

Date: September 10, 2008

To: Texas Carbon Capture and Storage Association

From: Molly Cagle
Darrick Wayne Eugene

Re: Comments on the Proposed Federal Requirements Under the Underground Injection Control Program for the Regulation of Carbon Dioxide Geologic Sequestration Wells

On Friday July 25, 2008, EPA published its proposed rules to establish a new program for regulating the injection and long term storage of Carbon Dioxide (CO₂). The rules, proposed under the Safe Drinking Water Act, identify a new category of Underground Injection Control (UIC) wells, Class VI wells, to specifically regulate the injection of CO₂ for storage and associated storage facilities. The technical aspects of the new rules focus on protecting underground sources of drinking water¹ (USDWs). As is always the case, EPA seeks comment on its proposed rules; in this instance, the comment period is 120 days. Written comments are due to the agency on or before **November 24, 2008**.

I. BACKGROUND ON THE UNDERGROUND INJECTION CONTROL REGULATORY FRAMEWORK

A. Regulatory Approach behind the Proposed Rules

The agency's proposed technical requirements for Class VI wells cover all the expected topic areas -- geologic site characterization; area of review; well construction and operation; mechanical integrity testing and monitoring; corrective action;² well plugging, post-injection site care;³ financial assurance and site closure. Critical to understanding the

¹ *Underground Source of Drinking Water (USDW)*: An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/l total dissolved solids and is not an exempted aquifer. 73 Fed. Reg. 43494 (July 25, 2008).

² *Corrective action*: The use of Director approved methods to assure that wells within the area of review do not serve as conduits for the movement of fluids into underground sources of drinking water (USDWs). 73 Fed. Reg. 43493 (July 25, 2008).

³ *Post-injection site care*: Appropriate monitoring and other actions (including corrective action) needed following cessation of injection to assure that USDWs are not endangered as required under § 146.93. 73 Fed. Reg. 43494 (July 25, 2008).

proposed rules (and developing a strategy to comment on the rules) is an appreciation of the policy approach EPA followed in drafting the rules. In this case, EPA adopted what it refers to as Regulatory Alternative #3, the Tailored Requirements Approach. EPA describes this approach as “moderately prescriptive.”

The primary benefit of the moderately prescriptive approach is its flexibility. A comparison between the monitoring requirements under the Class VI well proposal (moderately prescriptive) and the monitoring requirements for a hazardous waste landfill (adopted under Regulatory Alternative #4, i.e. a very prescriptive approach) reveals the significance of flexibility in an environmental regulatory program. Under the proposed Class VI well rules, for example, EPA requires that monitoring be sufficient to confirm that there is no migration that threatens a USDW. In contrast, under the hazardous waste program, EPA’s rules prescribe precisely how many and what type of monitors are required and where they must be installed. In the former, a performance standard is set and the regulated community has technical options to achieve that performance standard. The regulator has discretion in its rule interpretation and must make decisions on a case-by-case basis based on the information presented in the permit application. In the latter, the regulated community has no choice as to how it must meet the standards and the regulator merely fills out check lists.

Examples of the flexibility built into the federal proposal further underscore the benefit of this approach. For instance, under the proposed rules, the Director⁴ has discretion to grandfather existing wells into the new Class VI category. Not only is grandfathering allowed, but there is no defined procedure for how that grandfathering must take place. Those important implementation decisions are left to the discretion of the permitting authority with primacy over the program. Another example can be seen in the proposed rules establishing a 50-year post injection monitoring and care period—these rules also give the Director the flexibility to shorten or lengthen that term as the Director deems appropriate, so long as the action does not endanger USDWs.

For programs like the UIC program—especially in Texas where we currently expect the Railroad Commission to seek primacy for the Class VI well program—a tailored requirement approach will ensure that local permitting authorities have the discretion and flexibility to make appropriate decisions based on specific proposals for individual projects. If the final rules adopt this “one-size-does-not-necessarily-fit-all” policy, there should be a reduction in unnecessary burdens on owners, operators and permitting agencies. Especially

⁴ *Director*: The person responsible for permitting, implementation, and compliance of the UIC program. For UIC programs administered by EPA, the Director is the EPA Regional Administrator; for UIC programs in Primacy States, the Director is the person responsible for permitting, implementation, and compliance of the State, Territorial, or Tribal UIC program. 73 Fed. Reg. 43493 (July 25, 2008).

in light of the diversity of geology and physical conditions throughout the United States, it is critical to the program's successful implementation that EPA maintain at least the level of flexibility offered by Regulatory Alternative #3.

B. Current UIC rules

Although the rules place CO₂ injection wells in their own, separate category, the rules cross reference between the various well types. In addition, certain preamble explanations rely on comparisons among the various well classes. Thus, to fully appreciate the newly proposed rules, a minimal understanding of the current UIC regulatory framework is helpful.

There are currently five classes of injection wells regulated under the UIC program (defined at 40 CFR 144.6):

- Class I wells inject industrial non-hazardous liquids, municipal wastewaters or hazardous wastes beneath the lowermost USDW. These are disposal wells, most often the deepest of the UIC wells. Rules for well management impose technically sophisticated construction and operation requirements. In Texas, the Texas Commission on Environmental Quality (TCEQ) regulates Class I wells.
- Class II wells inject fluids in connection with conventional oil or natural gas production, enhanced oil and gas production, and the storage of hydrocarbons which are liquid at standard temperature and pressure. EOR wells are Class II wells, regulated by the Railroad Commission in Texas.
- Class III wells inject fluids associated with the extraction of minerals or energy, including the mining of sulfur and solution mining of minerals. The TCEQ has primacy over Class III wells.
- Class IV wells inject hazardous or radioactive wastes into or above USDWs. With rare exceptions for approved Federal or State ground water remediation projects, Class IV wells are banned.
- Class V includes all injection wells that are not included in Classes I-IV. In general, Class V wells inject non-hazardous fluids into or above USDWs; however, there are some deep Class V wells that inject below USDWs. Experimental technologies, including geologic sequestration pilot projects like the University of Texas' Bureau of Economic Geology Frio Brine Pilot Well, have been permitted under Class V. As for

CO₂ injection, all Class V wells permitted to date have been small with regard to injection capacity and storage.

II. THE PROPOSED CLASS VI RULES

Underlying EPA's July 25th proposal was an extensive agency effort to gather scientific data and political input on positions relevant to the rule package. As a part of this overall effort, EPA conducted seven workshops over three years to discuss technical issues associated with geologic sequestration (GS). Two public stakeholder meetings—each with more than 200 in attendance—facilitated identification of issues relevant to management of CO₂ GS. EPA also worked with four state co-regulators (including representatives from Texas) who are affiliated with the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission.

It is apparent from text of the preamble to the proposed rule that EPA is uncertain about the efficacy of its proposal. The agency openly concedes that there were regulatory options that it did not select that may offer advantages over those that it did select. In fact, EPA is actively soliciting public input, direction and recommendations on approximately 50 separate and specific areas. From a strategy perspective, it seems apparent that the agency's own uncertainties present fertile ground for improving the rules through public comment and the rulemaking process. In other words, the 50 areas in which EPA has explicitly requested comment are an ideal place for the intended regulated community to begin its rule evaluation. These areas are still relatively unresolved.

In light of the agency's appeal for input, we have organized this evaluation of the proposed rules around EPA's specific requests for comment. We organized EPA's 50+ specific requests by subject matter (or topic), and under each topic we discuss the agency's general proposal, followed by a summary of the agency's expressed uncertainties regarding the approach set forth in the rules. These topics include: location issues, programmatic issues, liability issues, technical issues (evaluation, operation, construction and monitoring), and permit issues (administration and financial assurance). In many instances, EPA laid out alternative regulatory approaches, and where it did, we set those out as possible alternatives.

A. Location Issues

What the Rules Propose:

- **Injection of CO₂ must be below the lowermost USDW.** EPA recognizes that its absolute insistence that the CO₂ storage be below the lowermost USDW will preclude storage in potentially suitable locations. For example, coal seams above the lowermost USDW may be viable storage sites, but would be unavailable under the proposed rules. Similarly, deep, marginal USDWs directly overlying crystalline basement rock and/or unmineable coal seams would be off limits under the proposed rule. In areas of the country with very deep USDWs, the need to construct GS wells beneath them may render GS technically impractical.

EPA's Requests for Comment:

- EPA is considering and requesting comment on alternative approaches that would allow injection in more geographical areas. One such approach might provide the Director discretion to allow injection above or between USDWs when an applicant demonstrates that geologic conditions exist that protect USDWs from endangerment and that, perhaps, there are special circumstances (such as limited area CO₂ storage capacity). EPA cites the Williston and Powder River Basins in Wyoming, North Dakota, and South Dakota, where receiving formations (formations with large CO₂ storage capacity) are above the lowermost USDW, but there may be thousands of feet of confining rock strata between the injection zone and the overlying and underlying USDWs.
- EPA also asks whether it should allow additional flexibility on "aquifer exemptions." To qualify for an exemption, EPA must typically first conclude there is no reasonable expectation that the aquifer will be used as a drinking water supply. When an aquifer is exempted, it no longer qualifies for protection as a USDW. Thus, as a more flexible approach, EPA could expand the criteria for exempting aquifers so that under certain circumstances, even suitable drinking water aquifers could be exempted to allow an otherwise ideal project to move forward. A more flexible use of aquifer exemptions could be applied to marginal USDWs directly overlying crystalline basement rock to allow for CO₂ storage in those formations.
- EPA also notes that another alternative to the absolute prohibition would be to set a minimum injection depth requirement for CO₂ GS rather than require that such injection take place below the lowermost USDW. A minimum injection depth of

approximately 800 meters (2,625 feet) has been suggested in technical workshops because this depth is thought to maintain CO₂ at pressure sufficient to keep it in a supercritical, liquid state, thus allowing storage of greater volumes and thereby increasing available underground storage capacity. Again, EPA seeks input on whether a minimum depth requirement would be appropriate in lieu of or in addition to requiring injection beneath the lowermost USDWs.

- EPA recognizes in the preamble that deep saline formations, depleted oil and gas reservoirs and unmineable coal seams are the target formations with the greatest GS storage capacity. EPA also recognizes that other formations, such as basalts, mined salt domes or salt caverns, other abandoned mines or shales, may be suitable for storage but may also be located above the lowermost USDW. The agency asks for comment about prohibiting injection into such formations, if they are above the lowermost USDW.

B. Programmatic Issues

What the Rules Propose:

- Under the proposed rules, injection of CO₂ for the purposes of enhanced oil and gas recovery (EOR/EGR) will continue to be permitted under the Class II program and those wells will retain this regulatory designation as long as production is occurring.
- EPA is proposing to give the Director discretion to carry over or “grandfather” the construction requirements (e.g., permanent, cemented well components) for existing Class I and Class II wells seeking a permit for GS of CO₂, provided he/she is able to make a determination that these wells would not endanger USDWs. EPA also proposes that the Director have the discretion to “grandfather” the construction requirements for Class V experimental wells when they are converted to full-scale GS Class VI wells.
- EPA historically has approved primary enforcement authority for States, Territories, and Tribes that wish to implement the UIC Program. Consistent with this historic practice, EPA proposes to allow delegation of the Class VI well program to states, territories, and tribes that adopt rules that are at least as stringent as, and may be more stringent than, the proposed minimum Federal requirements. Delegation of the program is clearly preferable as it assures states have the flexibility to enforce customized policies that address specific, local concerns.

- EPA proposes rules requiring financial assurance for corrective action, including injection well plugging, post-injection site care, site closure and emergency and remedial response, all aimed at providing security to prevent endangerment of USDWs. Significantly, the Safe Drinking Water Act (SDWA) (the Act under which the Class VI well rules are proposed) does not contain specific provisions for financial responsibility. Other Acts, such as the Resource Conservation and Recovery Act (RCRA) (which regulates hazardous waste), contain explicit provisions for financial assurance. EPA explains in the preamble to the proposed rule that although the SDWA does not explicitly provide authority to require financial assurance, EPA believes that the SDWA authority to prevent the endangerment of USDWs provides EPA with the general authority to set standards for financial responsibility for purposes of preventing endangerment of USDWs.
- With regard to public participation, EPA proposes what has become standard fare in environmental permitting: public notice, opportunity for public input on a project-specific basis, and response to comment. The notice requirement includes placement of newspaper advertisements, postings, mailings to interested parties and publication of a fact sheet or statement of basis that describes the planned injection operation and the principal facts and issues considered in preparing the draft permit. Under the proposed rule, permitting authorities would provide a 30-day comment period during which public hearings may be held. At the conclusion of the comment period, the permitting authority would be required to prepare a responsiveness summary that becomes part of the public record.

EPA's Requests for Comment:

- EPA asks whether the CO₂ GS program alone should be delegable, i.e. whether state agencies that handle no other aspects of UIC permitting should nevertheless be allowed to seek primacy for the Class VI program. This is not relevant for projects in Texas, but may be important for projects in other parts of the country. Although federal regulators may be competent to handle administration of the CO₂ GS program in a particular state, federal implementation is notoriously slow.
- With respect to public participation, EPA seeks input about whether additional requirements should be included, for example requiring publication of a project via cable networks, the Internet, and other new technology. EPA also requests comment on ways to enhance the public participation process, including engaging communities in the site characterization process as soon as candidate locations are identified.

- Another concern addressed in this section is the ability of an owner or operator to convert an existing UIC well to a well covered under the CO₂ GS program requirements or to continue to operate an existing well that injects CO₂ under regulations applicable to a different UIC class. If there are any plans to convert existing UIC wells to CO₂ GS, this could be an important issue.
- This section also includes requests for comment related to the validity of the cost assumptions set forth in the preamble to the rule. If the assumptions are incorrect, EPA may be willing to adjust the regulatory requirements. Additionally, numerous court decisions overturning rules have relied on the conclusion that the cost assumptions supporting a rule are incorrect.⁵
- In the area of financial assurance, EPA seeks input on a variety of topics:
 - What mechanisms should be allowed?
 - How frequently should cost estimates be updated?
 - Should well-plugging financial assurance be required at the time of permitting?
 - With regard to estimation of costs associated with post-injection site care, EPA asks if these costs can be reliably estimated at the time of permitting, or if they should be made when a facility is at closure. Because the default post-injection period is 50-years, there may be significant costs associated with post-injection care financial assurance. Requiring those costs upfront may limit the number of operators seeking GS permits.

C. Liability Issues

What the Rules Propose:

- EPA proposes using a combination of a fixed timeframe (50 years) and a performance standard (post-injection site care will continue until the plume is stabilized and cannot endanger USDWs) in establishing the period for post-injection site care.

⁵ In *Michigan vs. U.S. EPA*, a trade association challenged EPA's NOx SIP call rule, alleging that it was based on arbitrary and capricious actions by EPA, including flawed cost assumptions in EPA's determination of cost-effective control measures. *Mich. v. United States EPA*, 213 F.3d 663, 690 (D.C. Cir. 2000). While the Court in this case determined that the trade association failed to support its claim that the cost assumptions were arbitrary and capricious, the case indicates that flawed cost assumptions could support a challenge to a rulemaking.

- EPA is also proposing to allow the Director to shorten or lengthen the 50-year post-injection care period based on site performance. Under the proposed rules, the Director may require that the post-injection site care period extend beyond the 50-year time frame, if a demonstration of non-endangerment to USDWs cannot be made. Alternately, if an owner or operator demonstrates that the remaining pressure front and plume will not endanger USDWs, the Director may authorize site closure prior to the end of the 50-year default period.
- EPA tentatively offers the agency discretion to lengthen or shorten the 50-year period if appropriate. Note that the 50-year time frame for post-injection care exceeds the post closure period applicable to hazardous waste disposal facilities under the Resource Conservation and Recovery Act.
- EPA has defined “carbon dioxide stream” to exclude hazardous wastes, thus precluding injection of hazardous wastes in Class VI injection wells. According to EPA, if testing of a CO₂ stream reveals the presence of hazardous waste, the stream may only be injected into a Class I permitted well. Of course, the technical requirements for Class I wells are quite different than those applicable to Class VI wells under the proposed rules, leading to a potential dilemma for the well operator.

EPA’s Requests for Comment:

- EPA specifically seeks comment on its position that CO₂ containing hazardous wastes should not be disposed of under this program.
- Potential CERCLA, or Superfund, liability is another important consideration for any CO₂ project. Although CO₂ is not a hazardous substance, the stream might contain impurities that are classified as a hazardous substance or, because of its interaction with the media into which it is injected, a hazardous substance may be generated post-injection. A well failure or loss of containment might then result in the release of a hazardous substance not merely to or threatening a USDW, but to the environment generally, arguably triggering Superfund liability for the well operator and possibly the generator of the CO₂ stream. EPA seeks comment on potential CERCLA liability from a sequestration facility. EPA notes that CERCLA exempts from liability certain “federally permitted releases” including releases in compliance with a UIC permit under SDWA and explicitly states that “Class VI requirements and permits will need to be carefully structured to ensure that they do not ‘authorize’ inappropriate hazardous releases.” EPA also requests comment on other

considerations associated with the presence of impurities in the CO₂ stream related to CERCLA.

- EPA clearly is unsure of its proposal to use a combined fixed timeframe (50 years) plus a performance standard with Director discretion for regulating a sequestration facility's post-injection care term. Given the difficulty of predicting when a CO₂ plume within a GS facility will stabilize after injection has ceased, characterizing post-injection site care timeframes for GS is more challenging. According to the EPA, the buoyancy of CO₂, viscosity, and the large injection volumes associated with GS, the area over which CO₂ will spread in the subsurface is likely to be larger than for existing well classes, and therefore, the area over which there is potential for endangerment of USDWs is likely to be greater. EPA requests comment on the proposed use of a tentative 50-year fixed timeframe as a default period subject to adjustment at the Director's discretion based on monitoring and modeling data.

D. Technical: Evaluation Issues

What the Rules Propose:

- EPA proposes to use a combination of technologies and standard practices pertaining to site characterization, construction, operation, monitoring, closure, and post-closure requirements for CO₂ GS wells. These methods are listed in Chapter 2 of the Cost Analysis for the GS proposed rule and described in further detail in the Geologic CO₂ Sequestration Technology & Cost Analysis (USEPA, 2008h) developed in support of this proposed rule.
- Under EPA's proposed rules, the Director has discretion to require the owner or operator to identify and characterize additional confining and containment zones above the primary (i.e., lowermost) confining zone. These layers could provide additional sites for monitoring, mitigation, and remediation. Note that consistent with Regulatory Alternative #3, the rules do not require these additional zones be identified for all GS sites.
- The "Area of Review" (AoR) is an important concept in UIC permitting. The AoR defines the area that must be evaluated for a project, including the boundaries for monitoring, fracture investigation, well plugging, well closure and post-injection site care. For Class VI wells, EPA defines the AoR as "the region surrounding the geological sequestration project that may be impacted by the injection activity. The AoR is based on computational modeling that accounts for the physical and chemical

properties of all phases of the CO₂ injection stream.” Thus, EPA proposes that each operator delineate the AoR on a site-specific basis.

- The proposed rule requires that the owner or operator periodically reevaluate the AoR during the injection operation. Reevaluations would occur at a minimum fixed frequency, not to exceed 10 years, as agreed upon by the Director.

EPA’s Requests for Comment:

- EPA specifically asks industry to identify potentially-applicable voluntary consensus standards for site characterization, construction, operation, monitoring, closure, and post-closure requirements for CO₂ GS wells and to explain why such standards should be used in this regulation. Use of such standards will provide for more uniformity in the rules, potentially decreasing the flexibility to address site-specific problems with site-specific solutions.
- EPA specifically seeks comment on the merits of mandating identification of additional confining and containment zones. Making this requirement mandatory would reduce the regulatory flexibility provided by the proposed rule, which provides the Director with the discretion to require identification of these zones. Additionally, such a requirement appears to be unnecessarily burdensome, particularly because the absence of such features does not necessarily indicate inappropriateness of a GS site.
- EPA seeks comment generally on the use of modeling for AoR delineation as opposed to a fixed or default AoR standard. In particular, EPA seeks comment on the applicability of computational fluid flow models for delineating the AoR of GS sites.
- The agency recognizes that in some cases, owners or operators may choose to use proprietary models, and that as a result, the information used to support the AoR designation, and in turn the monitoring requirements, closure plan and financial assurance details, will not be available to the public. EPA seeks comment on allowing the use of proprietary models for GS sites.
- EPA seeks comment on the appropriateness of a 10-year minimum fixed frequency for AoR reevaluation. EPA also asks whether certain conditions should automatically trigger AoR reevaluation. Remember, the AoR is an intensive and potentially extremely expensive effort. Reevaluation of the AoR is likely to be a similarly burdensome task, and any expansion of the AoR as a result of the reevaluation could necessitate extensive adjustments to site monitoring and closure plans. Note also that

AoR requirements are closely tied to monitoring because monitoring results of GS wells are used as data inputs for reevaluation of the site computational model, AoR reevaluation and corrective action.

E. Technical: Operation Issues

What the Rules Propose:

- The proposed rules require an injection pressure limitation similar to existing UIC Class I deep well requirements. All permits must include a provision limiting CO₂ injection pressures, except during well stimulation. The purpose of the limit is to avoid creation of new fractures, exacerbation of existing fractures in the injection zone, or otherwise causing movement of injection or formation fluids that endanger USDWs.
- EPA proposes an absolute limit on the pressure in the injection zone—it must not exceed 90% of the fracture pressure of the injection zone. According to EPA, the 90% limit provides an added margin of safety in the well operation.
- The proposed rule prohibits fracturing of the confining zone at all times during injection and/or stimulation.
- The proposed rule also requires that automatic shut-off valves be installed down-hole in addition to being required at the surface. Traditionally, shut-off equipment has been installed at UIC sites at the wellhead (i.e., at the surface), but down-hole devices have been applied in offshore wells for years. The automatic shut-off would be triggered by various permit terms, including for example, significant pressure variations that might indicate a loss of confinement of the injectate. The requirement for mandatory down-hole shut-off valves appears to be a significant deviation from standard UIC practices. Furthermore, repairing and maintaining down-hole equipment can be expensive and result in increased downtime.

EPA's Requests for Comment:

- Although EPA prohibits fracturing of the confining zone, it recognizes that there are circumstances where fracturing of the injection zone would be beneficial. EPA asks the public for input on the extent and scope to which hydraulic fracturing should be allowed during GS injection, and whether the use of fracturing for the purposes of

well stimulation is appropriate. EPA also seeks data to better qualify the use of fracturing for GS injection in specific geologic settings and rock formation lithologies.

- EPA also requests opinions about the merits of requiring down-hole shut-off valves in GS wells.

F. Technical: Construction Issues

What the Rules Propose:

- The proposed rules include enhancements to typical deep well construction. For example, surface casing for GS wells must be set through the base of the lowermost USDW and cemented to the surface. The long-string casing would be cemented in place along its entire length. The rules also mandate that Class VI wells be constructed with a packer that is set opposite a cemented interval, with the location of the packer being selected by the Director.
- As previously noted, the rules allow the Director to grandfather existing permitted wells into the Class VI program and avoid the Class VI construction requirements.
- EPA allows substantial flexibility in the choice of construction materials for GS wells, so long as they are corrosive resistant and meet API or ASTM International or comparable standards approved by the Director. Corrosive resistant cement is also required.

EPA's Requests for Comment:

- Even though the agency acknowledges that the buoyancy and potential corrosivity of CO₂ would seem to necessitate the enhanced construction it proposes for GS wells, EPA nevertheless asks for input on the propriety of these measures. In particular, EPA seeks comment on the proposed GS well requirements for depth of surface casing, the cementing of long-string casing, and construction with a packer set opposite a cemented interval. EPA also seeks comment on how the proposed grandfathering provisions for existing wells (construction requirements) may affect compliance with the above, proposed construction requirements. EPA also seeks specific comment about its requirements for degradation resistant well construction materials such as acid resistant cement and corrosion resistant casing.

- EPA's preamble includes a lengthy discussion about the possible use of horizontal drilling techniques in GS projects, but makes no specific announcements in the rules about this drilling technique. For example, the rules do not state whether this technique will be acceptable in a GS project. Instead, the agency asks for comment about the merits of horizontal well drilling techniques for GS wells and asks about applicability of well construction requirements discussed in this proposal.

G. Technical: Monitoring Issues

What the Rules Propose:

- Deep well permits typically require mechanical integrity testing (MIT) via continuous monitoring of injection pressure, flow rate, temperature, and volumes of injected fluid as well as pressure on the annulus between the tubing and the long string casing. The GS rule proposes this standard litany of monitoring requirements. Thus, Class VI GS well permits must require internal mechanical integrity testing through continuous monitoring of injection pressure, flow rate, and injected volumes, as well as annular pressure and fluid volume, to assure that no anomalies occur that may indicate an internal leak. Specific MIT requirements for each well will be set on a case-by-case basis considering the unique properties the EPA assigns to CO₂ (buoyancy and potential corrosivity).
- Continuous internal mechanical integrity monitoring of GS project injection wells, instead of periodic testing (which is required for most other types of deep injection wells), is proposed in the rules because of the corrosive nature of GS waste streams, which makes immediate identification of corrosion-related well integrity loss critical. (Continuous computer-driven monitoring of internal MI is also essential to ensure appropriate triggering of automatic shut-off systems.)
- Instead of requiring external MI demonstrations every five years (the standard for other Classes of UIC wells), the proposed rule requires demonstration of injection well external mechanical integrity at least once annually. EPA justifies this increase in frequency on the potential corrosive effects of GS streams.
- The proposed rule gives the Director discretion on whether to require the use of tracers, and if so, what types of tracers. Tracers might perform a variety of functions: helping to facilitate early leak detection, helping to infer geochemical processes caused by CO₂ (e.g., dissolution or precipitation of calcium carbonate) that may pose risks, and indicating potential endangerment to USDWs.

- The proposed rule would require automatic down-hole shut-off mechanisms (see proposed injection well operating requirements section) in the event of an MI loss.
- The proposed rule does not change the existing allowable methods for demonstrating external MI in deep injection wells. Tracer surveys, a temperature or noise log, a casing inspection log, if required by the Director, or an alternative approved by the Administrator and, subsequently, the Director are all allowed. The proposed rule would also provide the Director with the discretion to request additional tests.
- EPA proposes semi-annual reports on injection pressure, flow rate, temperature, volume and annular pressure, and on the results of MITs. This is the same reporting frequency for other deep injection well classes.
- EPA is requiring CO₂ plume and associated pressure front monitoring for verification of modeling predictions. Monitoring may be conducted with a combination of direct and indirect techniques appropriate for the conditions of specific GS projects. Thus, operators must track the subsurface extent of the CO₂ plume and pressure front using pressure gauges in the first formation overlying the confining zone or using indirect geophysical techniques (e.g., seismic, electrical, gravity, or electromagnetic surveys) or other down-hole CO₂ detection tools, monitor for geochemical changes in subsurface formations, and if directed, monitor at the surface. The proposed rule would also require owners or operators to monitor ground water quality and geochemical changes above the confining system.
- The proposed rule would require that owners or operators perform a pressure fall-off test at least once every five years
- Under the proposed rule, all Class VI well permit applications must include a proposed testing and monitoring plan designed to verify that the project is operating as intended and is not endangering USDWs. The plan at a minimum must include: analysis of the chemical and physical characteristics of the CO₂ stream; monitoring of injection pressure, rate, and volume; monitoring of annular pressure and fluid volume; corrosion monitoring; a demonstration of external mechanical integrity (see proposed mechanical integrity testing requirements section of the preamble); a determination of the position of the CO₂ plume and area of elevated pressure; monitoring of geochemical changes in the subsurface; and, at the discretion of the Director, monitoring for CO₂ fluxes in surface air and soil gas, and any additional tests requested by the Director.

- Under the proposed rule, CO₂ streams must be monitored at a frequency sufficient to yield data representative of the stream's chemical and physical characteristics. Well materials also must be monitored and inspected for signs of corrosion, such as loss of mass, thickness, cracking, or pitting.
- Under the proposed rule, the Director has discretion to require surface air monitoring and/or soil gas monitoring in the AoR.

EPA's Requests for Comment:

- EPA seeks public input on the use of tracers in the Class VI program. EPA is uncertain about the use of tracers for GS projects. A variety of tracers are available, ranging from mercaptans, typically used in the gas industry, to perfluorocarbon (PFC). The effectiveness and cost-effectiveness of tracers is debatable, and there are known technical challenges, such as false positives, associated with their use. Additionally, PFCs, have a global warming potential many orders of magnitude higher than CO₂, so although they are less susceptible to degradation than the odorant tracers, they present a greater risk under release scenarios.
- The agency's MIT program has been generally successful to date. Nevertheless, the agency is willing to consider an alternate frequency for MITs for GS wells, and is interested in whether additional MITs are appropriate for these wells and how to optimize MITs for the GS program in general.
- EPA seeks comment on the use and frequency of pressure fall-off testing for Class VI wells.
- EPA is uncertain about the efficacy of various CO₂ tracking tools under certain geologic conditions, particularly given the cost of specific technologies. It is clear that the agency is convinced that tracking the plume and pressure front is an important companion step to address any uncertainties associated with initial AoR modeling. EPA requests additional input on more efficient alternatives that may be used to track the plume and pressure front.
- EPA also seeks public input on the appropriate amount and types of monitoring, specifically, the usefulness of indirect geophysical monitoring (e.g. eddy covariance techniques, hyperspectral image analysis and LIDAR (light detection and ranging)) and surface air and soil gas monitoring. Surface air monitoring over an entire AoR

could lead to unintended consequences and may have little relationship to the endangerment of USDWs.

H. Permit: Administration Issues

What the Rules Propose:

- Given the potential for CO₂ to migrate upward through existing usable and abandoned wells in the AoR, EPA's proposed rules address artificial penetrations in the AoR. The proposed rules would give the Director the discretion to allow implementation of corrective action measures with respect to those wells on an iterative, phased basis over the operational life of a GS project. Thus, at the outset, all wells penetrating the confining or injection zone within the site AoR would be identified. But only a portion, those that would come into contact with the CO₂ plume or pressure front during the first years of injection, would need to be addressed at the outset of the project. As the plume expands, the rules would require further progress on the corrective action plan to assure that all wells in the AoR that need corrective action eventually receive it.
- EPA proposes that Class VI wells be issued for the operating life of the facility, a preferred course. (Class I and Class V well permits are effective for up to 10 years. Operators must renew those permits, and the renewal process typically involves extensive public input.) Of course, under the Class VI program, both the facility and the permit would be subject to periodic review by the permitting authority as the AoR reevaluation is conducted, so there is ample opportunity for the agency to revisit the permit terms and conditions.
- EPA proposes that Class VI well applications include the following plans not currently required under existing UIC regulations: a monitoring and testing plan, an AoR, a corrective action plan, and a post-injection site care and site closure plan.
- Notification requirements are slightly reformed in the Class VI rules. Operators must notify the Director at least 60 days in advance (or according to whatever schedule the Director may set) of their intent to plug the well and of any updates to the post-injection site care and site closure plan. After the well is plugged, owners and operators must submit a well-plugging report stating that the well was plugged in accordance with the approved post-injection site care and site closure plan or specify the differences between the plan and the actual well plugging. During the post-injection site care (monitoring) period, owners or operators must report periodically

on the results of monitoring. At the end of the post-injection site care period, owners or operators must submit a site closure report along with a non-endangerment demonstration showing that conditions within the subsurface indicate that no additional monitoring is necessary to assure that there is no endangerment to USDWs associated with the injection.

EPA's Requests for Comment:

- EPA invites public comment on the phased corrective action approach for GS wells.
- EPA specifically seeks comment on its proposal to issue permits for the life of a CO₂ GS project, including the post-injection site care period.
- EPA also requests comment on whether it should require CO₂ GS sites to provide an annual report during the lifetime of the project, including the post-injection period, regarding the GS operation. According to the agency, this report would not only describe the status of the operation—it could also summarize for public consumption knowledge gained on GS technology that could contribute to the state of the science on GS.

I. Permit: Financial Assurance Issues

What the Rules Propose:

- As was previously noted, EPA wants owners or operators to be required to demonstrate and maintain financial responsibility, and have the resources for activities related to closing and remediating GS sites, including emergency and remedial response (similar to the EPA's RCRA hazardous waste program requirements). The rules only specify a general duty to obtain financial responsibility acceptable to the Director. The precise mechanism for meeting this requirement will be established through guidance at a later date.
- Also consistent with the RCRA program, EPA proposes to require periodic updates of the cost estimate for well plugging, post-injection site care and site closure, and remediation to account for any amendments to the AoR, corrective action plan, the plugging and abandonment plan, and the post-injection site care and site closure plan.
- EPA is also proposing that the owner or operator submit an adjusted cost estimate to the Director if the original demonstration is no longer adequate to cover the cost of

the injection well plugging, post-injection site care, and site closure. As proposed, the Director would set the frequency for demonstration of financial responsibility and resources.

EPA's Requests for Comment:

- EPA seeks comment on whether separate financial documentation should be submitted for plugging of the injection well and for the post-injection site care requirements. Post-injection site care typically will extend many years into the future, long after the date permit is issued. For this reason, EPA may require approval of the well plugging financial demonstration at permit issuance and the post-injection site care financial demonstration at a later time (e.g. within 180 days of notifying the Director that the well will be plugged and abandoned).
- Although EPA is comfortable with the financial assurance mechanisms it has used for decades under the RCRA program, it is considering and seeking comment on alternate mechanisms for GS projects. EPA is also questioning whether GS projects warrant a different pay-in period for trust funds, different surety eligibility requirements and whether insurance providers will be available.
- Financial assurance mechanisms are only as effective as the estimates on which they are based. EPA seeks outside input on cost estimation for plugging. EPA is assessing whether a financial ratings threshold for all companies using a self-guarantee, similar to those used by other Federal agencies, is appropriate. The Agency also is considering what constitutes an appropriate financial rating threshold, and whether a financial rating greater than BBB or Baa (i.e., the current rating threshold established under the UIC regulations) is appropriate for GS wells. EPA's absolute net worth threshold of \$10 million is also under scrutiny. Perhaps a net worth threshold more in line with the Minerals Management Service within the Department of Interior (which requires a net worth threshold at least 10 times the amount of the obligations being assured) would be more appropriate. In general, EPA is evaluating all aspects of its financial assurance options to assure appropriate measures are in place for GS wells.

III. COMMENTING ON THE PROPOSED CLASS VI RULES

EPA is uncertain about many aspects of its proposed rules for the regulation of CO₂ GS and is seeking input from the public on multiple topics. This uncertainty presents an opportunity for current and potential owners and operators of CO₂ GS wells to submit public comment to help improve the proposed Class VI well program rules. The proposed rules are

available online at: <http://www.epa.gov/fedrgstr/EPA-WATER/2008/July/Day-25/w16626.pdf>. Written comments are due to the agency on or before **November 24, 2008**. Note that EPA has consistently stated it will likely publish a notice of data availability (if needed) in 2009, but that the final rules will not be in place until late 2010 or early 2011. The EPA will also hold two public hearings on the proposed rules: 1) in Chicago on September 30, 2008 and 2) in Denver on October 2, 2008.

If you have any questions or would like additional information regarding the proposed Class VI well rules or providing comment on the proposed rules, please contact Molly Cagle of Vinson & Elkins LLP at 512.542.8552 or Darrick Eugene of Vinson & Elkins LLP at 512.542.8814.