Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale

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ABSTRACT

The issue of hydraulic fracturing has raised many concerns from the public as well as government officials. This paper will review the history and evolution of hydraulic fracturing, including environmental and regulatory considerations. Additionally, technical and environmental considerations applicable to hydraulic fracturing in the unconventional arena of gas shales, with an emphasis on the Marcellus Shale of the Appalachians, will be presented. Topics addressed in the paper will include discussions on: (1) the process of hydraulic fracturing; (2) the purposes and advantages of hydraulic fracturing; (3) applicable design and engineering aspects of well completions; (4) geological considerations such as confinement of the fracturing process; (5) potential risks to groundwater and underground sources of drinking water; and (6) the use of hydraulic fracturing fluids and associated technical considerations.

INTRODUCTION

Shale gas reservoirs are a growing source of natural gas development across the United States. The Marcellus Shale, still in the early stages of development, has the potential to be one of the largest natural gas plays in the United States. Horizontal well drilling and hydraulic fracturing, both parts of the successful development model established for the Barnett Shale of the Fort Worth Basin, appear to be key aspects of successful development of this important natural gas resource. This paper provides a review of the hydraulic fracture process, including a brief history of hydraulic fracturing as applied to shales like the Marcellus Shale.

Unconventional development of energy resource plays, including coal beds, tight sands, and shales, has been a growing source of natural gas development in the United States. Since 1998 unconventional natural gas production has increased nearly 65 percent, becoming an increasingly larger portion of total natural gas production. In 2007, unconventional production made up 46 percent of total natural gas production, up from 18 percent in 1998 (Navigant, 2008).

One type of unconventional development that has gained attention and contributed to this increase is natural gas from shale formations. Shale gas resources extend across the continental United States, offering abundant and available access to clean-burning natural gas. Shale gas resources have been developed in a variety of basins, including: the Barnett Shale of the Fort Worth Basin, the Fayetteville Shale of Arkansas, the Haynesville Shale of Louisiana, and the Devonian shales in the Appalachian Basin. Shale gas resources also have a much broader potential with possible development from shales located across the United States including: the Mowry Shale in the Powder River Basin; the Mancos Shale in the Uinta Basin; the Woodford Shale in the Ardmore Basin; the Barnett Shale in the Permian Basin; the Chattanooga Shale that is located in Iowa and Tennessee; the Hovenweep Shale in the Paradox Basin; and the Barnett/Woodford shale plays in the Delaware and Marfa basins (Brown, 2007). Figure 1 shows the distribution of gas shale formations in the continental United States including those areas in which development is ongoing or evolving.