Introduction

Experience shows that initial estimates of the size of newly discovered oil or gas fields are usually too low. As years pass, successive estimates of the ultimate recovery of fields tend to increase. The term “reserve growth” refers to the typical increases in estimated ultimate recovery that occur as oil or gas fields are developed and produced (Arrington, 1960; Attanasi and Root, 1994).

An example for a particular field helps explain the nature of reserve growth. Figure 1 shows ultimate recovery for a large natural-gas field in Texas as estimated in each year from 1977 through 1991. This gas field was discovered in the mid-1940’s. In 1977, its ultimate recovery was estimated to be 2.1 trillion cubic feet of gas (tcf). One might think that after some 30 years of development and production, the resource potential of a field would be well understood. However, by 1991 the estimated ultimate recovery of this field had increased to 3.1 tcf. Reserve growth over the 15-year period totaled 1.0 tcfg and shows no signs of stopping.

Historical Reserve-Growth Trends for Natural Gas

Increases of estimated ultimate recovery over time such as shown in figure 1 are typical of many United States gas fields. From 1978 through 1993, reserve growth of natural gas in existing United States fields totaled 205 tcfg, whereas initial size estimates of new-field discoveries totaled only 31 tcfg (fig. 2). (United States natural-gas production during the same time period totaled 277 tcfg.) From 1989 through 1993, reserve growth contributed about 15 tcfg/yr to United States proved gas reserves, whereas new-field discoveries added only about 1 tcfg/yr (fig. 2). In recent years, reserve growth has contributed far more to United States proved gas reserves than new-field discoveries.

Causes of Reserve Growth

Factors that contribute to reserve growth include (1) physical expansion of fields by areal extensions and development of new producing intervals, (2) improved recovery resulting from application of new technology and engineering methods, and (3) upward revisions of reserve calculations based on production experience and changing relations between price and cost. The causative factors that contribute to reserve growth are complex and interrelated, and have thus far resisted individual analysis. Estimates of the future reserve growth of a set of fields are at present usually based on empirical projections of past reserve-growth patterns.

U.S. Geological Survey (USGS) Estimates of Future Reserve Growth for Natural Gas

The USGS 1995 National Assessment of United States oil and gas resources (Gautier and others, 1995) was a scientifically based, unbiased analysis. In this assessment, the USGS estimated that 1,074 tcfg of technically recoverable natural gas remains in the United States (exclusive of Federal waters), of which 322 tcfg (30 percent of the total) is in the category of reserve growth of existing fields (fig. 3). By comparison, the ultimate technically recoverable volume of gas in conventional fields not yet discovered is estimated to be 259 tcfg (fig. 3).
Summary and Conclusions

Reserve growth is a major component—perhaps THE major component—of remaining United States natural-gas resources. Historical data (figs. 1, 2) support this premise, as do estimates of technically recoverable and of economically recoverable gas resources remaining in the United States (figs. 3, 4).

Yet, as Attanasi and Root (1994) emphasized when they referred to “the enigma of oil and gas field growth,” reserve growth is poorly understood. Projections of future reserve growth in the United States carry large uncertainty. Much work remains to be done on the phenomenon of reserve growth, which is arguably the most significant research problem in the field of hydrocarbon resource assessment.

References


Arrington, J.R., 1960, Predicting the size of crude reserves is key to evaluating exploration programs: Oil and Gas Journal, v. 58, no. 9 (February 29), p. 130-134.


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