Fracture Stimulation of the Eagle Sandstone on the Cedar Creek Anticline

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ABSTRACT

In 1996 Williston Basin Interstate Pipeline Company (WBI) implemented a pilot program to improve gas production from wells completed in the Eagle Formation along the Cedar Creek Anticline in southeastern Montana. By application of multiple new technologies and by developing an improved understanding of the reservoir, WBI adopted a multi-stage hydraulic fracture completion approach that improved its stimulation success ratio from less than 50% to 100%. Extensive pre- and post-fracture Absolute Open Flow Testing (AOF) was used to evaluate the benefits of stimulation. Gas production more than tripled when compared to direct offsets completed in previous years, and first year discounted Net Present Value (NPV) is expected to increase by 20%, or $11,600 per well. The ten-year incremental NPV is expected to be $352,000 per well as a result of applying advanced stimulation technology. Total 10-year incremental project NPV is anticipated to exceed $8.8 million.

INTRODUCTION

Williston Basin Interstate Pipeline Company (WBI), a wholly owned subsidiary of MDU Resources Group, Inc., produces natural gas from Upper Cretaceous Eagle gas sandstones at an average depth of 1200 ft to 1700 ft (Fig. 1). Previous completion designs included perforation of the entire 400+ ft interval and stimulation with a single-stage hydraulic fracture treatment. In 1996, WBI implemented a five well pilot program with the objective to investigate the cost, execution, and benefits of completing wells in the Eagle Formation utilizing advanced stimulation technologies promoted by the Gas Research Institute (GRI) and others. These technologies included: three-dimensional fracture modeling, strategic placement of perforations, enhanced fracture fluid systems, advanced logging techniques, and comprehensive flow testing. S. A. Holditch & Associates, Inc. (SAH) became involved in the project via the GRI Advanced Stimulation Technology (AST) Deployment Program. Halliburton Energy Services of Williston, North Dakota, provided the hydraulic fracturing services for WBI. Sunburst Consulting of Billings, Montana, provided WBI with logging and geologic interpretation. This paper discusses historical Eagle gas-sandstone completion practices, changes made as a result of AST, and the realized benefits. We first discuss the field history and geology.

FIELD HISTORY AND GEOLOGY

The first producing natural gas well on the Cedar Creek Anticline was drilled in 1914. By 1926, sufficient quantities of gas were being produced to provide natural gas to the Montana Dakota Utilities (MDU) electric power plant in Glendive, Montana. In 1936, oil was found in the deeper horizons of the Cedar Creek Anticline. In 1950 MDU entered into a production agreement with Shell Oil Company limiting the company to a depth of 2000 ft when completing natural gas wells. WBI is a subsidiary of MDU Resources and now operates the gas production