Is CO_2 Enhanced Oil Recovery Technology Applicable for Recovering Additional North Dakota Oil Reserves?

By Randy B. Burke and Ralph Nelms

The greatest constraint on the application of CO_2 enhanced oil recovery technology in North Dakota is economic, not technical or geologic. This was the conclusion reached in a recent paper (Nelms and Burke 2004) I presented with my coauthor at the Twelfth Williston Basin Petroleum Conference in Minot. After compiling a rather extensive petrophysical, engineering and geological data base on unitized oil fields in North Dakota (see related article), it is clear that North Dakota has sufficient remaining proven reserves in reservoirs (Figure 1) that have geologic characteristics as good as, or better than, those where CO_2 enhanced oil recovery (EOR) technology has proven economically successful. What are the principal economic constraints? They largely center around the long-term payouts on large upfront capital investments required for CO_2 projects. This requires long-term (15 to 25 years) agreements among all involved parties so that all can anticipate a reasonable return on their investment. This is particularly risky for all parties when financial success hangs on the sale of a highly volatile-priced product (oil) using a relatively expensive commodity (CO_2) to capture that product.

A review of the 66 CO_2 EOR projects attempted in the U.S. since the first one in 1972, shows that despite only one outright failure, 58% are clearly successful, and the remainder are either promising or it is too early to tell. The latter is the case for Weyburn Field, Saskatchewan, Canada; it is too early to tell, despite the fact that all indications are extremely promising (over a 27% increase in oil production, or >5,000 barrels a day).

One reason Weyburn Field was so attractive for the application of this technology was that the original oil in place was calculated to be 1.4 billion barrels and that an additional 120 to 130 million were anticipated to be recoverable using CO_2 EOR. Over 277 million barrels of oil (MMBO) reserves classed as *probable or possibly recoverable* (Nelms and Burke, 2004) using CO_2 are present in North Dakota. This oil, however, does not occur in one field or one rock unit like it does in Weyburn Field. To find volumes of oil in North Dakota similar to those in the Weyburn reservoir, it is necessary to group a number of field units and pools from different rock units together (Figure 1). Dakota Gasification Company recognized this almost a decade ago when they made plans to locate their pipeline along the Nesson Anticline, identified in this case by units combined to form Group I. At one to two hundred thousand dollars for each additional mile of pipeline, the most probable units to be developed initially will not be far from the current pipeline.

It seems reasonable to assume that, with this knowledge of the volumes of oil that potentially can be recovered using CO_2 EOR, that one day, another long-term commitment to share the risk between Dakota Gasification and the oil industry will be reached. Dakota Gasification Company has made a very bold pioneering move to bring this opportunity to North Dakota, but it was done in large part because Encana Oil and Gas Company was willing to share the long-term risks.

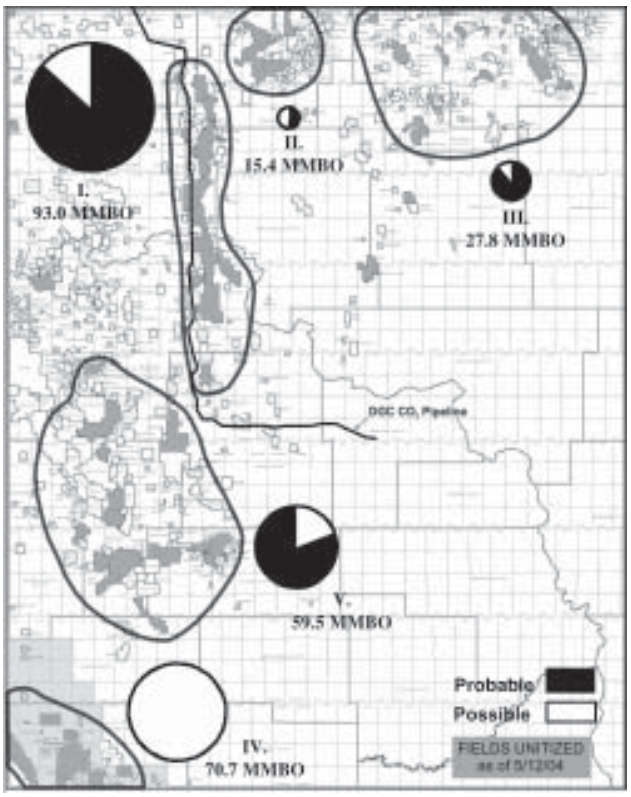

Figure 1. Map shows groups of unitized fields, the volume of their remaining oil reserves that are potentially recoverable using current CO_2 enhanced oil recovery technology, and their proximity to the existing CO_2 pipeline. Groups are based on their proximity to each other, which indirectly impacts the feasibility of using CO_2 because of the cost of laying CO_2 delivery pipelines. For example, Group I along the CO_2 pipeline and the Nesson Anticline has over 93 million barrels of oil that are potentially recoverable using CO_2. Of this, 87% (80.6 million barrels of oil) is considered probable recoverable and 13% (12.4 million barrels of oil) possible. Black areas in the pie diagrams are probable reserves and white areas are possible (defined in Nelms and Burke, 2004). Not shown are potential reserves considered unfavorable, or too small. For the entire state this amounts to over 19.8 million barrels of oil. Medium gray blocks are unitized fields. Base map of North Dakota Oil Fields is by Paul Diehl (2004).

References:

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