

C O L U M N S

Resolving Technical Issues to Realize the Promise of Geologic Sequestration

by Tom Munteer

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Conventional wisdom suggests that the future of coal-fired power generation—from which the United States derives roughly one-half of its power—depends in no small part on the realization of geologic sequestration of carbon emissions in underground formations (for more on this, see *Climate Change Deskbook* §1.2.3.1.2). Two recent proposals by the U.S. Environmental Protection Agency (EPA) bring this issue to the fore: the Agency's prevention of significant deterioration (PSD) tailoring rule and its geologic sequestration well rule.

EPA's proposed PSD tailoring rule, 74 Fed. Reg. 55292 (Oct. 27, 2009), if taken to its logical extension and finalized, would subject some 14,000 of the greatest emitting sources of carbon to new control technologies. This rulemaking begs the question of what control technology is best for controlling carbon dioxide (CO₂) emissions from coal-fired power plants. Some environmental groups argue that the best control technology for coal-fired plants is to switch their fuel to natural gas, believing that the Agency can compel fuel switches pursuant to its authority to select control technologies under the Clean Air Act. Others think such a command would be too drastic and falls beyond the realm of what control technology is intended to be. The control technology refuge for coal-fired plants might lie in the geologic sequestration of captured carbon.

Speaking more directly on the subject is EPA's proposed regulatory framework for the safe geologic sequestration of captured carbon. 73 Fed. Reg. 43292 (July 25, 2008). The Edison Electric Institute, the trade association for shareholder-owned electric companies, does not expect carbon capture and storage technologies to be commercially available until around 2025, with widespread commercial deployment five to ten years later. Given the complexities involved, it is probably none too soon for EPA to have embarked on this rulemaking.

The proposed rule, issued under the Agency's Safe Drinking Water Act authority, addresses injection well siting, construction, operation, monitoring, testing, and closure and aims to prevent carbon from escaping or contaminating underground sources of drinking water (USDW). In August 2009, EPA followed up with a supplemental notice and request for comment. 74 Fed. Reg. 44802 (Aug. 31, 2009).

EPA's proposed regulatory framework is largely adapted from the existing Underground Injection Control (UIC) Program. The UIC Program regulates five classes of injection wells, including wells in which CO₂ is injected to stimulate oil and natural gas production—so called enhanced oil recovery (EOR) wells. The proposed rule relies on the UIC Program's existing framework and establishes a sixth class for wells used to sequester CO₂. The proposal takes what the Agency calls a “tailored require-

ments approach,” balancing fairly stringent technical standards with some permitting discretion while allowing the flexibility to modify requirements to deal with the challenges of long-term carbon storage.

Now that the October 15, 2009, deadline for comments on the supplemental notice has passed, it is possible to see what the regulated community—and the states that will implement the program—think about EPA's approach. Some key areas of controversy include:

- the depth of CO₂ injection wells and whether carbon can be injected above a USDW;
- whether existing EOR wells can be repurposed for sequestration;
- construction and operation standards for sequestration wells; and
- appropriate closure requirements.

Depth of Injection Wells. The core issue with respect to the depth at which captured carbon must be injected is whether CO₂ must, in all instances, be injected beneath the lowermost USDW. Some believe there are geologic formations above or between drinking water sources that, with implementation of appropriate technical safeguards, could be appropriate sequestration locations. While EPA's July 2008 proposal suggested that the injection depth of sequestration wells be below the lowermost USDW, EPA's supplemental

notice offered several alternatives that would allow for a lesser injection depth in limited circumstances where there are deep USDWs. The supplemental proposal included a waiver mechanism to allow sequestration above or between USDWs. In their comments on the waiver mechanism, environmental groups found the standard for issuing waivers too vague, pointed out technical risks to siting sequestration locations between USDWs, and generally called for greater specificity and stringency.

EOR Repurposing. It may come as no surprise that those commenters engaged in EOR production advocated for a more widespread adoption of the existing regulatory regime that governs their operations. Many urged repurposing existing EOR wells for sequestration without imposing new construction standards. Proponents of this approach generally pointed to EOR wells' long track records for adequately protecting human health and the environment. Comments from the Natural Resources Defense Council (NRDC) warned, however, that the initial selection of EOR wells was not based on long-term storage. NRDC was also concerned about the lack of long-term incentives to contain injected carbon once a revenue stream from injection ends.

Construction and Operation Standards. While those engaged in EOR urged expansion of the EOR regulatory regime to geologic sequestration, those familiar with the hazardous waste program disagreed with EPA's proposal to adapt the same standards used for

hazardous waste injection wells to geologic sequestration wells. Regarding construction standards, commenters opposed EPA's proposal to require the cementing of wells to the surface and chastised EPA for proposing to require corrosive-resistant cements and construction design where the science did not support the need for either. Opponents also criticized EPA's proposed adaptation of a hazardous waste injection wells' annulus pressure requirement for carbon sequestration purposes and instead urged an approach that considered site-specific geomechanics. They also disfavored continuous mechanical integrity testing of injection wells, which can reveal the corrosion of the well casings, in favor of less burdensome testing requirements. Even those who opposed the wholesale adaptation of hazardous waste injection well standards for sequestration purposes, however, recognized the paucity of reliable and mature technologies to monitor plume movements remotely.

Closure Requirements. There is, on the other hand, one aspect of the hazardous waste injection standards that even those who otherwise oppose their adaptation to geologic sequestration wells might nevertheless like to see: the hazardous waste injection standards' typically shorter post-closure care period. The hazardous waste injection standards provide for a performance-based termination of the duration of the post-closure period, whereas EPA's proposal for geologic sequestration would provide a default, 50-year post-

closure care period for sequestration wells. EPA's proposed alternatives to the 50-year period—when the injected CO₂ is “stabilized” or when it no longer “poses an endangerment”—were too amorphous to provide commenters with much comfort.

One final issue warrants discussion: long-term liability. Senate Bill 1502, if enacted, would assess a risk-based fee on operators of sequestration facilities for each ton of CO₂ injected underground. The fees would enter a trust fund administered by the U.S. Department of Energy (DOE) to ensure prompt compensation for any damages related to geologic sequestration. The bill would also transfer long-term stewardship obligations from facility operators to the federal government, much like the liability regime for catastrophic nuclear accidents. To be sure, the bill leaves many of the program's details, such as the fee and fund amounts, to be resolved by DOE.

This column touches on just some of the many issues awaiting resolution before a regulatory framework for the geologic sequestration of captured carbon can be solidified. As set out in the comments submitted recently on EPA's proposed regulatory framework for geologic sequestration wells, technical issues awaiting resolution are plentiful. Technical issues are not the only hurdles; key liability considerations must be sorted out as well. Only then can the promise of geologic sequestration even start to be realized.