A Technical Brief Concerning

Shale Oil Development and Exploration

Submitted to:
Dr. Miguel Bagajewicz
University of Oklahoma
Department of Chemical Engineering

Prepared by
Justin Brady
Laura Kerr
Mike Potts

May 3, 2006

Executive Summary

Shale oil is seen by many as America's answer to dependence on importing foreign oil. Shale oil deposits in the western United States are estimated as containing 2 trillion barrels of recoverable oil in the form of kerogen, a precursor to common petroleum and natural gas. Through earth's natural heating and pressurizing, kerogen eventually forms oil and natural gas which are today's main energy source. Over the last hundred years there have been several methods devised to extract petroleum from kerogen, but none have been efficient or economical enough to pursue. However, Shell has been researching a new method of production for several years called the in-situ conversion process that looks promising for the future of shale oil production.

Shale oil has had a long history in the United States. The federal government first realized its usefulness in the early nineteenth century. Since then, several attempts have been made to develop a process that can economically produce shale oil on a commercial scale. The largest project attempted was the Colony II project. It was started by Exxon but after only two years was shut down because the price of foreign oil decreased dramatically.

Shell is currently researching in-situ conversion in the Piceance basin of northwestern Colorado. The process consists of several steps, each of which has their own challenges. What makes their process different than others previously attempted is that the conversion of kerogen into hydrocarbons occurs in place. This is different from previous processes because none of the rock has to be mined. Kerogen is converted into hydrocarbons by heating the ground with large electric heaters. To protect the groundwater around the area of the heated reservoir, a freeze wall is constructed around the site. This freeze wall is impermeable to water and hydrocarbons and keeps the two from mixing preventing contamination. Once the reservoir has reached 700^{o}F the produced hydrocarbons can be extracted from the ground using conventional methods.

A large surface facility is required to separate the hydrocarbons into different products. An 800 MW power plant will also have to be constructed to provide electricity to the heaters and the processing facilities. To transport the products to market two pipelines will have to be built. Analysis shows that the annual product cost is almost $678 million, which includes extraction costs, operations and maintenance, and production taxes. This facility will require a total capital investment of $867 million. The entire process will break even in 9.7 years and have a net present worth of $1.7 billion after 25 years of production.

With the above stated economic incentive, it is necessary to take a deeper look into how to produce shale oil from the ground in a safe and environmentally friendly way. The Shell in-situ conversion process proposes a new technology that would allow the exploration and production of shale oil. This process however has never been proven on a commercial level. Therefore, a study of the technical aspects behind the process including reservoir studies, subsurface operations, and processing facilities must be analyzed through models to determine the feasibility of the project.