. Since the Federal government through the FEA sets crude oil prices, they have the capacity to affect the royalty income to the State of Alaska. Decreased crude oil prices would not necessarily decrease income to the Federal government because they can make up the lost taxes downstream of the refinery. Any consideration of royalty bidding should include the possibility of the FEA setting crude oil prices which would affect income to the State.

Another disadvantage from the owner's viewpoint is that the royalty is a cost of

DISTRIBUTION OF GROSS INCOME

Based on Current Method of Leasing
(Bonus Bid @ 12.5% Royalty)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

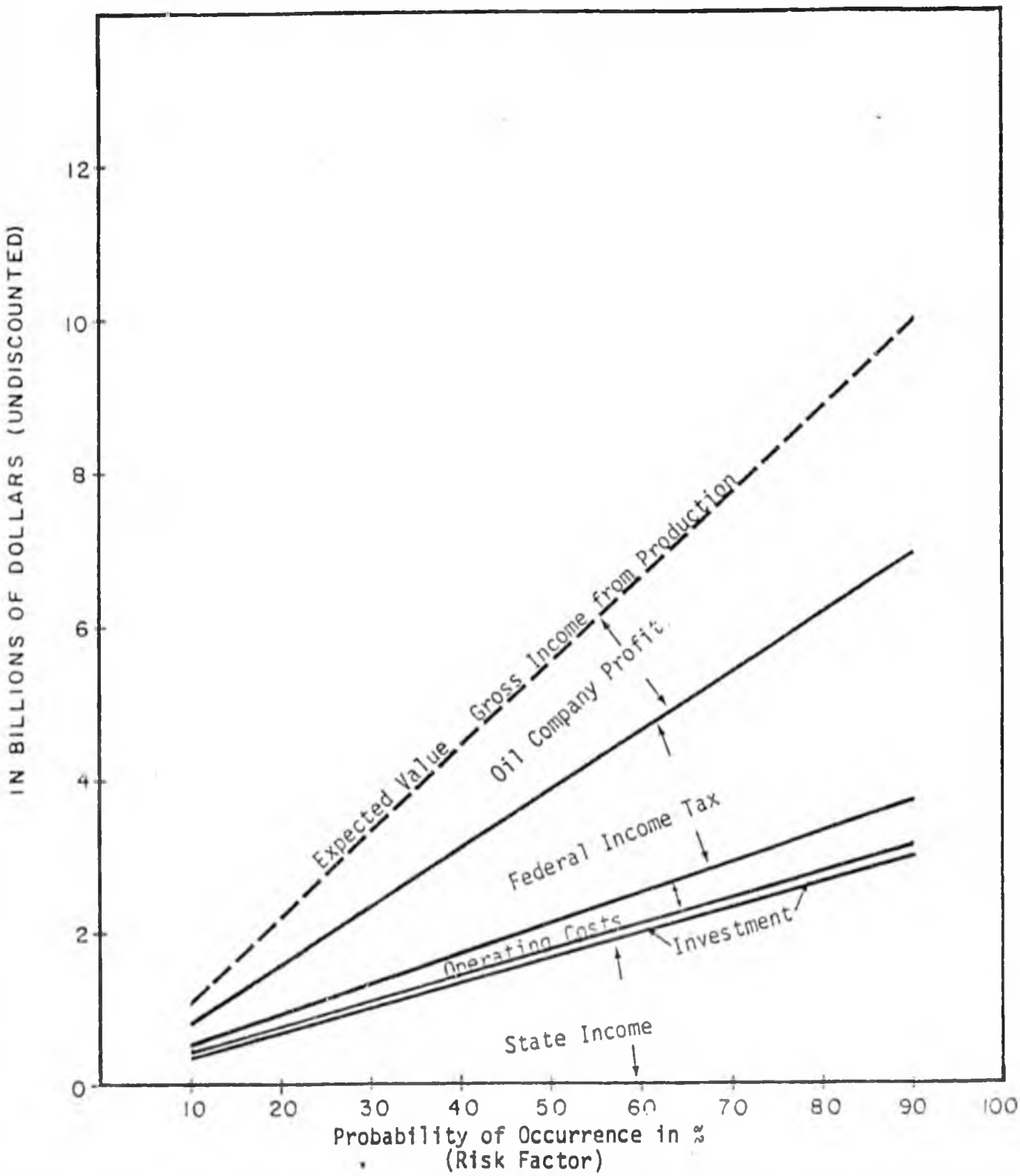


FIGURE III-1

DISTRIBUTION OF GROSS INCOME

Based on an Alternate Leasing Method
(Royalty Bid at Fixed Bonus)

Medium Expected Oil Field
(600 Million Barrels Recoverable)

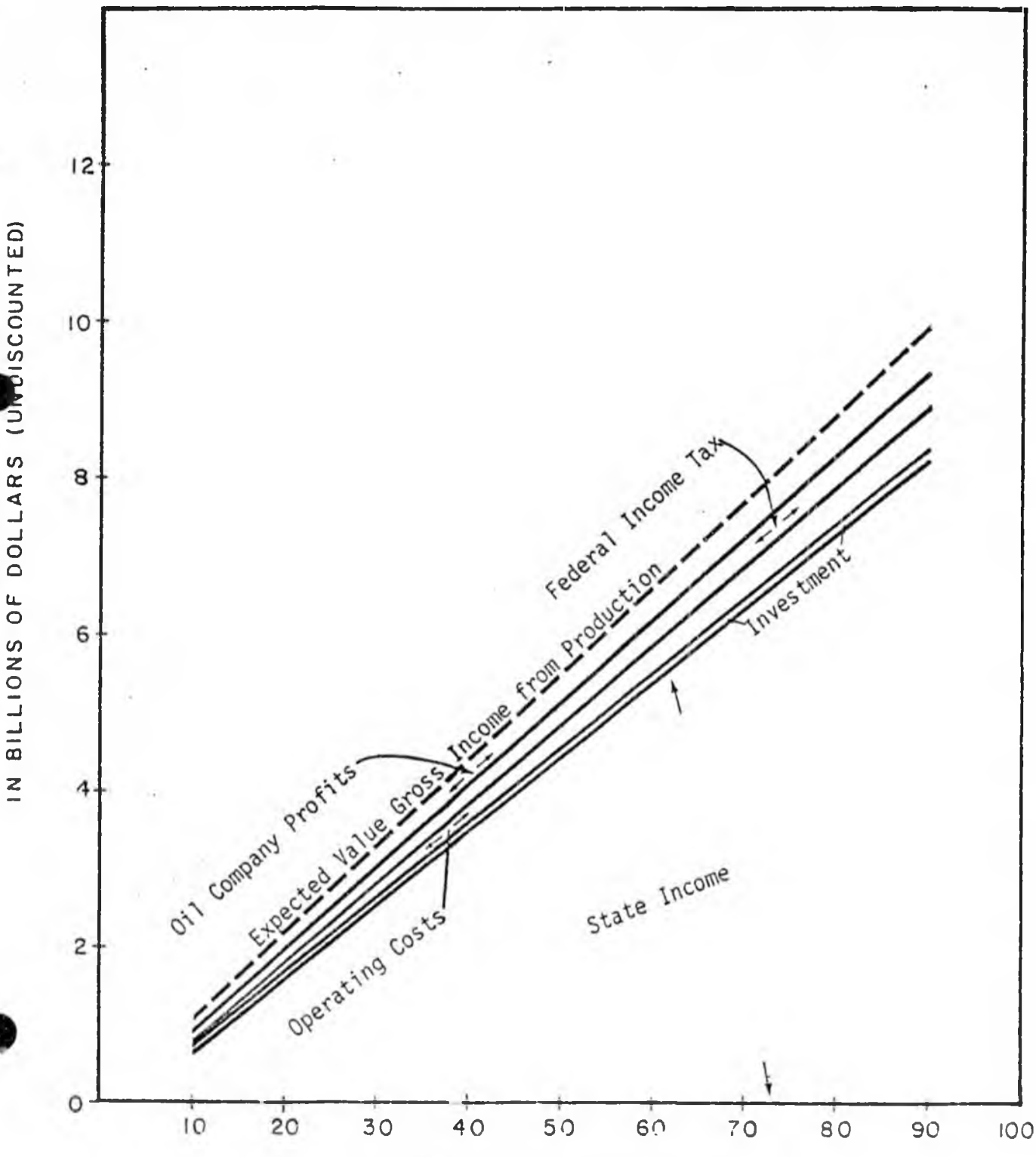


FIGURE III-2

production and, economically speaking, acts like a production expense. As the cost of production increases, the minimum economic production rate is increased. This means that the economic limit is reached sooner in terms of cumulative production as well as in years of field life. When the economic limit is reached at a lesser cumulative production, the amount of the resource left in the ground is increased, thus wasting a valuable resource. Reaching the economic limit sooner in years also reduces the number of Alaska jobs available. This problem could be resolved by having the royalty decrease as production declines in the field's old age period.

Royalty bidding should entice more competition in the leasing auctions. During OCS lease sale No. 36 in the Gulf of Mexico, some tracts were put up for royalty bid plus fixed cash bonus while other tracts were offered at a cash bonus bid plus 16.67% royalty. The tracts leased on the royalty basis averaged 7.1 bids per tract as compared to only 2.2 bids per tract for those leased by bonus bid.

From industry's viewpont, royalty bidding takes much of the uncertainty out of bidding. The majority of their committment is based on the contingency of production. If they develop production, they pay. If no production is developed, they don't pay. This aspect increases competition for the leases and allows the allocation of more capital for exploration; however, it also makes it much easier to walk away from poor prospects. By keeping the front end investment low, industry's capital financing is much easier to obtain. Indeed, if the capital market is weak, they may have a difficult time financing the entire project, e.g. the TransAlaska Pipeline.

Since royalty is based on production, it has the effect of increasing the minimum production costs and therefore, the minimum production rate for an economic

operation. Theoretically, as the minimum economic rate is increased, the economic life of the field is shortened; therefore, the company may discontinue production of a field at a lesser percent recoverable under royalty bid than would occur under bonus bidding. This is speculative reasoning because an integrated oil company may operate a field at a loss because refinery feed stock is needed and because operating losses can be made up downstream. In actual practice, very few fields have been abandoned. They may be shut in or production suspended awaiting recompletion, stimulation, or secondary recovery, but they are seldom abandoned to the extent of recovering the equipment, plugging the well bore and cutting off the casing below ground level.

Net Profit Bid Method. Under this system, industry bids on the percent of net profits (after capital recovery but before taxes) which will be returned to the resource owner. Profits which are to be split are those obtained after the lessee has recovered all of this invested capital plus a nominal interest value. Also, at the time of leasing, a small fixed cash bonus is required as earnest money. In this study, the fixed bonus was based on expected reserves within the leased acreage.

Economically, this system is very similar to the royalty bid system. That is, the front end money required is low. The majority of return to the resource owner is predicated on the profitable production of the resource. Similar to royalty bidding, the resource owner shares the risk of not obtaining profitable production. If profits are not made, the resource owner's only income is the small fixed bonus paid at the time of leasing.

Some of the financial advantages of this system are very similar to those of royalty bidding. Since the front end money is low, financing exploration and

development costs is much easier for the company than under the current bonus bid system. The lessee should be willing to bid more money contingent on future profits then he would be willing to bid for a lump sum cash bonus bid.

Similar to the royalty bid system, the net profit system operates as an increased cost of production. That is, it raises the minimum economic value of production. As this minimum economic value of production is increased, the economic life of the field is reached at a lesser cumulative production and at a shorter time in years. However, as was discussed under royalty bidding, the economic limit is not necessarily the cut-off point as far as the company's willingness to produce a field. This is because the company may need the feed stocks to operate their refinery; and because profits lost from operation can be made up downstream of the refinery. Also, marginal on-shore fields are generally kept in operation pending some remedial work, stimulation, secondary recovery plans or pending significant crude oil price increases.

A disadvantage of the net profit system is that since the resource owner's income is based on the net profits of the company, the resource owner will want to know what the actual profits are. To ensure that only applicable costs are deducted from income, it would be necessary that the resource owner do extensive auditing of the books of all of the companies which were producing from leases obtained under the net profits system of bidding. Also, there could be a good deal of controversy regarding the need for and the chargeable costs of some investment items.

Another disadvantage could be that the companies would attempt to consolidate

profitable ventures with losing ventures (this is sometimes called cross subsidy). This is possible within the same lease or field as when a profitable option is coordinated with an unprofitable one - for example; field extensions, pool extensions, secondary recovery projects, production acceleration projects, facilities expansion and others.

Sliding Scale Royalty Method. For this leasing method, royalty rates which increase with production rates are set by the resource owner; bids are awarded to the bidder who offers the highest cash bonus.

This method of leasing combines the good points of the cash bonus bid at fixed royalty system with the good points of the royalty bid system. In effect, it's a compromise between the two systems.

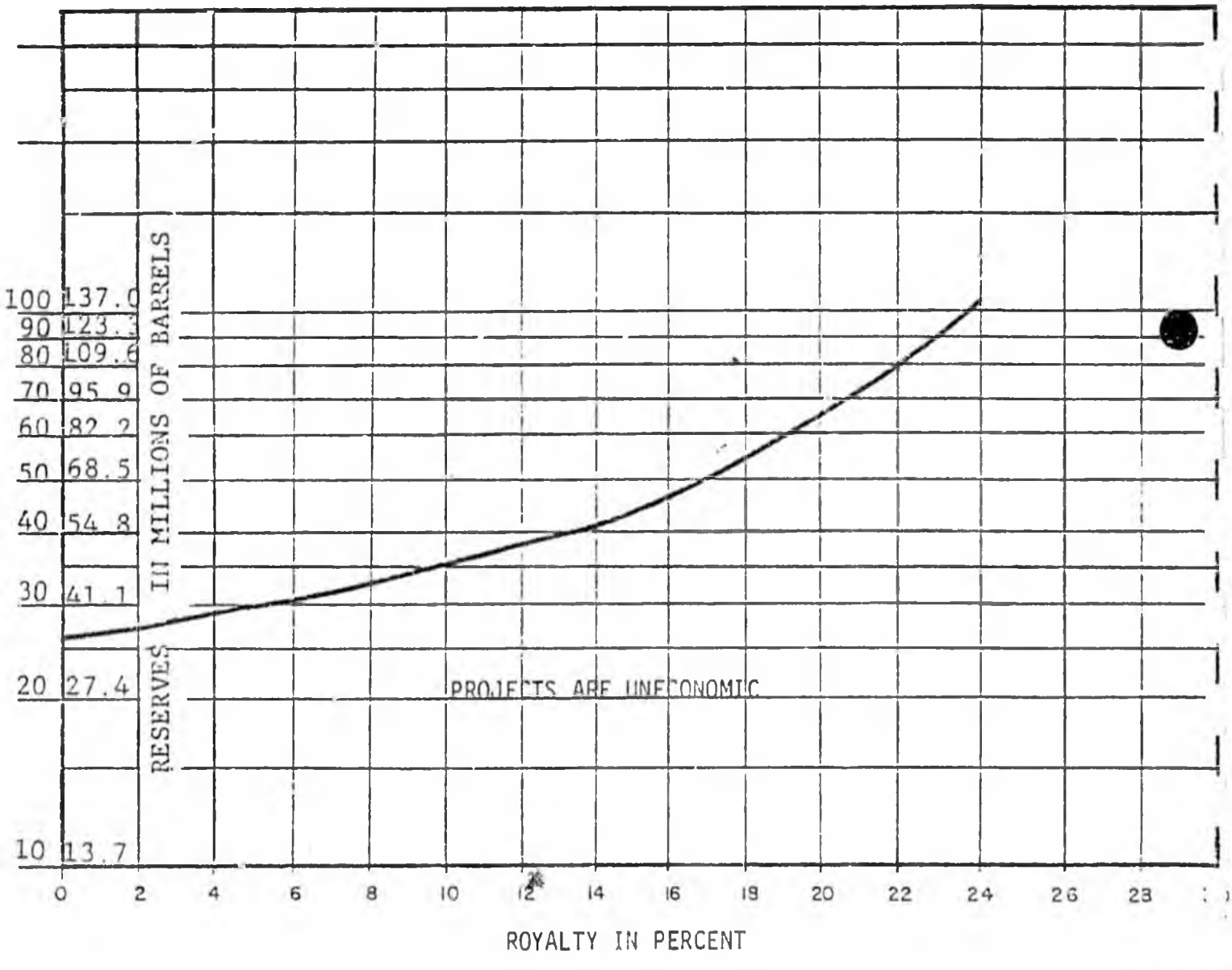
The sliding scale royalty system has the advantage of allowing the resource owner to realize some immediate income from lease sales and still allows some participation in the profits should a large field be discovered - for example, Prudhoe Bay. The cash bonus received would be less than under bonus bidding at fixed royalty, but would be more than the bonus required for either the royalty bid or the net profit systems. The royalty received would be greater than for bonus bidding and less than under the royalty bid or the net profit bid systems.

Under this method of leasing, prior to the sales, the State sets a predetermined sliding scale royalty rate which can be based on a variety of parameters. A very common one is production rate of the wells, individually or based on the average well production rate for the month. The interested bidders then bid on the

ECONOMIC LIMIT DEFINED BY

ROYALTY VERSUS RISK
FOR OIL WITH AVERAGE VALUE OF 10.5 DOLLARS/BARREL

Also Shows Royalty Versus Reserves
At The Economic Limit



amount of a fixed cash bonus which they will give to the resource owner for the privilege of exploring, developing, and hopefully producing from the leased tract.

The sliding scale royalty method is a very convenient tool which the State can utilize to prolong field life and increase ultimate recovery. As normally used, sliding scale royalty increases the percent royalty above a base percent (usually 12.5% or 16.67%) depending on production rate. However, for very small fields (and as large fields decline), the royalty percent could be decreased. Figure III-3 shows that for a crude oil price of $10.50/Bbl, and a rate-of-return of 18%, a field of 30 million barrels recoverable is only economic if the State is willing to accept about 6% royalty. It could also be economic if industry was willing to accept lower rates-of-return; however, for high risk ventures, a reasonable rate-of-return would probably be nearer to 25% than the 18% used in this report.

Percent of Acreage Option. Withholding a percent of the acreage is a leasing option which has resulted in increased income to resource owners. The elements of this option are that only 40 to 60 percent of the acreage is leased at the initial auction; the balance of the acreage is leased after a discovery is made. If only dry structures are found, the remaining acreage would not be leased.

At the initial leasing, all bids will be discounted for the risks involved. After exploratory wells have been drilled, either reserves will be found or the structure will be dry. If dry structures are found, the remaining acreage will not be leased. If reserves are found, the remaining acreage can be leased as proven reserves and will thus bring in premium bids.

This of course is what happened with the Prudhoe Bay oil field. Prior to discovering oil in 1969, Arctic Slope competitive bid bonuses totaled only 12 million dollars. After oil was discovered, competitive bonuses for the remaining acreage totaled 900 million dollars - most of this acreage straddled the oil/water contact and was definitely inferior to previously leased tracts.

Withholding acreage can increase income to the resource owner because irrespective of the risks initially applied, after a discovery is made the remaining acreage may be considered as probable reserves by the bidders. Thus, the increased income is due to a decrease in risk, not because of the bidding method utilized. In fact, any bidding method could be used in conjunction with the percent of acreage option.

There are some dangers in withholding acreage. In areas where a great deal of uncertainty exists, if too little of the structure or basin is offered at the initial auction, there may be few bidders. If too much of the basin is offered at the initial auction, it may turn out that the productive acreage is entirely within the leased tracts. Therefore, the bidding methods should be as carefully tailored to the particular structure or basin being leased as if the whole would be leased at the first auction.

The percent of acreage leasing option is a technique of withholding a part or a block of the leaseable acreage; it should not be confused with "checker boarding". Checker boarding is a leasing option whereby only alternate sections are leased initially. In the lower 48 states where fields are small, cost are relatively low, and well spacing may be as close as one to each 5 or 10 acres, checker boarding may be equitable to the operator. However, in

Alaska where well spacing is 1 well for each 160 acres and cost are high, fields must be large to encourage economic development. Checker boarding alternate sections in Alaska would be uneconomic to leasees and would probably result in the tracts not being leased. In the percent of acreage option, we are considering that only 40-60% of the structure is leased initially - that is, a few large blocks would be withheld.

OTHER CONSIDERATIONS

The purpose of an auction is to allow the bidders to set the fair market value of the commodity being sold. The fair market value can only be obtained when there is a sufficient number of bidders to insure actual competition. Anything that increases the number of bidders increases the competition and therefore increases the probability of the seller obtaining the true market value for his goods. On the other hand, anything that decreases the competition decreases the probability that the sale price will be the fair market value.

For a variety of reasons, the large oil companies tend to combine in partnership groups and make joint bids. This practice tends to spread their risks, but it also tends to reduce competition in bidding. In an attempt to encourage competition, the Federal government has prohibited the 9 largest oil companies from bidding together - the companies are listed in the Federal Register Announcement dated September 27, 1976. This is an option that Alaska ought to consider emulating in all future lease sales.

Also, the State should consider allowing industry to pay their cash bonus bids on an installment basis. This would spread out the income to the State and would ease financing problems for the companies. In Alaska where bonus bids, and exploration and development costs tend to be high, small companies are virtually excluded from competing. If they could pay their cash bonus bids on an installment basis, they could possibly compete in the bidding, (a bond should be required to insure payment of the balance). As discussed earlier, the winning bid at an auction is more apt to approach the fair market value when there are a large number of participants.

This report has presented analytical comparisons and discussions of four bidding methods and of one leasing option. Model fields were constructed based on existing Alaska fields. Income to the State was computer calculated for each of the analyzed bidding methods. The advantages and disadvantages of each of the four bidding methods was discussed, one method at a time. The major advantages and disadvantages which should be considered are summarized in the following paragraphs.

Proper selection of a bidding method can optimize benefits to the State in various ways:

1. Increase immediate income
2. Sustained yearly income
3. Increased total income
4. Encourage exploration activity
5. Prolong field life
6. Encourage development of marginal fields.
7. Increase the number of bidders.

There is no "one" best method which can maximize all of the above possible advantages to the State. To select a bidding method for a particular lease sale, the selector must know the relative importance of the above criteria at that point in time.

For each of the analyzed leasing methods, there are relative disadvantages as well as the advantages. The methods which have the most distinct advantage in one criteria will have a distinct disadvantage in another criteria. Some

of the more obvious disadvantages of the various leasing systems analyzed are:

1. Reduction in total state income
2. Reduction in immediate income
3. Decreased exploration activities
4. Shortened economic field life
5. Discourage development of marginal fields
6. Require strict State surveillance of oil industry accounting
7. Decrease the number of bidders.
8. Varying degrees of risk assumed by the State

These disadvantages are a compilation of the disadvantages of the various leasing systems analyzed. They are not all attributable to any one system.

Selection of the leasing method to be used for selling resources in a specific structure must include consideration of the disadvantages to be minimized as well as the advantages to be maximized or at least optimized. A flexible leasing system based on analytical research will allow not only the selection of the "best" method but the combination of various methods to produce a product that will maximize the benefits listed and minimize the disadvantages.

There is no single leasing method which is the best in all situations. The selection of a leasing method for a particular lease is dependent on the structures being leased and on the State's income requirements at the time of leasing. Analytical data has been presented which show some methods maximize immediate income while others maximize total income. All of the methods discussed in this report have advantages and disadvantages relative to the other methods. Only by understanding the atmosphere in the State and requirements of the State at the time of leasing can the "best method" be selected: e.g. the one which has advantages we want to maximize along with disadvantages we can tolerate.

PETROLEUM FIELD MODELS

APPENDIX A

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PETROLEUM FIELD MODELS

This study concerns the effect of different leasing methods on the income received by the State of Alaska from the development of its petroleum resources. Therefore, the study team chose known Alaskan fields as the foundation on which to build five oil field models. Each of the leasing methods was tested on the models, and the income to the State and to industry was measured, thereby enabling evaluation of the leasing methods. The discussion of the Engineering/Geologic models follows:

Proven Alaskan oil fields range in size from less than 80 million to about 8 billion barrels of recoverable oil. Five model fields which range from 50 million to 5 billion barrels of recoverable oil were chosen as representative of the sizes of oil fields which may be found in Alaska in the future. The smallest of the model fields, Mercury, contains approximately 50 million barrels. Mars 110 million, Venus 600 million, Neptune 1 billion and Jupiter 5 billion barrels. These fields are ranked as marginal, small, medium large and giant (as compared with Alaskan oil fields).

The 50 million barrel field is smaller than the smallest currently producing Alaskan field, but using this size of field reflects the future of development in a pioneer area such as Alaska. In the normal course of petroleum development in an area, the largest fields are discovered and produced first. As time passes, better technology and economics allow the discovery and development of smaller fields which were previously unknown and would have been uneconomic. Alaska may be entering this second stage of development in areas such as the Upper Cook Inlet.