IEA WEYBURN CO_2 MONITORING AND STORAGE PROJECT

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Introduction

The IEA Weyburn CO_2 Monitoring and Storage Project is a $28 million (USD) / $40 million (CDN), four year research project that began in August 2000. It builds upon the $1 billion (USD) / $1.3 billion (CDN) commercial CO_2-EOR flood operated by EnCana Corporation of Calgary. The CO_2 commercial flood operation began in late September 2000 following baseline data collection surveys by the IEA Weyburn project. The baseline data set makes this geological monitoring and verification project truly unique compared to its sister projects elsewhere in the world.

The IEA Weyburn project is managed by the Petroleum Technology Research Centre, located in Regina, Saskatchewan. The project has received financial sponsorship from 6 international government organizations and 9 private corporations from the energy and utility sectors. There are 22 research organizations actively engaged in the project from governments, universities and the private sector. Involvement in the project is global in character with participation from Canada, the United States, Europe and Japan.

Project Objective

The overarching objective of the IEA Weyburn project is to predict and verify the ability of an oil reservoir to securely and economically store CO_2. The driving forces are:

- a desire to contribute to the reduction of greenhouse gas emissions
- to improve the understanding of the performance of EOR projects on whose success this method of geologic storage directly depends.

Project Management

Research activities in the project are divided into several objectives, applying leading-edge science and engineering in geophysics, geomechanics, geochemistry, geology, reservoir engineering, risk assessment and economics. The research has been performed in over 55 separate tasks. Efficient and effective project management, coordination and integration have been critical to the success of this project.

EnCana's Commercial EOR Operation

The Weyburn field is located in southeastern Saskatchewan, Canada. 366 million barrels of oil were recovered at the Weyburn Unit under primary recovery and waterflood operation between 1955 and 2000, which was approximately 25% of the original oil in place. The estimated CO_2-enhanced incremental oil recovery over 30 years is 130 million barrels. The CO_2-EOR flood is currently producing over 6000 barrels per day of additional oil.

The source of the CO_2 injected at Weyburn is the Great Plains Synfuels Plant operated by Dakota Gasification Company (DGC) in Beulah, North Dakota. DGC owns and operates a new CO_2 pipeline for EOR operations in southeastern Saskatchewan and northern North Dakota; EnCana is injecting 5000 tonnes per day of CO_2. Currently, EnCana is injecting a further 1200 tonnes per day of CO_2 that is recycled from production wells.

IEA Weyburn Project Results

A regional geoscience model has been developed incorporating a wide variety of information from geological, hydrogeological, and geophysical tools, including core, well-log, seismic, fluid and lineament data obtained throughout the Williston Basin. This geoscience model is being extensively used in reservoir performance assessment and long-term performance assessment modelling activities.

Geochemical modelling has been based upon fluid monitoring surveys from over 40 wells which have been sampled every 4 months over the four year period of the project. The geochemistry model is also an integral part of the long-term performance assessment work. Geochemical modelling has shown that CO_2 is being stored in the reservoir via gaseous, oil, ionic and reservoir rock trapping mechanisms.

There is an important element of human intrusion into the reservoir: over 1000 wells have been drilled at the Weyburn unit, some of which are in active use and some of which have been abandoned. Geomechanics have proven to be critical in understanding the integrity of the wellbores and caprock as well as a key to understanding physical phenomena that may affect the integrity of the natural reservoir "container".

CO_2 movement in the reservoir has been monitored using a variety of geophysical methods including 3D-9C, VSP, crosswell, 4D-3C time-lapse, and microseismic surveys. Deterministic and probabilistic performance assessment methodologies are being investigated to determine the long-term fate assessment of CO_2 in the geosphere and the biosphere.

Expert Review

At the midpoint of the project, the IEA Greenhouse Gas R&D Programme was asked to lead an external expert review of the IEA Weyburn project. The review panel determined that the project has made substantial progress toward meeting its very challenging objectives. Some knowledge gaps were identified which will be addressed in future work undertaken by the project.

Conclusions

The IEA Weyburn project is due to be completed by mid-2004. A second phase of the project is being planned to begin at that time to ensure integrity of the data sets and continued growth of the knowledge base established in phase one. The second phase of the project will focus on determining the most effective monitoring and verification tools for geological storage, developing a better understanding of geological storage and CO_2-EOR using data obtained in phase one of the project, filling knowledge gaps, and developing the beginnings of a geosequestration "toolbox".