

Valuation of Oil Properties

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INTRODUCTION

Those of the oil industry, who are concerned with the earning power of oil producing properties, visualize a valuation report as a rather stereotyped presentation of data in a form that engineers use to present the results of an analytical engineering appraisal. Specifically an engineering appraisal is an estimate of future recoverable oil and the cash profit to be derived from the production and sale of that oil. It should present with clarity the difference between factual material and the opinions formed from the analysis of that material. In presentation the engineer should keep in mind the purpose of the appraisal and the background of the people to whom the report is addressed.

FACTORS CONSIDERED

The fundamental features of an engineering appraisal for oil producing properties are:

The type of interest in oil production that is being appraised and the contents of the documents which create the interest.

The acquisition of data on the physical aspects of the oil reservoir and the income and expenses that are connected with the removal and marketing of the oil and its associated hydrocarbons and the use of such information to forecast the probable future earnings of the property.

There are many types of interest that may exist in a piece of oil producing land. There is a mineral interest, a landowner's interest, an overriding royalty interest, an operating or lessee interest, sometimes called the working interest, a carried working interest, and a participating interest.

Each has a distinctive character determined by the wording of the legal document or contracts which create and transfer its ownership from party to party. Careful consideration of all the terms of a lease and their effect on the earning power of an oil property from a lessor and lessee's point of view is not feasible. Nor is it proper to attempt a review of the effect many features of operating agreements and assignments may have on the worth of various interests in oil production. A brief examination of some of the terms commonly found in various contracts concerning oil properties might be of interest to engineers.

For example, the term of a lease is divided into two parts. The primary term is usually limited to a fixed number of months or years during which the lease may be maintained in good order without drilling operations. The secondary term covers the development and production of oil from the land. Many leases permit production operations "as long as oil is produced in commercial quantities." The right to drill, re-drill, and deepen wells may be either for an indefinite period or a fixed term. There were many leases drawn during the 1920's

in California that had a secondary term with a specific date upon which production and drilling rights terminate. With properties still producing oil at rates well above the economic limit at the time the lease terminates, the type of interest being appraised becomes doubly important. If it is an interest in the land and/or the minerals in place, its earning power may increase. If it is an interest in the lease only, it may enjoy no further income. The advantage in such a situation may rest with either the lessor or lessee. The abandonment clause may determine where leverage exists in negotiations for a new agreement.

Lands Not Fully Developed

Drilling requirements and quitclaim clauses may be of vital interest where producing lands, not fully developed, are being appraised. The drilling requirements set forth the spacing of the wells as agreed to between lessee and lessor. They often require that the number of acres under lease divided by the number of wells shall be equal to 5, 10, 20, 40 or more. Spacing requirements sometimes apply to each zone or formation. The lease terms on well spacing may apply only if a sufficient number of wells are drilled to retain all of the acreage. When complete development appears inadvisable as a result of information acquired during drilling operations, the quitclaim clause becomes important. This clause often holds less and on some occasions more acreage per well than would be retained under the terms of the spacing agreement if the property were fully developed.

Provisions for the payment of ad valorem and severance taxes on the mineral value of the land are usually prorated to the lessee and lessor interests in accordance with their respective participation in the production from the property. The lessor is required to pay the tax on the surface value of the land. The lessee pays the property tax on his producing and other equipment. There are, however, many agreements that permit the lessor to force quitclaim and abandonment of the property when the royalty income does not return, during a specified period of time, a fixed percentage of the current market value of the surface of the land after the payment of all taxes chargeable to the lessor interest. What is the effect of such a lease term on the earning power of a mineral interest, or an overriding royalty interest, on the operating or other working interests? In areas such as the Los Angeles Basin the action of this clause on an estimate of future cash profit may be far reaching.

Many leases grant the lessor the right to take his share of production in kind and then nullify this right. For example, lease form Oil Age 86-C revised, provides: "At Lessor's option, exercised not oftener than once in any one calendar year upon x days' previous written notice, Lessee shall deliver into

Lessor's tanks on the leased premises, or at the mouth of well or pipeline designated by Lessor free of cost. Lessor's royalty oil, provided that Lessee may at any time purchase and take Lessor's royalty oil at said posted available market price."

The right of either party to freely assign their interests, the stop production clause, the right of the lessor to acquire the bore hole for a fixed per cent of the salvage of the casing in the well or wells prior to abandonment, are all parts of a lease document that can and often do influence the earning power of an interest in oil producing land.

Operating Agreements

Operating agreements often impose restrictions on the working interest that do not exist in the original lease. Methods of accounting to participating but non-operating interests, the methods of fixing charges for overhead and supervision, and procedures for the contingent payment of obligations out of oil production are pertinent in the appraisal of oil interests. The collateral value of an interest, that shares in the operating profit but has no voice in the management of the property, is less than that of an equivalent interest that controls operations.

Sales contracts, their existence and general terms, and particularly the cancellation clause, have direct bearing on the operating profit to be derived from oil producing properties. For collateral purposes in time of price instability, a long term purchase contract may be considered advantageous. In period of short supply, the existence of a long term sales contract may be a liability.

The existence of contractual obligations in operating agreements, assignments and contingent oil payments, is not evident from examination of the lease document alone. Specific inquiries should be made as to their existence, their contents and terms.

Data Needed for Appraisal

The acquisition of data, its accuracy and reliability is a major problem with the appraiser of oil properties. In many instances, records of oil shipped and its price are the only factual data available for the preparation of an engineering estimate. Paul Paine's book, *Oil Property Valuation*, contains a check list covering the material desired for a thorough analysis of oil properties leading to an estimate of future recoverable oil and cash profit.

The appraisal of interests in oil production should always include:

The base date (day, month and year) on which the estimate is prepared.

A description of the property, legal preferred.

A brief of the lease document showing such information as the date of the lease, the term, drilling requirements, spacing, development rate, offset distance, quitclaim and method of determining retained acreage, distribution of taxes, the right to take in kind, the abandonment clause, etc.

Run tickets and revenue returns and the receipts of payment to the interest being appraised should be examined. This often shows discrepancies in the net interest or its nature. It is not uncommon to find that what has been described as a royalty is in actuality a participating interest paying some share of the operating costs.

The existence of sales contracts, their general terms and cancellation clause, operating agreements and oil payments should be part of the record.

Data for the preparation of an analytical engineering valuation of oil properties include material for the estimation of:

The amounts of future recoverable oil,

The income to be realized from the sale of oil and its associated hydrocarbons,

The expense connected with its extraction from the ground, its treatment and sale, and the profits to be expected from this operation.

Estimating Oil Reserves

The expression, future recoverable oil or oil reserves, does not have an interpretation that is universally accepted. It should be defined for the management or the client. Used in connection with an engineering appraisal, the term, oil reserves, might well be required to meet the following conditions:

The presence of oil must be proved to a high degree of probability.

The oil must be producible by techniques known today.

The operation must return a profit after the payment of all costs connected with its development, extraction, treatment and sale.

There are many methods of estimating oil reserves. All have one common characteristic. Their use requires judgment and experience. No one method is always acceptable nor can any one method be used in a rigid and routine manner.

The relationships between oil production decline and time, rate of oil production and gas oil ratios, rate and cumulative oil, reservoir pressure and cumulative oil, are all used for the estimation of future recoverable oil. The oil rate-time relationship is one of the oldest and most reliable tools for the estimation of oil reserves. Even this procedure must be used with care. Its accuracy depends upon the length of production histories of the well or wells being appraised, the accuracy of production records, the production of the well or wells at capacity rates.

Capacity production is seldom realized. Curtailment may be imposed on production rates by state law, production costs, prices, and taxes. The last item is playing an increasingly important part in the determination of operating policy.

The decline curve method of estimating future recoverable oil does provide an estimate of the rate at which the oil will be recovered. No other production decline relationship offers this advantage.

The oil rate-cumulative procedure for estimation of future recoverable oil requires capacity production and a gas depletion type reservoir if it is to yield reliable results. The method does not give an estimate of production rate.

The reservoir pressure decline and cumulative oil method of estimating reserves assumes a gas depletion type reservoir with no change in productive index. This system does not produce an estimate of production rates.

The calculation of reserves by the use of material balance equations and the estimation of recovery factors by Turner predictions or some other formula are in every day use. This approach has much in its favor particularly where unitized operations are underway or being considered. Its application and usefulness still require judgment and experience. The determination of what data is truly representative and the selection of critical factors that will give tenable results cannot be made with uncompromising inflexibility.

The volumetric method of estimating future recoverable oil is easily understood and applied. It therefore enjoys much popularity. It does however lend itself to considerable misuse in engineering estimates connected with the appraisal of oil lands. The adequacy of the material available for a volumetric estimate of reserves should always be tested. Some estimates are prepared without any core analysis of the reservoir material. It is not uncommon to find estimates involving large

amounts of future recoverable oil that have as their foundation the porosity, permeability and/or interstitial water factors developed from the analysis of only four or five samples of the reservoir rock. The choice of a recovery factor alone permits a wide range of results to be derived from identical basic information. The appraisal engineer should carefully describe the quality and source of the data that are the foundation for his estimate.

All methods of estimating reserves, except the projection of oil rate decline *vs* time, require some more or less arbitrary presentation of future production rates. The client or management is interested in the payout period, annual earnings, etc. The best money is the early money. It can be predicted with greater accuracy than can the long delayed earnings. The appraiser may be able to do no more than divide the estimated future oil recovery into equal amounts for the anticipated economic life of the property. Or he may prepare a pattern of future rates of recovery according to his concept of probable operating policies and methods. In every case, the engineer should set forth with clarity what has been done in forecasting production rate and the reasons for the procedure adopted.

Estimating Income

Estimates of future income for an analytical engineering appraisal should be forecast at current commodity prices with consideration given to any existing contractual agreement concerning those prices. For property where future production will see only nominal changes in gas-oil ratios, the forecast of oil, gas and gasoline income in terms of a barrel of oil is acceptable procedure. Properties that may experience a drastic change in gas-oil ratio require careful consideration by the appraiser of the probable future yields of these hydrocarbons. It is not uncommon to find these products producing 20 to 40 per cent of the total income from oil producing properties. The trend toward higher prices for dry gas and the general outlook for an increase in the demand for natural gasoline and liquid petroleum gases will make the income from these substances increasingly important.

The device of using actual realization, *i.e.*

$$\frac{\text{actual income from oil, gas, gasoline}}{\text{actual bbl oil shipped}} =$$

realization per bbl oil

for the estimation of future income is helpful where gas and gasoline yields are expected to remain at approximately current levels. The procedure, in effect, weighs the gravity of the oil, the gas and gasoline production for the individual wells and their respective contributions to the income from the property. Even the use of this device requires care. One well or group of wells may not contribute to present production in the same proportion that it will contribute to future recoverable oil.

The appraisal engineer is not expected to be an economist, nor can he be expected to predict fluctuations in commodity prices. It is proper, however, to advise clients or management of any condition or situation that might affect the price structure of oil and its associated hydrocarbons. Significant developments may range from new manufacturing processes and production techniques to the supply and demand outlook provided by reliable sources of published material.

It is often advisable in analyzing the future earning power of an oil producing property to illustrate the effect of possible changes in the price of oil on the estimate of future earnings.

Expense

The estimation of future expense connected with the extraction and sale of oil, gas and gasoline is a feature of the analytical engineering appraisal. It requires analysis of the

future behavior of the reservoir, the drilling operations and production techniques and in some cases even the philosophy of those responsible for producing the oil.

Unfortunately there is no formula or fixed procedure for the estimation of operating cost, supervision and administrative expense. When future profits are estimated for the purpose of loan negotiations, past history is the best indication of probable future performance.

The direct well costs, in other words, all expenses directly attributable to specific wells or leases are fixed within limits by the depth of the producing zone, the capacity and type of production equipment, the number of the wells on the property, the proximity of the lease to other oil production controlled by the same operating interest.

These costs should be forecast in most cases on a well-month or well-year basis. After production reaches the pumping stage, the direct cost of operation experiences but little change since it is related to the depth of the producing zones, the capacity and type of production equipment, etc. Direct well costs may range from \$75 per well-month for shallow wells with small fluid production to \$1,000 or more per well-month for deep wells producing large amounts of fluid. The lifting cost per barrel of oil produced increases as well productivity declines since direct well expense is relatively constant. Estimates of future operating charges when made on a per barrel basis often fail to increase with sufficient rapidity to offset the decline in well production.

The estimates of direct well costs on a cents per barrel basis find their most useful application when used in conjunction with volumetric estimates of future recoverable oil. A forecast of future production rates and the probable economic life of an oil property does not often accompany a volumetric estimate of reserves. Therefore the unit cost per barrel is most effective here.

One item of operating expense often overlooked is the creation of a sinking or reserve fund for redrill or recompletion work. Most properties in a long lived multiple zone field experience at least one workover program. The usual every day operating costs do not reflect such expense. The engineer preparing an estimate of future cost often does not provide for these somewhat indefinite but nevertheless real costs of a producing property.

Development Costs

Development costs are probably forecast with less deviation from actual experience than any other expense in oil field operations. Minimum development rate is often established by the lease document. Diligent drilling is usually necessary to fulfill lease obligations. The money is spent over a relatively short period of time. Hence the influence on development cost estimates of long time economic trends and changes in drilling techniques is minimized.

In addition to those items of expense that can be assigned to a specific well or property, a realistic estimate of future profit must include the indirect costs connected with the operation of an oil property. With large companies that aggressively replace their reserves, supervisory and administrative overhead are fairly well related to production. These costs can then be estimated as a unit charge per barrel of oil produced.

Where small organizations are appraised, the same items are better related to the number of wells being operated. Administrative and supervisory expense for production owned by an individual or small company is sensitive to change in production rates, prices and management. In these instances, past history does not necessarily reflect future trends. Indirect expense can be controlled. The amount and form of indirect

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costs is often dictated by tax considerations. The small company, whose principal stockholders are the management and operators of the property, often absorbs profits that might be dividends, in the form of corporate salaries. This avoids the double income tax. Hence the profit and loss statements for such organizations do not necessarily reflect in their cash profits the true earning power of the property. The ability of the individuals involved to adjust themselves to changing economic conditions, to reduce overhead and partake directly in field operations, becomes important to the appraisal engineer in his efforts to estimate the minimum limits to which overhead costs could be pared.

Operating Cash Profit

Cash profit, sometimes called operating cash profit, net revenue, and operating net revenue, has a variety of meanings and requires definition. The term, cash profit, as used here, is equivalent to income less all costs except depletion, depreciation and income tax. There is no correlation between oil prices and cash profit. The ratio of unit profit to price ranges from almost nothing to 80 or 90 per cent. The most significant use of cash profit estimates is the measurement of the relative values of oil producing properties. Seldom does the estimate of future cash profit, except for very limited time periods, come close to actual experience.

Present Worth

The use of discount factors to reduce future earnings to a present worth seems to be significant to many people. The application of discount factors should be limited to the use value of money. In other words, it should give effect only to the loss of interest on money that cannot be used immediately because it will not be received until some future time.

Market Value

In addition to the estimated earning power of an oil producing property, its market value is of interest to the lender of money and the security analyst. Market value is the price at which various types of interests in oil producing properties are changing hands. It reflects the current opinion of those who buy and sell oil interests.

The prices paid for oil properties do not always appear to be justified by the results of an analytical engineering appraisal. In such cases, it may be that the intangible features of the contracts bearing on the values of the oil interest do not lend themselves to engineering analysis. However, the analytical engineering appraisal is a useful yardstick for the measurement of the relative values of oil producing properties.

In addition, there are other means of measuring relative value, for settled production, the ratio of purchase price to daily barrels of oil net to the interest, for flush production, the dollars per barrel of reserve or the dollars per dollar barrel of reserve. The latter method modifies the effect of price differential.

Some buyers are interested in the time required to return the purchase price, either before or after deductions of income tax costs, and some are interested in the ultimate earnings that may be realized.

It should be remembered that the market values of oil properties fluctuate. They do not remain constant for any extended period of time. Changes in oil, gas and gasoline prices can, almost overnight, increase or depress the sales

value of an oil interest. In California, earthquakes have reduced the market value of an oil property in a matter of seconds.

The estimate of market value is good only for the date for which it has been prepared.

Value of Unproved Acreage

In the analysis of the value of the stocks of oil producing companies, the holdings of unproved but prospective acreage is important. The acquisition of well chosen unproved acreage is the life blood of any progressive oil company. The production of oil is in reality a reduction in capital assets. Therefore a company that does nothing to replace reserves is actually in the process of liquidation and the value of its stock should be judged accordingly.

Unproved land cannot be credited with reserves. It has no earning power. It must be appraised on the basis of market value. The market value of such acreage is mercurial. It changes rapidly with developments in the immediate vicinity of the individual parcels of land. The results of a core, a formation test, or completion, may well change the market value of unproved land many times, in a short period of time. A company holding acreage on the trends of known oil producing geologic features and with a good geographic distribution of such acreage will not only replace but will probably increase its reserves, hence its assets. The existence of such unproved acreage in the portfolio of an oil producing company regardless of the actual dollar value is encouraging for it represents an aggressive and forward looking policy. ★ ★