VII. Barriers to Brown Shale Gas Production

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Obstacles to gas production from the Brown shale are of two types: (1) barriers to immediate development of Brown shale reserves using available drilling and completion techniques; and (2) barriers to future production using improved reservoir analysis techniques, drilling methodology, and completion practices. While these two aspects are treated separately in this assessment, they are interrelated.

Obstacles to Development Using Available Technology

The major barrier to increasing production using available technology is the present controlled level of the interstate wellhead price of gas. Gas production is economically feasible (greater than a 10-percent rate of return on investment) only in the very high-quality areas of Brown shale under current controlled price levels. Current development of the Brown shale is, therefore, limited to seeking out the very high-quality areas of Brown shale. With this restriction, a significant expansion of exploration and development activity in the Appalachian Basin is unlikely.

Following a recent increase in prices for new interstate gas *($.52* per Mcf to $1.42 per Mcf), there was a noticeable increase in drilling activity in the higher-quality Brown shale of the Appalachian Basin.

Development of the Brown shale using available technology is also hindered by problems associated with high local drilling costs, difficulties in lease acquisition, and title clearance. Drilling costs are substantially higher in southwestern West Virginia and eastern Kentucky because of the rugged terrain and poor roads, which make equipment movement difficult and expensive and increase the costs of installing gas gathering and distribution systems.

Areas with multiple minable coal seams require additional casing for each coal seam which, in turn, increases drilling rates per foot and tangible expenses for casing for wells that penetrate coal seams. The problems associated with drilling through minable coal seams will increase in the future due to the increased value of coal, and more intensive exploration and development efforts by coal operators. Additionally, leasing and purchasing of coal mining rights by investors far removed from the site will result in delays in acquiring approval to drill through coal seams. To gain approval to drill through a coal seam, a plat of the drill-site location must be submitted to the operator holding the mining rights on the potential drill-site property. If a drill site is approved by the coal operator, that operator must agree to leave a pillar of coal around the drill hole to provide an unbroken well bore through the seam. This procedure results in a loss of recoverable **coal. If, in areas of low- to medium-quality Brown shale, minable coal seams are numerous and thick, the amount of coal left as pillars around the well bore may have a greater value than the potential gas from the proposed well and, therefore, the coal operator** will refuse to permit a gas well to be drilled through the coal seams.

Brown shale areas are notorious for property and title problems. For example, in eastern Kentucky tax maps are nonexistent, courthouse records are poor, and many of the mountain people living on the land have no knowledge of the mineral ownership. problems in leasing and title clearance in such areas can be time consuming and expensive. It is not unusual to invest 6 months to 1 year to locate owners and clear the title for a potential drilling site on the Appalachian Plateaus.

Environmental constraints do not pose serious deterrents to Brown shale development. Fluids produced from wells must be contained by on-site tanks to prevent stream pollution, all pits are required to be closed, disturbed land must be reseeded, and surface erosion from access roads and the drilling site must be controlled by drainage ditches. Recent legislation imposing stringent controls on potential stream pollution and land degradation has increased drilling costs by $2,000 to $5,000 per well. This increase in well cost is minimal, representing between 1 and 4 percent of the cost of drilling and completing a typical gas well in the Brown shale.

Shortages of drilling and well-completion rigs could pose a temporary constraint on development of gas production from the Brown shale of the Appalachian Basin, Currently, there are about 73 rigs in the Appalachian area capable of drilling shale wells. [1] After a well is drilled, rigs are needed to stimulate and clean out the shale wells; about 65 to 75 such completion rigs are available in the Appalachian Basin.[2] A modern drilling rig can drill about two shale wells per week, and stimulation rigs can complete about one shale well every 10 days. Under favorable conditions, the 73 drillings rigs could drill about 7,600 holes per year and about 2,400 to 2,700 of these could be brought into production by the 65 to 75 completion rigs. Therefore, even if all of the rigs currently in the Appalachian Basin were used exclusively to drill and complete new shale wells, it would not be possible to develop enough wells (69,000) to produce 1.0 Tcf per year of shale gas over the next 20 years, Favorable economics could possibly overcome the drilling and completion rig constraint over a 3 to 5 year period.

Obstacles to Advances in Shale Gas Technology

An important barrier to advances in Brown shale gas production technology is the lack of resource characterization. Even though approximately 10,000 wells produce gas from the Brown shale, very few quantitative data are available to adequately characterize the resource. Only a few of the 10,000 wells in the Brown shale have core samples available for examination, and those that do come from a relatively small portion of the 163,000-square-mile extent of the Appalachian Basin. Until the Brown shale resource is adequately characterized, focusing on specific targets for technology development is very difficult. Lack of specific research targets could result in haphazard hit-and-miss and trial-and-error experimentation with only limited chance of significant success in the near future. Detailed chemical-petrophysical data are needed for the Brown shale before significant progress can be expected in technology capable of releasing gas from those shales. Additionally, basic research is required to determine the manner in which gas is held by the Brown shale, i.e., is it only in the fractures, in the pores, adsorbed on the shale surface, or contained within the matrix porosity?

Characterization of the Brown shale involving shale petrography, core analysis work, geochemical research, and other pertinent data collection by different people in separate localities and agencies must be carefully coordinated to be effective.

Resource characterization is the initial and most pressing step for advancing technology for the purpose of increasing gas production from the Brown shale. Without an intimate knowledge of what the resource is, it is almost impossible to

[1] Information from: S.6. Plammer, Hughes Tools NE Area Regional Manager Pittsburgh, Pa; Frank Whyte, Drilling Manager, Delta Drilling Company, Indiana, Pa; James Willitt, Vice President, S.W. Jack Drilling Company, Buckhannon, W.Va.; John William, Vice President, Union Drilling Co., Buckhannon, W.Va.; John Foster, Production Eng, Columbia Gas Trans. Co, Charleston, W.Va.; James Ray, Ray Resources, Inc, Charleston, W.Va.; Roy Hancock, Petroleum Information, Charleston, W.Va.; James Burgin, President Gaspro Inc., Cambridge, Ohio; and Don Cayton, President, Central Well Service, Parkersburg, W.Va.

[2] Ibid.

program research efforts in stimulation technology, logging methods, or any of the various satellite research needs dependent on reservoir characterization.

In the past, efforts to produce gas from the Brown shale have used every conceivable stimulation method known to man; however, it has been impossible to evaluate the effectiveness of various techniques because basic reservoir characteristics have not been adequately documented. If more than 15 **to** *25* Tcf of gas is to become available from the Brown shale, -research programs must be aggressive, coordinated, and innovative.