Potential Issues and Costs Associated with Verifying CO$_2$ Storage During and After CO$_2$-EOR

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Abstract

Under the U.S. Environmental Protection Agency’s (USEPA’s) “Clean Power Plan,” CO$_2$ storage with CO$_2$ enhanced oil recovery (CO$_2$-EOR) operations is recognized as a potential compliance mechanism. The USEPA has promulgated requirements for geologic storage of CO$_2$, establishing a new class of wells -- Class VI -- under authority of the Safe Drinking Water Act’s Underground Injection Control (UIC) Program. In a separate rulemaking, USEPA also established reporting requirements under its Greenhouse Gas Reporting Program (GHGRP) for facilities that inject CO$_2$ underground; Subpart UU applies to CO$_2$ injected to enhance hydrocarbon recovery; Subpart RR to CO$_2$ injected for geologic storage.

Similarly, the International Standards Organization (ISO) is in the process of developing standards (ISO/TC 265) on the design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities associated with CO$_2$ capture, transportation, and geological storage (CCS), including that for CO$_2$ that may be stored in association with CO$_2$-EOR.

Both the USEPA rules and ISO standards recognize that CO$_2$-EOR operations injecting anthropogenic CO$_2$ could qualify for CO$_2$ storage during EOR operations, and/or be converted to permanent geologic storage projects. Recent guidance issued by the USEPA, for example, confirms that CO$_2$-EOR operations can result in stored CO$_2$. This guidance implies that for a CO$_2$-EOR operation to get “credit” for stored CO$_2$, complete conversion to CO$_2$ storage (only) operations may not be necessary.

This paper characterizes the potential issues and estimated costs associated with adapting a CO$_2$-EOR project to enable it to get “credit” for stored CO$_2$, as well as for converting a CO$_2$-EOR project to a CO$_2$ storage project. Estimated costs to provide storage assurance are provided, based, in part, on cost analyses developed as a part of USEPA rulemakings, as well as the actual costs incurred at US Department of Energy-funded CO$_2$ storage research projects. Consideration of the issues and costs will include those associated with well construction (or rehabilitation), existing well abandonment, well operation, testing and monitoring, post-injection site care, and site closure. The paper will also show that many of the activities that would serve to ensure/verify CO$_2$ storage are already part of most CO$_2$-EOR operations.
Several scenarios will be explored in terms of the acceptable activities that a CO₂-EOR operator would need to pursue to get “credit” for stored CO₂, as well as for what would be required for converting a CO₂-EOR project to a CO₂ storage project.

These potential scenarios are applied to several fields currently undergoing CO₂-EOR operations to approximate a “real world” implementation of this strategy.

The paper will also describe how transitioning CO₂-EOR operations to CO₂ storage may proceed through one or more phases: (1) conventional CO₂-EOR; (2) CO₂-EOR with credit for stored CO₂; (3) transition from CO₂-EOR to CO₂ storage, and (4) CO₂ storage post-CO₂-EOR operations (Class VI). Phases 1 through 3 may still represent, for the most part, traditional CO₂-EOR/Class II well operations. However, in Phases 2 through 4, additional MRV activities may be necessary and/or required to verify the volumes of CO₂ stored for which credit is desired.

For Phase 3, there will likely be a rationale to “prepare” the reservoir for CO₂ storage, prior to the end of CO₂-EOR operations, in order to “re-optimize” the oil field for storage. This may be particularly important for reservoirs that have undergone a water-alternating-gas (WAG) CO₂-EOR process, to reduce reservoir pressure, improve injectivity for CO₂, and increase storage capacity.

The logic associated with the need for carrying out this transition, as well as for alternative strategies to carry this out, will be discussed.

Finally, the paper will discuss concerns about potential fundamental conflicts between USEPA requirements and state-level mineral property, resource conservation, and environmental law in the United States that still, possibly, need to be addressed. These include the process for and timeliness of EPA approval of monitoring, reporting, and verification (MRV) plans for CO₂-EOR projects, what constitutes “new” activity in a CO₂-EOR project necessitating submittal of a new MRV plan, how do federal requirements relate to current state CO₂-EOR permitting processes, and the extent to which MRV plans are subject to potential litigation.