Storage of Carbon Dioxide in Geologic Structures

A Legal and Regulatory Guide for States and Provinces

The Interstate Oil and Gas Compact Commission

Task Force on Carbon Capture and Geologic Storage

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In July of 2002, the Interstate Oil and Gas Compact Commission (IOGCC), with sponsorship from the U.S. Department of Energy (DOE), convened a meeting of state regulators and state geologists in Alta, Utah. The purpose of the meeting was to decide whether or not oil and natural gas producing states, and in particular the oil and natural gas regulatory agencies in these states, might be able to play a meaningful role in the sequestration (otherwise known as "storage") of carbon dioxide (CO_2). The meeting concluded that states were indeed interested in examining the issue further.

In response to that meeting, the IOGCC in December 2002 passed Resolution 02.124 calling for the establishment of a "Geological CO_2 Sequestration Task Force". (Subsequent IOGCC resolutions in 2004 {04.102} and 2006 {06.102} have extended the work of the Task Force.) On July 14, 2003, I appointed Lawrence Bengal Chairman of the Task Force. Its membership included representatives from IOGCC member states and international affiliate provinces, state and provincial oil and gas agencies, DOE, DOE-sponsored Regional Carbon Sequestration Partnerships, the Association of American State Geologists (AASG), and the oil and natural gas industry.

Funded by DOE and its National Energy Technology Laboratory (NETL) through a cooperative agreement with the University of Illinois, the Task Force began an examination of the technical, policy, and regulatory issues related to the safe and effective storage of CO_2 in subsurface geological media (oil and natural gas fields, coal seams, and deep saline formations) for both enhanced hydrocarbon recovery and long-term CO_2 storage. The culmination of this effort was the Final Report that was publicly released in early 2005 (This phase of the Task Force is henceforth referred to as Phase I).

A key conclusion of that report was that given the jurisdiction, experience, and expertise of states and provinces in the regulation of oil and natural gas production and natural gas storage in the United States and Canada, the states and provinces would be the most logical and experienced regulators of the geologic storage of carbon dioxide.

Although the Task Force recognized in Phase I that states and provinces with Oil and Natural Gas Conservation Acts and states and provinces with natural gas storage statutes might be able to utilize those statutory and regulatory frameworks for CO_2 injection and storage, it also concluded that some modification of those frameworks might be advisable or necessary, particularly for the post-operational phase for which no regulations exist. The Task Force also recognized that further research into the ownership of subsurface storage rights with respect to CO_2 storage, as well as an analysis of the regulatory relevance of the Underground Injection Control Program (UIC) of the Safe Drinking Water Act and its applicability to CO_2 storage, would be useful to the states.

To this end, the Task Force, under the sponsorship of DOE/NETL, began work on a second project in 2006 (Phase II) to start development of this detailed Guidance Document. Composition of the Task Force was much the same as in Phase I, with the addition of

representatives from the U.S. Environmental Protection Agency (EPA) and the U.S. Bureau of Land Management (BLM) who attended as observers.

The most critical component of this document is a Model CO_2 Storage Statute and Model Rules and Regulations governing the storage of CO_2 in geologic media and an explanation of those regulatory components. Also included herein is a report addressing the ownership and right of injection of CO_2 into the subsurface.

Given the breadth and complexity of the regulatory issues addressed in this report, the Task Force relied on several guiding principles in its drafting efforts. These principles enabled the Task Force to effectively direct its efforts in addressing this complex issue:

SEAMLESS - The statutory and regulatory framework developed needed to be seamless to maximize economic and environmental benefits while providing a "cradle to grave" framework with fully integrated regulatory oversight and clearly identified risk parameters for industry.

SIMPLE - The temptation to over-regulate for the exotic needed to be avoided by developing a simple framework that initially addressed only those scenarios most likely to occur. It was recognized that, as necessary, regulations would be amended in the future based on the experience gained in the initial projects.

FLEXIBLE and RESPONSIVE - "One size will not fit all". Proposed projects will have many site-specific variations throughout the states and provinces and therefore it was recognized that any regulatory framework needed to flexible and responsive to the site variations and developing technologies. Regulatory experience and technology developments are certain to change over time, and each project will only improve the regulatory and technical knowledge base.

DOABLE - Given the speed at which this issue is progressing, a regulatory framework that can be rapidly implemented and fielded was necessary. The Task Force recognized that problems will occur; however, it also recognized that most of those problems are issues with which the states/provinces and oil and gas industry have already dealt and will generally be easily solvable. The Task Force channeled its efforts to prevent the regulatory framework development process to be side-tracked by not trying to resolve every conceivable issue from the outset. The development of a regulatory framework will be an ongoing regulatory development process as experience is gained

POSITIVE PUBLIC PRESENTATION - Geologic storage of CO_2 is an integral part of a solution that offers the potential for both economic and environmental benefits. Nothing will be achieved by regarding CO_2 geologic storage as a regulatory protection solution to a waste problem.

The intent of this document is to provide to a state or province contemplating adoption of a legal and regulatory framework for the storage of carbon dioxide (CO_2) in geologic media the resources needed to draft a framework that meets the unique requirements of that particular state or province. It is anticipated that a state or province adopting a regulatory framework for CO_2 storage will make changes to the model framework as necessary to conform to state or provincial law. The Task Force therefore envisions that what will result will be a substantially consistent system for the geologic storage of CO_2 regulated at the state and provincial level in conformance with national and international law and protocol. Most importantly, states and provinces are likely to continue to regard CO_2 as a valuable resource that should be managed using resource management frameworks, therefore avoiding the treatment of CO_2 as waste. The Task Force

strongly believes that treatment of geologically stored CO_2 as waste using waste disposal frameworks rather than resource management frameworks will diminish significantly the potential to meaningfully mitigate the impact of CO_2 emissions through geologic storage.

The IOGCC gratefully acknowledges the support of the U.S. Department of Energy, the National Energy Technology Laboratory, the New Mexico Institute of Mining and Technology as well as the critical support of the states and provinces and other entities that so generously contributed their employees' time to the production of this document. In particular, the IOGCC expresses its deep appreciation to Task Force Chairman Lawrence E. Bengal for his outstanding leadership and to the Task Force participants without whom the production of this document would not have been possible. The IOGCC also recognizes the contribution of its legal subcommittee composed of S. Marvin Rogers of Alabama, Cammy Taylor of Alaska, and David Cooney of Texas. The assistance of Lawrence E. Bengal of Illinois, Berry H. "Nick" Tew, Jr. of Alabama and Michael Stettner of California in helping to draft and integrate Task Force comments on the remainder of the guidance document is also gratefully acknowledged.

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Executive Summary

This report is the product of the Interstate Oil and Gas Compact Commission (IOGCC) Task Force on Carbon Capture and Geologic Storage. It is the culmination of a two-phase, five-year effort.[1] This Phase II report takes the form of a Guidance Document for U.S. states and Canadian provinces. Its purpose is to provide to a state or province contemplating adoption of a legal and regulatory framework for the storage of carbon dioxide (CO_2) in geologic media the resources needed to draft a framework that meets the unique requirements of that particular state or province. It is anticipated that a state[2] adopting a regulatory framework for CO_2 storage will make changes to the model framework as necessary to conform to state law. The Task Force therefore envisions that what will result will be a substantially consistent system for the geologic storage of CO_2 regulated at the state and provincial level in conformance with national and international law and protocol.

The Task Force was composed of representatives from IOGCC member states and international affiliate provinces, state and provincial oil and gas agencies, U.S. Department of Energy (DOE)-sponsored Regional Carbon Sequestration Partnerships, the Association of American State Geologists (AASG), and independent experts. Representatives from DOE, the U.S. Environmental Protection Agency (EPA), the U.S. Department of the Interior's Bureau of Land Management (BLM), and the environmental group, Environmental Defense, also participated as observers.

The interest of states in the geologic storage of CO_2 arises because, in addition to conservation, it is among the most immediate and viable strategies available for mitigating the release of CO_2 into the atmosphere. The thirty member states and four Canadian affiliate member provinces of the IOGCC are well suited for regulation of CO_2 storage because of their jurisdiction, experience, and expertise in the regulation of oil and natural gas production. For half a century, most of these states have been the principal regulators of enhanced oil recovery (EOR), as well as natural gas storage and acid gas disposal. They also are strategically well situated for the storage of CO_2. Regulations already exist in these petroleum-producing states covering many of the same issues that need to be addressed in the regulation of CO_2 storage, and consequently serve as adaptable frameworks for CO_2 storage.[3] Several associate member and non-member states of the IOGCC also might be geologically suitable for CO_2 storage and might find the IOGCC Guidance Document valuable in developing a regulatory framework for CO_2 geological storage.

The IOGCC Task Force, funded by the U.S. Department of Energy and its National Energy Technology Laboratory, through a cooperative agreement with the New Mexico Institute of Mining and Technology, has produced for the first time a clear and comprehensive model legal

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[1] The first phase concluded with the publication of a Final Report publicly released in early 2005. This phase of the Task Force is henceforth referred to as Phase I.

[2] Although references throughout this Executive Summary are, for the most part, to "state" or "states", it is the intent of the Task Force that the comments and provisions are equally applicable to Canadian provinces. Of course, this would not apply to discussions concerning underground storage rights and the Underground Injection Control Program of the U.S. Safe Drinking Water Act.

[3] States that do not have oil and natural gas production may have experience regulating natural gas storage that will give them an important analogous regulatory experience for purposes of CO_2 geologic storage.

and regulatory regime for the geologic storage of CO_2. As a result of this effort, states and provinces, and indeed other nations using our model, can begin immediately the process of enacting legislation and promulgating regulations enabling CO_2 geologic storage projects. California, New Mexico, North Dakota, Texas, and Wyoming are already in various stages of developing a legal and regulatory framework for geological storage as a result of the work of the Task Force.

The Guidance Document prepared for the states contains, in addition to background information, a paper analyzing property rights issues related to underground space used for geologic storage of carbon dioxide; an overview and explanation of the Model General Rules and Regulations, a Model Statute for Geologic Storage of Carbon Dioxide, and Model General Rules and Regulations.

Development of these model laws and regulations for geologic storage facilitates more states beginning to put in place this critical legal and regulatory infrastructure for CO_2 storage. This should enable timely and responsible development of CO_2 geologic storage projects and, concomitantly, the continued development of CO_2 geologic storage technology.

The Guidance Document does not address the regulatory issues involving CO_2 emissions trading and accreditation for the purpose of securing carbon credits. However, the Task Force strongly believes that development of any future CO_2 emissions trading and accreditation regulatory frameworks should utilize the experiences of the states. The Task Force-proposed Model General Rules and Regulations developed in this report primarily address the regulatory issues related to public health and safety and environmental protections associated with the geologic storage of CO_2. The Task Force concluded that the issue of CO_2 emission trading and accreditation might best be addressed in the marketplace and/or at the federal government level and was beyond the scope of this report.

The Task Force addressed the issue of the content of the CO_2 emission stream proposed to be stored. Given the many technical and regulatory complexities involved in the transportation and geologic storage of varying qualities of CO_2, the Task Force defined CO_2 for purposes of this report as "anthropogenically sourced CO_2 of sufficient purity and quality as to not compromise the safety and efficiency of the reservoir to effectively contain the CO_2." In its Phase I Report, the Task Force defined CO_2 as a direct emissions stream with purity in excess of 95 percent or a processed emission stream with commercial value. However, after much discussion, this definition was modified to accommodate the evolving capture technologies and new research regarding reservoir storage capabilities. The Task Force discussed and is cognizant of the many complexities involving the transportation and injection of CO_2 of varying quality. In addition to quality requirements for transportation of CO2, ultimately it will be up to the State Regulatory Agency to decide what is and what is not suitable to long-term geologic storage.

One of the issues addressed by the Task Force was the most appropriate state regulatory entity to implement the rules and regulations. Because most of the proposed CO_2 geologic storage regulations are based on natural gas storage and oil and gas injection well rules, the Task Force reasoned that states might well conclude that the most logical and best equipped lead agency for implementing and administering regulations effectively and efficiently would be the state oil and gas regulatory agency. However, the Task Force recognizes that other states, especially those without an existing oil and gas regulatory framework, might choose to designate another regulatory agency, such as an environmental agency or public utility commission, as the lead agency for the state.

Most importantly, many states are likely to regard CO_2 as a resource for purposes of enhanced oil recovery projects and consequently will regulate CO_2 utilizing resource management frameworks and will avoid treatment of CO_2 as a waste. The Task Force reiterates a key conclusion reached in its Phase I Final Report -- although contaminants and pollutants such as H_2S, NO_x, SO_2 and other emission stream constituents should remain regulated for public health and safety and other environmental considerations, CO_2, which is generally considered safe and non-toxic and is not now classified at the federal level as a pollutant/waste/contaminant, should continue to be viewed in a manner that allows beneficial uses of CO_2 following removal from regulated emission streams. The Task Force strongly believes that treatment of geologically stored CO_2 as waste using waste disposal frameworks rather than resource management frameworks will diminish significantly the potential to meaningfully mitigate the impact of CO_2 emissions on the global climate through geologic storage.

The Task Force concluded that control of the reservoir and associated pore space used for CO_2 storage is necessary to allow for the orderly development of a storage project. The right to use reservoirs and associated pore space is considered a private property right in the United States, and must be acquired from the owner. Therefore, the Task Force concluded that control of the necessary storage rights should be required as part of the initial storage site licensing to promote orderly development and maximize utilization of the storage reservoir. In the U.S., with the exception of federal lands, the acquisition of these storage rights, which are considered property rights, generally are functions of state law. The Model General Rules and Regulations propose the required acquisition of these storage rights and contemplates use of state natural gas storage eminent domain powers or oil and gas unitization processes to gain control of the entire storage reservoir.

A major issue was how to deal with long-term monitoring and liability issues. The Task Force has proposed a two-stage Closure Period and Post-Closure Period. The Closure Period is defined as that period of time when the plugging of the injection well has been completed and continuing for a defined period of time (10 years unless otherwise designated by the State Regulatory Agency) after injection activities cease and the injection well is plugged. During this Closure Period, the operator of the storage site would be responsible to maintain an operational bond and individual well bonds. The individual well bonds would be released as the wells are plugged. At the conclusion of the Closure Period, the operational bond would be released and the liability for ensuring that the site remains a secure storage site during the Post-Closure Period would transfer to the state.

During the Post-Closure Period, the financial resources necessary for the state or a state-contracted entity to engage in future monitoring, verification, and remediation activities would be provided by a state-administered trust fund. Although other methodologies were reviewed, the Task Force concluded that the most efficient methodology to accomplish these tasks --- and which can be readily fielded --- is to utilize existing frameworks developed by the states for addressing abandoned and orphaned oil and gas wells. Consequently, the Task Force is proposing the creation of an industry-funded and state-administered trust fund as the most effective and responsive “care-taker” program to provide the necessary oversight during the Post-Closure Period. The trust fund would be funded by an injection fee assessed to the site operator and calculated on a per-ton basis, at the point of custody transfer of the CO_2 from the generator to the site operator.

Given that the state is the proposed “care taker” and responsible party during the Post-Closure Period, the Task Force did not address monitoring and related issues in the Model General Rules and Regulations because the state regulatory entity would have the authority to implement any

monitoring, verification, and remediation methods necessary to ensure the security of the storage site. In addition, there are numerous innovative methodologies that could be employed, and many future methodologies might be developed that will be available to ensure the security of the storage site. A full investigation into existing and future methods will require more detailed regulatory research into the implementation of these approaches, which was beyond the scope of this Guidance Document. However, given the availability of the state-administered trust fund model and assuming the reservoir has been adjudged by the State Regulatory Agency (SRA) to be appropriate for long-term storage, adequate resources should be available for the state entity, as care taker, to field these monitoring, verification, and remediation methods.

Finally, there has been considerable discussion at the national level regarding the proper venue for CO_2 geological storage regulation, in particular whether the U.S. EPA might be the best regulatory authority for oversight of storage. Although the UIC Program may be applicable at the discretion of a state program, the current limitations of the UIC program make it applicable only to the operational phase of the storage project. It would therefore appear that given the ownership issue and the proposed long-term "care-taker" role of the states, the states are likely to be best positioned to provide the necessary "cradle to grave" regulatory oversight of geologic storage of CO_2.

Background

The major components of greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), and ozone (O_3). These gases account for about 0.04 percent of the atmosphere. They are referred to as "greenhouse gases" because of their effect on the climate.

The "greenhouse" effect results in the capture of radiation from sunlight by preventing radiative heat from reflecting back into space. Although this greenhouse effect is critical in making our planet warm and habitable, the fact that concentrations of CO_2 are increasing yearly raises concern that it could be a primary factor in climate change, or global warming. There is growing interest both within industry and government in the possible opportunities for mitigating the release of carbon into our atmosphere, particularly through carbon capture and geologic storage (CCGS).

Reducing concentrations of anthropogenic[1] greenhouse gases can be accomplished in four basic ways: 1) through energy conservation and energy efficiency; 2) by using technologies involving renewable energy, nuclear power, hydrogen, or fossil fuels containing lower carbon content, e.g., natural gas; 3) by indirect capture of CO_2 after its release into the atmosphere utilizing the oceans or terrestrial sequestration, e.g., reforestation, agricultural practices, etc.; or 4) by carbon capture and geological storage (CCGS), whereby CO_2 is captured and stored in geologic formations through underground injection (instead of being released into the atmosphere).[2]

The thirty member states and four Canadian affiliate member provinces of the IOGCC are well suited for regulation of CO_2 storage because of their jurisdiction, experience, and expertise in the regulation of oil and natural gas production. For half a century, most of these states have been the principal regulators of enhanced oil recovery (EOR), as well as natural gas storage and acid gas disposal. They also are strategically well situated for the storage of CO_2. Regulations already exist in these petroleum-producing states covering many of the same issues that need to be addressed in the regulation of CO_2 storage, and consequently serve as adaptable frameworks for CO_2 storage. Several associate member and non-member states of the IOGCC also might be geologically suitable for CO_2 storage and might find the IOGCC Guidance Document valuable in developing a regulatory framework for CO_2 geological storage.[3]

The IOGCC Task Force on Carbon Capture and Geologic Storage (Task Force) has concluded, however, that while perhaps not necessary, it is advisable for states and provinces to enact a new regulatory framework governing storage of CO_2 in geologic structures. It is that framework which is set forth and explained in this document.

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[1] Anthropogenic is defined in this context as "of, relating to, or influenced by the impact of man on nature." *Webster's New Collegiate Dictionary* 48 (1st ed., G. & C. Merriam Company 1975).

[2] The Department of Energy's Office of Fossil Energy, on behalf of the United States government, has begun an aggressive research program in this regard through its National Energy Technology Laboratory (NETL).

[3] Some states that do not have petroleum production store natural gas and, therefore, have in place natural gas storage regulations. Thus these states, too, have regulations that at least in part cover many of the same issues that need to be addressed in the regulation of CCGS.

The framework developed relies on four analogues, which, in the opinion of the Task Force, provide the technological and regulatory basis for storage of CO_2 in geologic media: 1) naturally occurring CO_2 contained in geologic reservoirs, including natural gas reservoirs; 2) the large number of projects where CO_2 has been injected into underground formations for EOR operations; 3) storage of natural gas in geologic reservoirs; and 4) injection of acid gas (a combination of H_2S and CO_2), into underground formations, with its long history of safe operations.

It should also be noted that there exists a significant number of CO_2 EOR and acid gas injection projects in the U.S. and Canada, and, therefore, "storage" of CO_2 is already taking place. Most of this CO_2 is from natural sources, as opposed to anthropogenic or industrial sources (as would be the case with CCGS). CO_2 EOR injection and storage also has the economic benefit of increasing the production of oil. This fact makes it possible that CO_2 EOR projects could be an important vehicle in driving CCGS, at least in its early years. It also could prove the means to build both injection/storage experience, regulatory and otherwise, and provide the physical infrastructure (pipelines/facilities). Together the EOR, natural gas storage, and acid gas injection models provide a technical, economic, and regulatory pathway for long-term CO_2 storage.

However, owing to the scarcity of post-injection CO_2 EOR projects and abandoned natural gas storage fields, inadequate guidance for a long-term CO_2 storage regulatory framework exists. Consequently, a regulatory framework needs to be established to determine long-term liability and to address long-term monitoring and verification of the reservoir and mechanical integrity of wellbores penetrating formations in which CO_2 has been emplaced.

Most importantly, many states are likely to regard CO_2 as a resource for purposes of enhanced oil recovery projects and consequently will regulate CO_2 utilizing resource management frameworks and will avoid treatment of CO_2 as a waste. The Task Force reiterates a key conclusion reached in its Phase I Final Report -- although contaminants and pollutants such as H_2S, NO_x, SO_2 and other emission stream constituents should remain regulated for public health and safety and other environmental considerations, CO_2, which is generally considered safe and non-toxic and is not now classified at the federal level as a pollutant/waste/contaminant, should continue to be viewed in a manner that allows beneficial uses of CO_2 following removal from regulated emission streams. The Task Force strongly believes that treatment of geologically stored CO_2 as waste using waste disposal frameworks rather than resource management frameworks will diminish significantly the potential to meaningfully mitigate the impact of CO_2 emissions on the global climate through geologic storage.

The Task Force reiterates two recommendations contained in its Final Report of January 2005. The first is that the states and provinces actively solicit public involvement in the process as early as possible. The second is that from the outset, the process be clear and transparent. As stated previously, CO_2 is not considered a pollutant and not considered hazardous. Further, it has a long and safe history of being transported, handled, and used in a variety of applications and, thus, the public must be educated on the facts and included in an open regulatory development process.

Part 1: Analysis of Property Rights Issues Related to Underground Space Used for Geologic Storage of Carbon Dioxide

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Several legally recognized interests might exist in property where underground pore space in a particular interval or intervals is to be used for geological storage (GS). Surface owners, mineral owners, lessees of solid minerals, oil and gas lessees, and owners of non-operating interests in production all might have legal rights that could be affected by GS.[1] Because the law recognizes an ownership interest in subsurface pore space, a regulatory program that manages storage (as opposed to water protection) should include clear rules about how these rights will be recognized and protected, as well as a process for assuring that the storer secures the legal property right to store CO_2.

The Interstate Oil and Gas Compact Commission (IOGCC) Geological CO_2 Sequestration Task Force identified three working models that can provide technological and regulatory guidance for GS: (1) injection of CO_2 into underground formations for enhanced oil recovery (EOR) operations, (2) storage of natural gas in geologic reservoirs, and (3) injecting acid gas into underground formations. Legal paradigms associated with storage of natural gas in geologic reservoirs are most closely related to activities expected to occur in GS projects. This paper will discuss how various states address subsurface property rights and liabilities of parties engaged in and affected by activities involving the use of underground pore space for storage, and relate observations from various commentaries.

Case law from various states relating to natural gas storage provides an effective comparison for GS. Even though natural gas is stored for relatively short periods of time and carbon dioxide likely will be stored for very long periods of time, the storage time should not impact

[1] *See* Williams and Meyers, Oil and Gas Law Vol. 1, §222 (Matthew Bender, 2006), for identification of property interests related to storage of natural gas in geologic reservoirs.

determining who has legal interests in the structure used for storage and how a regulatory program should treat them.

Case Law Survey

In Texas, there is no clear general rule on which estate, surface or mineral, possesses ownership of the pore space for storage purposes unless the severance contract expressly specifies. The natural gas storage case law in Texas gives conflicting results because in one case, *Mapco v. Carter*, the mineral owner prevailed[2] while another case, *Emeny v. U.S.*, held in favor of the surface owner.[3] The Texas Supreme Court in *Humble Oil v. West* cited *Emeny*, but the court's holding did not rely on *Emeny*.[4]

In *Mapco*, the court held that the subsurface storage area was owned by the mineral owner, who was entitled to compensation for the use of the storage area.[5] The mineral owner had created the cavern within a salt dome for the purpose of storing natural gas.[6] The cavern walls were constructed of salt, a mineral in Texas (and specifically reserved to the mineral owner in lease documents); therefore, the mineral owner in this case had the exclusive right to the storage.[7] This decision was overruled in part by the Texas Supreme Court, but not on the matter of ownership of the storage space.[8]

In *Emeny*, the Federal Court of Claims, applying Texas law, held that the surface owners retained all property rights, except the mineral rights for oil and gas operations, and the geological subsurface pore space belonged to the surface owners for storage purposes.[9] The natural gas produced elsewhere was transported through the mineral owner's pipeline into the pore space and stored there until the gas was needed.[10] The contracted rights of the mineral owners contained in the oil and gas lease were "for the sole and only purpose of mining and operating for oil and gas and of laying pipe lines . . . to produce, save, and take care of said products."[11] The court reasoned that this language allowed the mineral owner to store gas produced only from the leased premises, not extraneous gas produced elsewhere.[12] *West* cited *Emeny*, stating the surface owner retained the pore space for storage purposes of natural gas.[13] However, ownership of the pore space was conceded to the surface estate, and *West* turned on the issue of whether the

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[2]*Mapco, Inc. v. Carter*, 808 S.W.2d 262 (Tex. App.—Beaumont 1991), *rev'd in part*, 817 S.W.2d 686 (Tex. 1991).
[3]*Emeny v. United States*, 412 F.2d 1319 (Ct. Cl. 1969).
[4]*Humble Oil & Refining Co. v. West*, 508 S.W.2d 812 (Tex. 1974).
[5]*Mapco*, 808 S.W.2d at 274.
[6]*Id.* at 264.
[7]*Id.* at 274.
[8]*Mapco, Inc. v. Carter*, 817 S.W.2d 686, 688 (Tex. 1991).
[9]*Emeny*, 412 F.2d at 1323.
[10]*Id.* at 1322.
[11]*Id.* at 1323.
[12]*Id.*
[13]*Humble Oil*, 508 S.W.2d at 815.

pore space could be used for storage purposes prior to all gas being produced from the pore space.[14]

In the current analysis, it is fair to conclude that in Texas, *Mapco* applies only when the storage space is created and comprised of a mineral. Arguably, *Mapco* is inapplicable for GS because the space will be a geological non-mineral pore space. Surface owners in Texas have a solid interest because the *Mapco* court did emphasize that the storage space was comprised of salt and not a geological pore space.[15]

Texas case law on storage ownership seems to indicate that surface owners have a stronger argument for the right to authorize the pore space for storage. However, the case law is uncertain, and the mineral owners have valid arguments that a potential purchaser of the pore space should be required to obtain their consent as well, particularly if the GS project could adversely affect mineral exploration or production. Perhaps the most important aspect of Texas law is that the question of pore space ownership is not clearly settled, highlighting the need for statutory and regulatory clarity.

In a West Virginia Supreme Court of Appeals case, *Tate v. United Fuel*, the judges held that ownership of the storage space belonged to the surface owner because the mineral exception contained in the deed to the surface owner only excepted the right to *produce* minerals.[16] (Emphasis added). The exception in the deed stated, "[t] he oil, gas and brine and all minerals, except coal underlying the surface of the land hereby conveyed are expressly excepted and reserved . . .."[17] The deed further defined and limited the term mineral as not including "clay, sand, stone, or surface minerals except such as may be necessary for the operation for the oil and gas and other minerals reserved and excepted herein."[18] The court found that limiting of the term "mineral" in the deed exception created a situation in which clay, sand, and stone for purposes other than mining and drilling operations were expressly conveyed to the surface owner.[19]

Tate can be analyzed in more ways than one concerning storage space rights. Surface owners would state that *Tate* should stand for the proposition that once the minerals are extracted and production has ceased, the underground storage space belongs to the surface. Mineral owners' response would be that because of the peculiar language in the deed that limited the general meaning of the term "mineral" the court did not issue a rule that the storage space belongs to the surface owner in every instance. The totality of the circumstances were analyzed in *Tate* and the surface owner prevailed; however, under different circumstances without the term "mineral" being limited, the court might have reached a different decision. Furthermore, it has been

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[14]*Id.*
[15]*Mapco*, 808 S.W.2d at 274.
[16]*Tate v. United Fuel Gas Co.*, 71 S.E.2d 65, 72 (W. Va. 1952).
[17]*Id.* at 67.
[18]*Id.* at 68.
[19]*Id.* at 70-71.

argued, "[a] bout as far as the *Tate* case can be stretched is to say that in West Virginia, an oil and gas owner probably lacks the power to grant storage rights."[20]

In *Ellis v. Arkansas Louisiana Gas*, an Oklahoma case, the Tenth Circuit held that in general the pore space belonged to the surface owner for gas storage purposes; however, in this particular case the mineral owner prevailed because the court found a prescriptive easement.[21] The mineral owner appealed the trial court's ruling concerning the prescriptive easement, but did not challenge the court's determination that the surface owner held the rights to the pore space.[22] Once again, an issue aside from the right to the storage space prevents a general rule being derived. One could assume that had there not been a prescriptive easement, the surface owner would have prevailed.

In *U.S. v. 43.42 Acres of Land*, applying Louisiana law, the court held that after the extraction of minerals, the storage space that remained belonged to the surface owner, and the mineral owner had no claim for compensation.[23] Compensation for the value of the storage space taken by eminent domain is not necessarily determined by the right to produce and mine the minerals.[24] The court further added that regardless of a state's ownership or non-ownership policy pertaining to mineral rights, in no instance should the mineral owner be found to have ownership of the pore space for storage purposes.[25] This decision is important because it involved who was owed compensation for the taking of the storage space, which tells us who under the law had the right to authorize the storage of natural gas. The court seemed clear that in Louisiana the surface owner had the prevailing interest in the storage space in all facets.

In *Department of Transportation v. Goike*, the Michigan Court of Appeals held that the storage space left after the minerals had been excavated belonged to the surface owner.[26] The court reasoned that a mineral owner possesses a right solely to the minerals, not to the other property surrounding the minerals.[27] However, the court made it clear that when native oil or gas remains in the pore space, the mineral owner may preclude the surface owner from using the storage space as "[o]only the surface owner . . . possesses the right to use the cavern for storage of foreign minerals or gas, and then only after [the mineral owners] have extracted the native gas from the cavern."[28] As long as there is no debate whether native gas remains in the pore space, it appears that the approach in Michigan would be to grant the right to authorize storage to the surface owner.

In *Central Kentucky Natural Gas v. Smallwood*, the Kentucky Court of Appeals held that rentals from a storage space must be paid to the mineral owner.[29] The justices added that to reach their

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[20] Williams & Meyers, 1 Oil & Gas Law § 222 (Matthew Bender 2006) (citing Holland, "Underground Storage of Natural Gas: A Legal Overview," 3 Eastern Min. L. Inst. 19 – 1 at 19 – 13 (1982).
[21] *Ellis v. Ark. La. Gas Co.*, 609 F.2d 436, 439 (10th Cir. 1979).
[22] *Id.* at 439.
[23] *United States v. 43.42 Acres of Land*, 520 F.Supp. 1042, 1045 (W.D. La. 1981).
[24] *Id.* at 1044.
[25] *Id.* at 1046.
[26] *Dep't of Transp. v. Goike*, 560 N.W.2d 365, 366 (Mich. Ct. App. 1996).
[27] *Id.* at 365-66.
[28] *Id.* at 366.
[29] *Cent. Ky. Natural Gas Co. v. Smallwood*, 252 S.W.2d 866, 868 (Ky. Ct. App. 1952).

decision clarification was not needed on whether ownership of the pore space belonged to the mineral or surface owner.[30] The court cited the English Rule, which provides that the mineral owner possesses the exclusive right of production as well as the exclusive right to the storage space left after production has ceased.[31] This case was overturned, but only concerning the issue of the stored gas being personal property, and not on the issues of ownership of the pore space or the rentals accruing from the pore space.[32] In opposition to the court's view, surface owners would argue that *Smallwood* was overturned and should not be influential even though it was overturned on grounds not related to pore space ownership.[33] Furthermore, *Smallwood* seems to employ the English rule in regard to ownership and surface owners would argue that the English rule should not be adopted in their jurisdiction, wherever that may be.[34]

While not found in case law, a recent state report from New Mexico provides that deep aquifers would belong to the surface owner for the right to use and authorize them for storage purposes, even though by statute the water in the aquifer is deemed within the public domain.[35] New Mexico's policy towards ownership of pore space is somewhat ambiguous because the state and public entities have the right to use aquifer storage to recharge the aquifer, but the report states that use for other purposes may require compensation. [36] The New Mexico paper indicates that New Mexico would side with the theory that "the subsurface geologic structures – including the pore space as distinct from the mineral estate – belong to the surface property owner . . .."[37]

Commentary

Commentators have varied perspectives on whether the surface or mineral owner should have title to the pore space for gas storage purposes. Elizabeth Wilson and Mark de Figueiredo note that while surface owners in most states prevail in pore space ownership of stored natural gas situations, mineral owners have valid interest as well and it would be prudent for a potential purchaser to secure the rights from both estates.[38] While the commentators' suggestion may be unsatisfactory to potential purchasers who prefer not obtaining consent from both the mineral owner and the surface owner, as well as paying just compensation to both estates, this approach may be highly beneficial in that a potential purchaser will clearly know who to contact and pay to secure the storage space rights without the fear of litigation.

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[30] *Id.* at 868.
[31] *Id.*
[32] *Tex. Am. Energy Corp. v. Citizens Fid. Bank & Trust Co.*, 736 S.W.2d 25, 28 (Ky. 1987).
[33] *Id.*
[34] *Smallwood*, 252 S.W.2d at 868.
[35] *Carbon Dioxide Sequestration: Interim Report on Identified Statutory & Regulatory Issues*, New Mexico Energy, Minerals, Natural Resources Dep't, Oil Conservation Division, pp. 12-13 (June 27, 2007).
[36] *Id.* at 12 – 13.
[37] *Id.* at 10.
[38] Elizabeth J. Wilson & Mark A. de Figueirdo, Geologic Carbon Dioxide Sequestration: An Analysis of Subsurface Property Law, 36 ELR 10114, 21 (2006).

Williams & Meyers suggest four different conclusions regarding subsurface storage of gas.[39]

First, the mineral owner should be granted the exclusive right to the storage space "for all purposes relating to minerals, whether 'native' or 'injected', absent contrary language in the instrument severing such minerals."[40] Under this view, the surface owner should not have any rights or be owed any compensation concerning the pore space unless some use of the surface is needed for the storage,[41] which might be a reasonable approach when the subject is a mineral such as natural gas, but not so reasonable for GS.

Second, the owners of non-operating interests in the production of minerals should not be compensated and their consent should not be needed if the pore space no longer contains minerals; i.e., if the pore space is empty and using the space for storage as the next logical step, then those owners have no interest in the space.[42]

Third, the operating rights owner should not be compensated and consent should not be needed for the right to store natural gas unless the operating rights owner will be negatively impacted by the injection of natural gas.[43]

Finally, the consent of the mineral owner should be required regardless of whether the pore space still contains oil and gas.[44]

Through their conclusions, it appears that Williams & Meyers strongly believe that the dominant interest in the storage space belongs to the mineral owner, not the surface owner. Extrapolating their view, the mineral owner's rights must be secured in every situation where a potential purchaser seeks to acquire the storage space, whereas the surface owner's rights need not be secured unless the use of the surface is required.

Subsurface Trespass

Subsurface Trespass cases offer an indication of how the law treats ownership interests in underground pore space. Based on case law, subsurface trespass is probably a cause of action, and adjacent property owners may be able to prevail if they can demonstrate reasonable and foreseeable damages caused by unauthorized use of their pore space. An analysis comparing secondary oil and gas recovery and hazardous waste case law to the storage of carbon dioxide will be undertaken to help develop reasonable policy for property rights affected by GS.

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[39] Williams & Meyers, 1 Oil & Gas Law § 222 at 334.
[40] *Id.* at 335.
[41] *Id.* at 334.
[42] *Id.* at 336-337.
[43] *Id.* at 337.
[44] *Id.* at 338.

Trespass by EOR

In Texas, a cause of action for damages probably exists for subsurface trespass attributable to secondary recovery operations; however, the issue of subsurface trespass is far from certain because the case law is on both sides of the trespass debate. In *Railroad Commission of Texas v. Manziel*, the Texas Supreme Court held that a permit from the Texas Railroad Commission for oil and gas recovery precludes a trespass cause of action seeking injunctive relief.[45] The issue in *Manziel* was whether the water from the secondary recovery projects would constitute trespassing when it crossed ownership lines.[46] The court announced the "negative rule of capture" whereby "[j]ust as under the rule of capture a land owner may capture such oil and gas as will migrate from adjoining premises . . . so also may [a landowner] inject into a formation substances which may migrate through the structure to the land of others . . . ."[47] In conclusion, the court found that trespass was not a cause of action when the state regulatory body permitted the injection project. The court was without power to issue an injunction sought by the adjacent property owner.[48]

In *Mission Resources v. Garza Energy Trust*, the Corpus Christi Court of Appeals found that Texas recognizes a cause of action for subsurface trespassing for secondary recovery fracture treatment.[49] The court declined to settle the conflict between two previous cases in which one held subsurface trespass by fracture treatment was a cause of action, and the other held there was no cause of action.[50] The decision in *Garza Energy Trust* was appealed and thereafter the Texas Supreme Court granted review. The appellate court's holding was somewhat narrow in that it was not a blanket acceptance of a cause of action for subsurface trespass but limited the cause of action allowed to subsurface trespass for fracture treatment.[51]

The implication of these cases for carbon dioxide storage is debatable. Whether a court would find the storage of carbon dioxide to be a public necessity where adjacent property owners' rights are trumped by the importance of carbon sequestration is uncertain. On the one hand, the storage of carbon dioxide may lower greenhouse gas pollution, but on the other it is questionable whether the potential benefit of lowered greenhouse gas is more important than the property rights of the adjacent property owners. Secondary recovery methods are producing fungible resources in the form of oil and gas whereas the storage of carbon dioxide will not yield fungible resources. Both *Manziel* and *Garza Energy Trust* seem to key on the importance of secondary recovery of oil and gas, and the arguments why a trespass cause of action should not be actionable is based on fungible resources being produced. A regulatory program for GS should include a declaration that the activity is of high public importance.

Trespass by Hazardous Waste Injection

Hazardous waste case law seems to permit a cause of action for subsurface trespass. The Ohio Supreme Court in *Chance v. BP Chemicals* held that regardless of the fact that the defendant was

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[45]*R.R. Comm'n of Tex. v. Manziel*, 361 S.W.2d 560, 568 (Tex. 1962).
[46]*Id.* at 567.
[47]*Id.* at 568.
[48]*Id.*
[49]*Mission Res., Inc. v. Garza Energy Trust*, 166 S.W.3d 301, 310 (Tex. App.—Corpus Christi 2005, review granted.
[50]*Id.* at 310-11.
[51]*Garza Energy Trust*, 166 S.W.3d at 310-11.

operating under a valid permit, trespass as a cause of action is not precluded.[52] Even though ultimately the adjacent property owners lost the suit due to not meeting their burden of proof in proving that trespass had indeed occurred, the court allowed the cause of action.[53]

In *Mongrue v. Monsanto Co.* the Fifth Court of Appeals found that subsurface trespass was a valid cause of action, and stated that a valid permit "does not necessarily bar claims of trespass when authorizing the disposal of waste through injection wells."[54] Subsurface trespass as a cause of action was not a primary issue for the court due to the trespassing claim being dropped,[55] but the court briefly addressed the issue anyway,[56] which might illustrate that the justices wanted to clarify whether there was a cause of action for subsurface trespass. Even though in both cases the party bringing the trespass action did not ultimately prevail for various reasons, subsurface trespass was allowed as a cause of action, which further highlights the law's recognition of property rights in subsurface pore space.

These cases also raise a couple of principles applicable to GS: Plaintiffs in both cases were surface owners, and it was difficult for the plaintiffs to prove they had suffered damages because they could not show that they actually used the subsurface and that the use had been compromised. The inability to show damages played a larger role in the outcome of these subsurface trespass situations cases than whether a cause of action existed in the first place. The law recognized the ownership right in the subsurface, but the plaintiff was not able to show an intended use was compromised or damaged. GS will be a new legitimate use of the subsurface.

Conclusion

The law recognizes an ownership interest in subsurface pore space. Therefore, a regulatory program that manages storage (as opposed to water protection) should include clear rules about how these rights will be recognized and protected as well as a process for assuring that the legal property right to store CO_2 is secured. Based on the foregoing review of subsurface property law, GS statutes and rules would best serve the public by clearly declaring that GS is an important activity for the public interest, clearly identifying the surface owner as the person with the right to lease pore space for storage, while protecting other stakeholders from potential damage attributable to sequestration activities.

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[52] *Chance v. BP Chemicals, Inc.*, 670 N.E.2d 985 (Ohio 1996).
[53] *Id.* at 991.
[54] *Mongrue v. Monsanto Co.*, 249 F.3d 422, 433 n. 17 (5th Cir. 2001).
[55] *Id.* at 425.
[56] *Id.* at 433 n. 17.

Part 2: Overview and Explanation of the Model General Rules and Regulations

Regulations Overview

Overview and Explanation of the Model General Rules and Regulations

The Interstate Oil and Gas Compact Commission's Task Force on Carbon Capture and Geologic Storage has prepared this guidance document. Much of the work has been accomplished by the Task Force's Model Regulations Working Group. The Task Force began its work June 28-30, 2006, in Dallas, Texas, at which time the tasks and responsibilities of the Model Regulations Working Group were defined. The group held three meetings: a kick-off meeting on September 5-8, 2006, in St. Louis, Missouri; a mid-point meeting on October 18, 2006, in Austin, Texas; and a joint wrap-up meeting with the entire Task Force on May 5, 2007, in Point Clear, Alabama.

The guidance document is being prepared for IOGCC member states, including its affiliate member provinces. Although references throughout this document are, for the most part, to "state" or "states", it is the intent of the Task Force that the comments and provisions are equally applicable to Canadian provinces. Specific notation of this is made in both the Model Rules and Regulations and Model Statute attached. Additionally, in Canada, protection of both groundwater resources and deep injection fall entirely within provincial jurisdiction, and there is no federal equivalent of the U.S. Safe Drinking Water Act and the UIC program. Accordingly, regulations may vary from province to province, but their essence is the same and comparable with the U.S. regulations.

This overview section is followed by an appendix consisting of three parts. Appendix I provides a draft model statute for the Geologic Storage of Carbon Dioxide. It contains legislative language necessary to enable a State Regulatory Agency to implement the draft model rules and regulations. Appendix II contains the draft model rules and regulations for geologic CO_2 storage. Taken together, Appendices I and II are the principal deliverable work products of the Task Force. Appendix III contains background material on the "Analysis of the Ownership of Storage Rights Relating to the Storage of CO_2 in Geologic Structures".

The following provides an overview, explanation, and rational for the various sections in Appendix II (Model Rules and Regulations).

Section 1.0. Applicability

The Task Force discussed the applicability of these rules and regulations relative to CO_2 injection in enhanced oil recovery (EOR) projects, as well as to CO_2 injection for storage in non-EOR applications, such as storage in depleted oil and gas reservoirs, deep saline formations, and coal seams. The Task Force does not intend for these rules and regulations to apply to EOR

projects during their normal working life except to the extent an EOR project operator may propose to also permit the EOR project as a CO_2 storage project simultaneously. The Task Force assumed that this conversion generally would occur at the end of the normal operating life of an EOR project. An operator desiring that an EOR project be simultaneously used or converted for CO_2 storage only could submit that project for approval under this program.

Although the potential of developing different sets of rules and regulations to deal with ongoing or former EOR and non-EOR geologic projects was discussed, the Task Force concluded that the similarities were greater than the differences. Consequently, one set of rules and regulations was written to accommodate both scenarios and, thus, these rules and regulations are designed to have general applicability.

The Task Force in its Phase I Final Report did not address the regulatory issues involving CO_2 emissions trading and accreditation for purposes of securing carbon credits. However, the Task Force strongly believes that development of future CO_2 emissions trading and accreditation regulatory frameworks should utilize the experiences of the states and provinces outlined in the Phase I report. Subsequent deliberations of this issue by the Task Force in this current phase (Phase II) concluded that the proposed Model Rules and Regulations should primarily address the regulatory issues related to public health and safety and environmental protections associated with the geologic storage of CO_2. The Task Force believes that the issue of CO_2 emission trading and accreditation might best be addressed either in the marketplace and/or at the federal government level. The Task Force believes that the development and implementation of the necessary economic frameworks to provide for CO_2 emissions trading and accreditation is beyond its scope.

The Task Force also recognizes that even in advance of state adoption of these model rules, it may be necessary to permit and operate experimental and demonstration CO_2 sequestration projects. States are encouraged to advance those projects under existing authority rather than to delay them to await adoption of this program.

Section 2.0. Definitions

The Task Force has provided definitions for many of the terms used throughout the model rules and regulations. The reader should note that several new terms were developed to clearly define the various aspects and stages of a CO_2 storage project. These terms, such as Geological Storage Unit (GSU), CO_2 Storage Project (CSP), and CO_2 Facility (CF), are used extensively throughout the model rules and regulations. Familiarity with these and other definitions will assist the reader in reviewing and applying the model rules and regulations.

"CO_2" is defined in the Model Rules and Regulations. Although the Task Force in its Phase I Report defined CO_2 as a direct emissions stream with purity in excess of 95 percent or a processed emission stream with commercial value, after much discussion this definition was modified to accommodate the evolving capture technologies and new research regarding reservoir storage capabilities. In addition, the Task Force clarified in its definition of "CO_2" that the Model Rules and Regulations only addressed anthropogenically sourced CO_2, which is produced as a byproduct of combustion in the industrial process (including CO_2 generated from oil and gas production and processing operations) and not non-hydrocarbon associated geologically occurring CO_2. The Task Force discussed and is cognizant of the many complexities involving the transportation and injection of CO_2 of varying quality. In addition to

quality requirements for transportation of CO_2, ultimately it will be up to the State Regulatory Agency to decide what is and what is not suitable to long-term geologic storage.

For this report and in the Model Rules and Regulations, the state regulatory agency is referred by the acronym SRA. The Task Force discussed the most appropriate state regulatory entity to implement the rules and regulations, but ultimately each state will have to make its own decision in this regard. Because the analogs for the majority of the proposed regulations are based on natural gas storage and oil and gas injection well rules, states might well conclude that the most logical and best equipped lead agency for implementing and administering regulations in an effective and efficient fashion would be the state oil and gas regulatory agency. However, other states, especially those without an existing oil and gas regulatory framework, might choose to designate another regulatory agency, such as an environmental agency or public utility commission, as the lead agency for the state.

Section 3.0. General Requirements

The Task Force discussed the necessity for state regulatory personnel to have full authority to enter and inspect a CO_2 project facility for compliance with the proposed model rules and regulations. This authority is generally granted to oil and gas regulatory agencies with respect to oil and gas operations and sites. However, as noted, a state may designate a non-oil and gas regulatory agency the responsibility for administering the proposed model rules and regulations. Therefore, the authority to gain access for inspection purposes has been included in the model rules and regulations.

The Task Force also discussed the potential problems that could be encountered in the transfer of ownership of a CO_2 project. The proposed regulations seek to ensure that transfers of ownership encompass all operational liabilities, including transfer of required financial assurances to the state. Further, it is required that the new owner meets all requirements established by the designated state regulatory agency as a qualified CO_2 storage facility permit holder.

Section 4.0. CO_2 Storage Project (CSP) Permit

The Task Force recognizes that a reservoir intended for storage of CO_2 might require the consolidation of all the participating interests in the reservoir before a permit to operate the storage project is issued. The Task Force further recognizes the need for the designated state agency to have the authority to require compulsory joining of all participating interests in the reservoir and such of the surface property necessary for project requirements if the state determines the consolidation of the unit is feasible, necessary, and justifiable under all conditions affecting the unit. These model rules and regulations specify the actions the project applicant may exercise to acquire the rights and interests necessary to operate a CO_2 storage project. Care should be exercised to ensure selection of an appropriate choice of law provision. This typically would involve application of unitization laws to oil and gas reservoirs and eminent domain laws to non-oil and gas producing reservoirs, such as deep saline formations, which would mirror more closely natural gas storage ownership rights. Unitization applies to mineral property rights with respect to oil and gas production covered by an oil and gas lease wherein natural gas storage rights historically have been the property right of the surface owner and therefore subject to eminent domain proceedings. Consequently, the issue arises as to what would happen when an oil and gas EOR project operating under an oil and gas lease terminates and converts to a CO_2 storage project. This issue needs further study to determine whether the ownership rights also

shift to the surface owner and how that potential shift would impact the ability of the EOR project operator to deal seamlessly with the transition from an EOR project to a CO_2 storage project.

The Task Force discussed the need for the designated State Regulatory Agency to have the appropriate permitting authority to require an operator to submit any data necessary to evaluate a proposed CO_2 storage project. The authority should give SRA the ability to require an operator to provide detailed data that, in the judgment of SRA, are pertinent and necessary for the evaluation of a proposed CO_2 storage project. For SRA to perform the evaluation, it is incumbent upon the applicant to submit adequate engineering and geological data along with a CO_2 injection plan that includes a description of mechanisms of geologic confinement, with regard to the ability of that confinement to prevent migration of CO_2 beyond the proposed storage reservoir. This information will be used in conjunction with geological and engineering data and well records that it might have on file to make the necessary evaluation.

The Task Force included within this section a requirement for a public health and safety and emergency response plan, worker safety plan, corrosion monitoring and prevention plan, and a facility and storage reservoir leak detection and monitoring plan. The Task Force engaged in a comprehensive discussion regarding the required level for measurement, monitoring and verification (MMV) of injected CO_2 and its containment within the storage reservoir. While the Task Force recognizes the importance of maintaining containment integrity, given the uncertainties and changing technologies of surface monitoring techniques --- which are the subject of much current research --- the Task Force concluded that monitoring and verification would be accomplished best in the subsurface. Therefore, the Model Rules and Regulations focus primarily on subsurface monitoring of the geologic storage reservoir and overlying formations through the use of observation wells. The Task Force believes that early leak detection in the subsurface of any CO_2 would be the best mechanism to protect public health and safety and the environment and offer sufficient time to address the cause of that leakage. As an example, early detection in the subsurface would allow for the drilling of wells to remediate leakage by producing or capturing leaked CO_2 and re-injecting that CO_2 back into storage. Rather than being overly prescriptive, the Task Force is recommending that the Model Rules and Regulations require the operator to submit a comprehensive monitoring plan for evaluation by SRA that shall be tailored to the specific characteristics of the site prior to issuance of a project permit.

Also included is the requirement for a performance bond that would sufficiently cover well plugging and abandonment, CO_2 injection and/or subsurface observation well remediation, and bond release. The Model Rules and Regulations utilize industry standard methodologies currently employed in regulated activities such as coal mining (regulated under SMCRA) and highway construction to calculate bond amounts. It should be noted that the bond release requirement in this section releases the CO_2 storage operator and generator from future SRA regulatory liability by providing a mechanism for transfer of that liability to the state.

The mechanism for transfer of the long-term liability relating to monitoring and caretaking responsibilities is provided through the creation of a state-administered trust fund. It is proposed that the trust fund be capitalized by a tax or fee paid by the CO_2 storage project operator on a per-ton-of-injected-CO_2 basis. The per-ton cost is yet to be determined. The tax or fee would be deposited in the trust fund and would need to be sufficient to cover the costs related to long-term monitoring, verification, remediation, and capture of CO_2 should any CO_2 escape from the storage reservoir. The Task Force determined that if no trust fund is established to clearly address future liability, the operators would be required to retain the long-term liability, similar

to hazardous waste law requirements, which most likely would have such onerous implications that it could inhibit CO_2 storage projects from occurring.

This section of the Model Rules and Regulations also briefly describes the requirements that must be met to amend an existing permit whenever the CO_2 project operator wishes to enlarge the original areal extent, add other reservoirs, increase the permitted storage reservoir volume, and/or any other significant changes.

Section 5.0. Amalgamation of Rights to Operate GSU

The Task Force concluded, as discussed in Part 3 of this report, that the control of the GSU and associated pore space used for CO_2 storage, is necessary to allow for the orderly development of a CSP. The right to use reservoirs and associated pore space is considered a private property right in the United States, and must be acquired from the owner of those rights. These subsurface rights are treated differently in the enhanced oil recovery and natural gas storage projects used as analogies in this report. This situation might be different in Canada.

In the case of natural gas storage in the United States, the owner of the land surface often holds the underground storage rights. The right to store (storage rights) natural gas in underground reservoirs must be acquired by the operator of a storage project prior to receiving a state permit to operate an underground natural gas storage project. If these rights can not be acquired voluntarily, the operator can request that the state use eminent domain powers to acquire those properties and the associated storage rights necessary for orderly development and operation of the natural gas storage project.

In the case of CO_2 enhanced oil recovery projects, the right to inject CO_2 into the subsurface oil reservoir generally is contained in and part of the oil and gas leasethat would have been obtained to develop the project. During the operation of a CO_2 enhanced oil recovery project (EOR), a certain amount of the injected CO_2 remains in the oil reservoir, and should be considered stored CO_2. Consequently, the right to use an oil reservoir for the associated storage of CO_2 during the operational phase of a CO_2 EOR project would be permissible under an oil and gas lease. However, at the conclusion of a CO_2 EOR project when active oil production ceases and the remaining reservoir capacity is used for CO_2 injection for the purpose of long-term storage, the extension of the underlying oil and gas lease granting this authority has not been clearly enumerated in existing law or in associated case law. It's possible that at the time CO_2 EOR ceases and storage begins, the subsurface rights necessary for storage might need to be acquired, if they had not already been acquired at the beginning of the project. In addition, the potential also could exist that the final CO_2 storage phase of a CO_2 EOR project might not necessarily end further oil production. A long-term CO_2 "soaking" phase could be contemplated, followed by reactivation of another phase of oil production, before the final storage of CO_2 in the reservoir is initiated. This "soaking" phase might be covered by the initial oil and gas lease; however, the necessary storage rights eventually will need to be acquired as part of the final storage phase.

The Task Force concluded that control of the necessary storage rights should be required as part of the initial GSU site licensing to promote orderly development and maximize utilization of the GSU. In the U.S., with the exception of federal lands, the acquisition of these storage rights, which are considered property rights, generally are functions of state law. The Model Rules and Regulations propose the required acquisition of these storage rights and contemplate use of state natural gas eminent domain powers or oil and gas unitization processes to gain control of the entire GSU. The situation might be different in Canada.

If the proposed CSP Operator is unable to acquire the necessary subsurface rights covering the entire proposed GSU, the CSP Operator could elect to use the authority granted by this program to gain control of the GSU. Although the authority which allows the CSP Operator to gain control of the GSU is a state power, the process of eminent domain or unitization might reside in a state agency not involved with the initial site licensing process, resulting in two simultaneous processes. The Model Rules and Regulations contemplate these regulatory processes occurring at the same time, and with respect to the public hearing required in each of the processes (eminent domain and site licensing) and given that the required public hearings could occur in multiple agencies, the Task Force recommends that the regulatory agencies combine the hearings to facilitate an efficient and streamlined process. In addition, the state regulatory agencies involved with the hearings will need to determine who has standing at the hearing; such as whether only affected property owners have standing to object (which would be in the case of an eminent domain or unitization hearing) or if non-property ownership interests also have standing to object during the permit licensing phase of a consolidated hearing. To streamline the hearing process, these agencies should contemplate determining what would constitute grounds for a legitimate objection.

The Task Force recognizes that a state might develop alternative mechanisms to acquire property rights. Possibilities include the development of a unitization process to address subsurface interests while using eminent domain process for surface interests. The Task Force is less concerned about what mechanism is used and more concerned that all necessary property rights be acquired by valid, subsisting and applicable state law.

Section 6.0. CSP Well Permits

These Model Rules and Regulations specify the procedures for permitting and operating CSP wells to safeguard life, health, property, and the environment. The regulations specify design standards to ensure that injection wells are constructed to prevent the migration of CO_2 into other than the intended injection zone. Design standards include requirements for the placement of sealing materials within the annular space between well casing and the borehole to ensure fluids do not migrate vertically; installation of tubing and packer and wellhead components; mechanical integrity testing of the casing; and the witnessing and verification of mechanical integrity testing by SRA.

The regulations in this section also detail the well permit amendment process to ensure any modifications or changes to well operations, such as a change in storage zone or a change in injection rates and pressures, remain in compliance with permit conditions.

Section 7.0. CO_2 Storage Project Operational Standards

This section details the operational standards and requirements with which CO_2 storage project operators must comply in implementing the approved safety, corrosion monitoring and prevention, leak detection, and reporting programs approved in the permit issued by SRA.

Section 8.0. Reporting Requirements

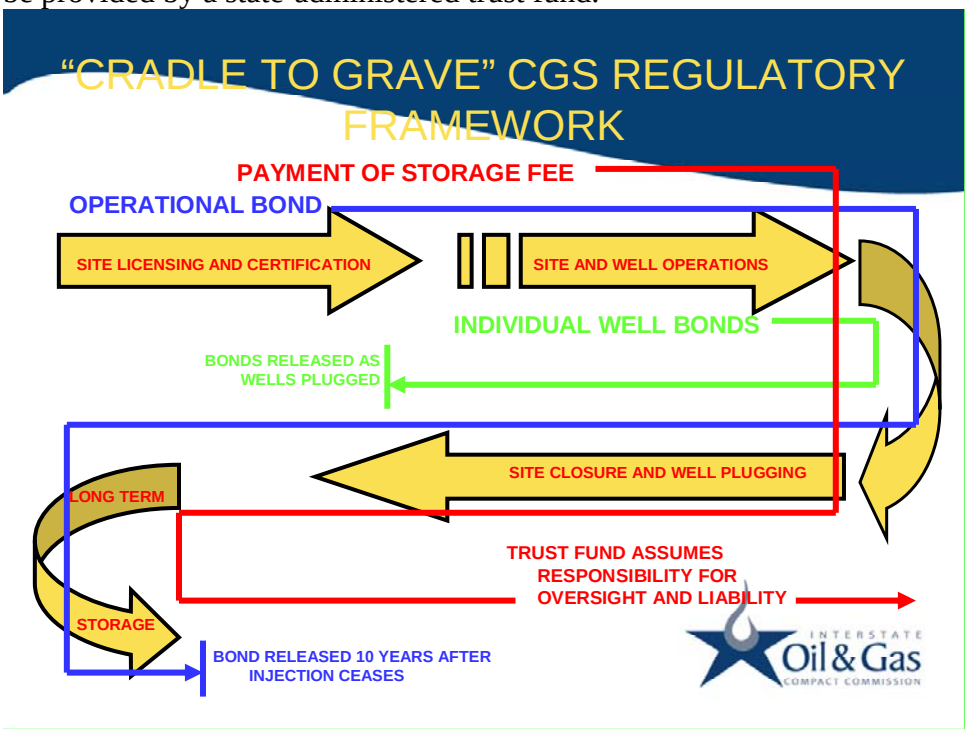
This section of the regulations specifies the reporting requirements that serve to demonstrate and document that CO_2 storage projects and associated wells are operated in accordance with all

approved operating parameters and procedures, including limitations on injection pressures and temperatures; prescribed chemical constituents and composition of the CO_2; status and projections of storage response and capacity; monitoring of corrosion and corrosion prevention plans and/or all other operating parameters and procedures as specified in the CO_2 project permit issued by SRA. Quarterly and annual reports are required.

Section 9.0 CSP Closure

Closure is proposed to be divided into a Closure Period and Post-Closure Period. The Closure Period is defined as that period of time when the plugging of the injection wells (excluding wells to be used as observation wells as agreed upon between the CSP Operator and the SRA) is completed and continuing until a future date is reached, defined as some period of time (10 or 29 years, etc.) after injection activities and the injections wells are plugged. During this Closure Period, the operator of the CSP would be the responsible party and be required to maintain the CSP operational bond and individual or blanket well bonds specified in Section 4. The individual well bonds will be released as the wells are plugged. At the conclusion of the Closure Period, the operational bond would be released and the liability for ensuring that the CSP remains a secure storage site during the Post-Closure Period would transfer to the state.

During the Post-Closure Period the financial resources necessary for the state or a state-contracted entity to engage in future monitoring, verification, and remediation activities would be provided by a state-administered trust fund.



The Task Force also reviewed other methodologies of Post-Closure monitoring, verification, remediation, and liability, including:
(1) The Texas FutureGen model: a legislative assumption of liability by the state with no funding mechanism (which at this time only applies to the single FutureGen prototype plant);

(2) A governmental insurance fund along the lines of the federal flood insurance program;
(3) A private insurance program funded through premiums;
(4) The Price-Anderson Act analog, which would protect the liability of the CSP operator and the CO_2 generators;
(5) The Federal Superfund model under CERCLA;
(6) The Federal Oil Pollution Act of 1990 Model;
(7) Acquisition by the state of the storage rights through private purchase of the storage rights from private owners;
(8) The Resource Conservation and Recovery Act (RCRA)[1] model where the generators of the CO_2 would be the responsible party.

Although other methodologies were reviewed, the Task Force concluded that the most efficient methodology to accomplish these tasks --- and which can be readily fielded --- is to utilize existing frameworks developed by the states for addressing abandoned and orphaned oil and gas wells. The Task Force is proposing the creation of an industry-funded and state-administered trust fund as the most effective and responsive "care-taker" program to provide the necessary oversight during the Post-Closure Period. The trust fund would be funded by an injection fee assessed to the CSP Operator and calculated on a per ton basis, at the point of custody transfer of the CO_2 from the generator to the CSP Operator.

Given the state is the proposed "care taker" entity and responsible party during the Post-Closure Period, the Task Force did not propose Model Rules and Regulations because the state regulatory entity would have the authority to implement any monitoring, verification, and remediation methods necessary to ensure the security of the CSP. In addition, there are numerous innovative methodologies that could be employed, and many future methodologies might be developed that will be available to ensure the security of the CSP. A full investigation into existing and future methods will require more detailed regulatory research into the implementation of these approaches, which was beyond the scope of this guidance document. However, given the availability of the state-administered trust fund model and assuming the reservoir has been adjudged by the State Regulatory Agency (SRA) to be appropriate for long-term storage, adequate resources should be available for the state entity, as care taker, to field these monitoring, verification, and remediation methods. No model regulations were proposed, but following is a list of items the state entity should consider in an ongoing monitoring program during the Post-Closure Period:
(1) Measurement of pressure and fluid samples from observation wells;
(2) Seismic mapping of plume location and movement;
(3) Drilling of additional monitoring wells;
(4) Updating of simulation models that predict CO_2 volume placement and movement;
(5) Installation and monitoring of potential surface monitoring instrumentation;
(6) Ongoing monitoring of human activity to ensure public awareness during construction activities in the area of the CSP;
(7) Monitoring of biological indicators; and
(8) Maintaining adequate records regarding the location and performance of the CSP for state, public and industry use.

[1] 42 U.S.C. §§ 6901 et seq. (1976).

Appendices

Appendix I: Model Statute for Geologic Storage of Carbon Dioxide

Model Statute [1]

GEOLOGIC STORAGE OF CARBON DIOXIDE

Section 1. Legislative declaration; jurisdiction. [2]

(a) The Legislature of the State of _____ declares that (1) the geologic storage of carbon dioxide will benefit the citizens of the state and the state's environment by reducing greenhouse gas emissions; (2) carbon dioxide is a valuable commodity to the citizens of the state; and (3) geologic storage of carbon dioxide gas may allow for the orderly withdrawal as appropriate or necessary, thereby allowing carbon dioxide to be available for commercial, industrial, or other uses, including the use of carbon dioxide for enhanced recovery of oil and gas (EOR).

(b) The State Regulatory Agency shall have the jurisdiction and authority over all persons and property necessary to administer and enforce effectively the provisions of this article concerning the geologic storage of carbon dioxide. In exercising such jurisdiction and authority granted to it, the State Regulatory Agency may conduct hearings and promulgate and enforce rules, regulations, and orders concerning geologic storage of carbon dioxide.

Section 2. Definitions.

(a) ***Carbon dioxide.*** Anthropogenically sourced carbon dioxide of sufficient purity and quality as to not compromise the safety and efficiency of the reservoir to effectively contain the carbon dioxide.

(b) ***Oil or gas.*** Oil, natural gas, or gas condensate.

(c) ***Reservoir.*** Any subsurface sedimentary stratum, formation, aquifer, or cavity or void (whether natural or artificially created) including oil and gas reservoirs, saline formations and coal seams, suitable for or capable of being made suitable for the injection and storage of carbon dioxide therein.

(d) ***Storage facility.*** The underground reservoir, underground equipment, and surface buildings and equipment utilized in the storage operation, excluding pipelines used to transport the carbon dioxide from one or more capture facilities to the storage and injection site. The underground reservoir component of the storage facility includes any necessary and reasonable areal buffer and subsurface monitoring zones designated by the State Regulatory Agency for the purpose of ensuring the safe and efficient operation of the storage facility for the storage of carbon dioxide and shall be chosen to protect against pollution, invasion, and escape or migration of carbon dioxide.

(e) ***Storage operator.*** Any person, corporation, partnership, limited liability company, or other entity authorized by the State Regulatory Agency to operate a storage facility.

(f) ***Geologic storage.*** Permanent or short-term underground storage of carbon dioxide in a reservoir.

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[1] Canadian provinces should replace "state" with "province" as appropriate.

[2] The purpose of this section is to make clear that the primary goal is to permanently store carbon dioxide to mitigate its impact on global climate change; however, given the commodity status of carbon dioxide, under certain circumstances states need statutory authority to regulate withdrawal of previously stored carbon dioxide for EOR and other uses that do not involve release to the atmosphere.

Section 3. State Regulatory Agency approval; recordation or order, certificate of operation of storage facility.

(a) The use of a reservoir as a storage facility for carbon dioxide is hereby authorized, provided that the State Regulatory Agency shall first enter an order, after public notice and hearing, approving such proposed geologic storage of carbon dioxide and designating the horizontal and vertical boundaries of the geologic storage facility. In order to establish a storage facility for carbon dioxide, the State Regulatory Agency shall find as follows:

(1) That the storage facility and reservoir are suitable and feasible for the injection and storage of carbon dioxide;

(2) That a good faith effort has been made to obtain the consent of a majority of the owners having property interests affected by the storage facility and that the operator intends to acquire any remaining interest by eminent domain or otherwise allowed by statute;

(3) That the use of the storage facility for the geologic storage of carbon dioxide will not contaminate other formations containing fresh water or oil, gas, coal, or other commercial mineral deposits; and

(4) That the proposed storage will not unduly endanger human health and the environment and is in the public interest.

(b) Upon the State Regulatory Agency's issuance of an order of approval as set forth above, said order, or a certified copy thereof, shall be filed for record in the probate court [or other appropriate entity of jurisdiction where land records are filed] of the county or counties in which the storage facility is to be located.

(c) Prior to commencing injection of carbon dioxide, the storage operator shall record in the county or counties in which the storage facility is located, and with the State Regulatory Agency, a certificate, entitled "Certificate of Operation of Storage Facility," which shall contain a statement that the storage operator has acquired by eminent domain or otherwise all necessary ownership rights with respect to the storage facility, and the date upon which the storage facility shall be effective.

(d) If any depleted pool for any previously established field(s) or producing unit(s) for hydrocarbons is contained within the boundaries of the storage facility, the State Regulatory Agency may in its order of approval for such storage facility order that such field(s) or unit(s) shall be dissolved as of the effective date of the storage facility as set forth in the Certificate of Operation of Storage Facility.

Section 4. Protection against pollution and escape of carbon dioxide.

The State Regulatory Agency shall issue such orders, permits, certificates, rules and regulations, including establishment of appropriate and sufficient financial sureties as may be necessary, for the purpose of regulating the drilling, operation, and well plugging and abandonment and removal of surface buildings and equipment of the storage facility to protect the storage facility against pollution, invasion, and the escape or migration of carbon dioxide.

Section 5. Eminent domain or other applicable statutory authority. [3]

(a) Any storage operator is hereby empowered, after obtaining approval of the State Regulatory Agency as herein required, to exercise the right of eminent domain provided by law, to acquire all surface and subsurface rights and interests necessary or useful for the purpose of

[3] Although the Task Force determined that the most likely mechanism for amalgamating the property rights (surface or subsurface) necessary for the permitting and operation of a carbon dioxide storage facility is eminent domain, the Task Force also recognizes that particular states might have other mechanisms more appropriate for this purpose, e.g., unitization. It is important to note, however, that the Task Force has concluded that the amalgamation of property rights is absolutely necessary to properly permit, construct and operate a carbon dioxide storage project. Further, the eminent domain power outlined in this model statute is an eminent domain authority solely authorized within the carbon dioxide storage statute and is in addition to any eminent domain authority that may already be possessed by a non-government entity such as a public utility.

operating the storage facility, including easements and rights-of-way across lands for transporting carbon dioxide among facilities constituting said storage facility. Such power shall be exercised under the procedure provided by other applicable laws relating to eminent domain. [4]

(b) No rights or interests in storage facilities acquired for the injection, storage, and state authorized withdrawal of carbon dioxide by a party who has obtained an order from the State Regulatory Agency under the provisions of Section 2, shall be subject to the exercise of the right of eminent domain authorized by the article. The State Regulatory Agency, however, may reopen an earlier order for the purpose of balancing the interests of both projects. Nothing in this article shall alter or revise any power of eminent domain that may exist under any other authority.

(c) The right of eminent domain granted in this section shall not prevent the right of the owner of said land or of other rights therein to drill through the storage facility so appropriated in such manner as shall comply with the rules and regulations of the State Regulatory Agency issued for the purpose of protecting the storage facility against pollution or invasion and against the escape or migration of carbon dioxide. Furthermore, the right of eminent domain granted in this section shall not prejudice the rights of the owners of said lands or other rights or interests therein as to all other uses not acquired for the storage facility.

Section 6. Establishment of Carbon Dioxide Storage Facility Trust Fund. [5]

There is hereby established the Carbon Dioxide Storage Facility Trust Fund to be administered by the State Regulatory Agency. There is hereby levied on the storage operator [6] a tax or fee equal to $------- on each ton of carbon dioxide injected for storage for the purpose of funding the Carbon Dioxide Geologic Storage Trust Fund. The Trust Fund shall be utilized solely for long-term monitoring of the site, including remaining surface facilities and wells, remediation of mechanical problems associated with remaining wells and surface infrastructure, repairing mechanical leaks at the site, and plugging and abandoning remaining wells under the jurisdiction of the State Regulatory Agency for use as observation wells. The Trust Fund shall be administered by the State Regulatory Agency.

Section 7. Administration expenses for this article relating to geologic storage of carbon dioxide.

For the purpose of funding the administration and enforcement of these laws relating to geologic storage of carbon dioxide by the State Regulatory Agency during the operational phase of the storage facility, and for the purpose of compliance inspections including the expense of inspecting, testing, and monitoring the geologic storage facility, there is hereby levied on the storage operator a per ton tax or fee collected as a percentage of the fee or tax levied in Section 6 above. The State Regulatory Agency may utilize these monies as it deems appropriate solely for administering and enforcing this article.

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[4] In the exercise of the power of eminent domain, a state might consider allowing a storage operator the right of early entry if such right is not otherwise specifically authorized in those circumstances where the eminent domain process may be lengthy.

[5] The purpose of the Trust Fund will be to provide the State Regulatory Agency with sufficient funds to provide long-term "caretaking" of the facility and to allow the operator and the producer of carbon dioxide the necessary regulatory certainty that ultimately includes release from liability. Based on a particular state's requirements, each state will have to determine the methodology used to provide adequate funding, which would need to include a detailed analysis of the costs anticipated over the lengthy project "caretaking" time frames contemplated.

[6] It is contemplated that the tax or fee will be assessed to and paid by the state-permitted entity. However, in all likelihood the facility operator would recover the tax or fee from the generator of the carbon dioxide.

Section 8. Liability Release. [7]

Ten years,[8] or other time frame established by rule, after cessation of storage operations, the State Regulatory Agency shall issue a Certificate of Completion of Injection Operations, upon a showing by the Storage Operator that the reservoir is reasonably expected to retain mechanical integrity and remain emplaced, at which time ownership to the remaining project including the stored carbon dioxide transfers to the state. Upon the issuance of the Certificate of Completion of Injection Operations, the operator and all generators of any injected carbon dioxide shall be released from all further State Regulatory Agency liability associated with the project. In addition, upon the issuance of the Certificate of Completion of Injection Operations, any performance bonds posted by the operator shall be released and continued monitoring of the site, including remediation of any well leakage, shall become the responsibility of the Carbon Dioxide Storage Facility Trust Fund.

Section 9. Cooperative Agreements.

The State Regulatory Agency is authorized to enter into cooperative agreements with other governments or government entities for the purpose of regulating carbon dioxide storage projects that extend beyond state regulatory authority under this article. [9]

Section 10. Enhanced hydrocarbon recovery operations. [10]

The State Regulatory Agency is expressly authorized to develop rules to allow conversion of an existing enhanced recovery operation into a storage facility. Upon approval of the conversion of such a project the provisions of this article shall apply. Nothing in this article shall apply to the use of carbon dioxide as a part of or in conjunction with any enhanced recovery methods where the sole purpose of the project is enhanced oil or gas recovery.

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[7] The intent of this section is to provide a methodology whereby the operator and the generator of the carbon dioxide can be released from future liability. This aspect of the statute will allow for regulatory certainty by the industry and help to promote the development of carbon dioxide storage.

[8] While the Task Force decided that a 10-year time frame prior to release of the operator and carbon dioxide generator from liability would allow adequate time to determine that there are no known issues as to the integrity of the storage facility, the amount of time prior to release of the operator and generator from liability is ultimately a state decision. Time periods ranging from 3 to 10 years were discussed. The Task Force, however, felt that a release of operator and generator liability would be necessary to encourage timely development.

[9] Such an agreement might allow the state that hosts the injection well to take the lead in permitting and might allow other affected states the right to "certify" a project in much the same way as is done under the current program under Section 404 of the Clean Water Act in the United States.

[10] The purpose of this section is to ensure that the State Regulatory Agency will have authority (i) to provide a flexible regulatory framework that will allow a carbon dioxide EOR project to convert to a carbon dioxide storage project or vice versa or (ii) to develop a regulatory framework to allow EOR and a storage project to occur simultaneously.

Appendix II: Model General Rules and Regulations

General Rules and Regulations

GEOLOGIC STORAGE OF CARBON DIOXIDE

Section 1.0. Applicability

The following rules and regulations shall govern the geologic storage of CO_2 in geologic reservoirs. These rules apply to all CO_2 storage operations occurring within the territorial jurisdiction of the state. [1]

Section 2.0. Definitions

The following terms, as used in these regulations for geologic CO_2 storage facilities, shall have the following meanings:
(a) **CO_2** means anthropogenically sourced carbon dioxide of sufficient purity and quality as to not compromise the safety and efficiency of the reservoir to effectively contain the CO_2.
(b) **CO_2 Facility** (CF) means, all surface and subsurface infrastructure including wellhead equipment, down hole well equipment, compression facilities and CO_2 flow lines from injection facilities to wells within the Geological Storage Unit (GSU), monitoring instrumentation, injection equipment, and offices. CF does not include the main transportation pipeline to the GSU and pump stations along that pipeline.
(c) **CO_2 flow lines** means the pipeline transporting the CO_2 from the CF injection facilities to the wellhead.
(d) **CO_2 injection well** means a well used to inject CO_2 into and/or withdraw CO_2 from a reservoir.
(e) **CO_2 Storage Project** (CSP) means the project in its entirety, including CF and GSU.
(f) **CSP Closure Period** means that period of time (10 years unless otherwise designated by the State Regulatory Agency {SRA}) from the permanent cessation of active CSP injection operations until the expiration of the CSP performance bond, unless monitoring efforts following the operational period demonstrate to SRA that a different time frame is appropriate.
(g) **CSP Operational Period** means the period of time in which injection occurs.
(h) **CSP Operator** means that entity required by SRA to hold the permit.
(i) **CSP Permit** means the permit issued by the state or province to operate a CSP.
(j) **CSP Post Closure Period** means that period of time after the release of the CSP performance bond.
(k) **Formation fracture pressure** means the pressure, measured in pounds per square inch, which, if applied to a subsurface formation, will cause that formation to physically fracture.
(l) **Fresh water** means USDW unless otherwise defined by SRA.
(m) **Geological Storage Unit** (GSU) means the reservoir used by an entity that holds the SRA permit authorizing CO_2 injection activities.
(n) **Geologist or Engineer** means a person qualified by education and experience to be recognized as an expert by SRA.

[1] This document is drafted using the word "state". Canadian provinces should substitute either the word "province" or "provincial" as required. Similarly, Canadian provinces should substitute as appropriate the definitions of Underground Sources of Drinking Water (USDW) and Safe Drinking Water Act (SDWA) here and in the following text.

(o) **Reservoir** means for the purposes of these rules any subsurface sand, stratum, formation, or cavity or void (whether natural or artificially created), including oil and natural gas reservoirs, saline formations and coal seams, suitable for or capable of being made suitable for the injection and safe and efficient storage of CO_2 therein.
(p) **SRA** means the State Regulatory Agency designated by the state for purposes of these regulations.
(q) **Subsurface observation well** means a well either completed or re-completed for the purpose of observing subsurface phenomena, including the presence of CO_2, pressure fluctuations, fluid levels and flow, temperature, and in situ water chemistry.
(r) **Underground Sources of Drinking Water** (USDW) means:

(1) An aquifer or its portion:

(A) Which supplies any public water system; or

(B) Which contains a sufficient quantity of ground water to supply a public water system; and

(i) Currently supplies drinking water for human consumption; or

(ii) Contains fewer than 10,000 mg/l total dissolved solids; and

(2) An aquifer or its portion which is not an exempted aquifer as defined in the U.S. Safe Drinking Water Act [2] (SDWA).

Section 3.0. General Requirements

Section 3.1. Site Access

(a) SRA shall, at all times, have access to and may inspect all CO_2 storage operations and records for the purpose of determining that performance is being conducted in accordance with the CSP permit, or the requirements pursuant to Sections 3.0–9.0, or in accordance with the orders of SRA approving CO_2 storage operations.

Section 3.2. CSP Permit Transfer

(a) Transfer Notification by Transferor: The CSP operator shall notify SRA, in writing, in such form as SRA may direct, of the sale, assignment, transfer, conveyance, exchange, or other disposition of the CSP by the operator of the CSP as soon as is reasonably possible, but in no event later than the date that the sale, assignment, transfer, conveyance, exchange, or other disposition becomes final. The operator shall not be relieved of responsibility for the CSP until SRA acknowledges the sale, assignment, transfer, conveyance, exchange, or other disposition, in writing, and the person or entity acquiring the CSP is in compliance with all appropriate requirements. The operator's notice shall contain all of the following:

(1) The name and address of the person or entity to whom the CSP was or will be sold, assigned, transferred, conveyed, exchanged, or otherwise disposed.

(2) The name and location of the CSP, and a description of the land upon which the CSP is situated.

(3) The date that the sale, assignment, transfer, conveyance, exchange, or other disposition becomes final.

(4) The date when possession was or will be relinquished by the operator as a result of that disposition.

(b) Transfer Notification by Transferee: Every person or entity that acquires the right to operate a CSP, whether by purchase, transfer, assignment, conveyance, exchange, or other disposition, shall, as soon as it is reasonably possible, but not later than the date when the acquisition of the

[2] 42 U.S.C. § 300(h)(1) (1976).

CSP becomes final, notify SRA in writing, of the person's or entity's operation. The acquisition of a CSP shall not be recognized as complete by SRA until the new operator provides all of the following material:

(1) The name and address of the person or entity from which the CSP was acquired.

(2) The name and location of the CSP, and a description of the land upon which the CSP is situated.

(3) The date when the acquisition becomes final.

(4) The date when possession was or will be acquired.

(5) Performance bonds required by Geologic CO_2 Storage regulations 4.0 (10) and (11).

Section 4.0. CO_2 Storage Project (CSP) Permit

Section 4.1. CSP Permit Requirements

(a) No CSP shall be constructed or operated without:

(1) The CSP operator holding the necessary and sufficient property rights for construction and operation of the CSP. The CSP operator is deemed to be holding such rights for any individual property to the extent that the applicant has initiated unitization or eminent domain proceedings related to that property and thereby gained the right of access to the property. The intention of the CSP operator to employ unitization or eminent domain to acquire property rights shall be included in public notice as defined in Section 5.0; and

(2) Obtaining a license from SRA.

(b) Application for CSP permit shall be submitted to SRA as required and shall include the following:

(1) A current site map showing the boundaries of the GSU, the location and well number of all proposed CO_2 injection wells, including any subsurface observation wells and the location of all other wells including cathodic protection boreholes and the location of all pertinent surface facilities within the boundary of the CSP;

(2) A technical evaluation of the proposed CSP, including but not limited to, the following:

(A) The name of the GSU;

(B) The name, description, and average depth of the reservoir or reservoirs to be utilized for geologic CO_2 storage;

(C) A geologic and hydrogeologic evaluation of the GSU, including an evaluation of all existing information on all geologic strata overlying the GSU including the immediate caprock containment characteristics and all designated subsurface monitoring zones. The evaluation shall include any available geophysical data and assessments of any regional tectonic activity, local seismicity and regional or local fault zones, and a comprehensive description of local and regional structural or stratigraphic features. The evaluation shall focus on the proposed CO_2 storage reservoir or reservoirs and a description of mechanisms of geologic confinement, including but not limited to rock properties, regional pressure gradients, structural features, and absorption characteristics with regard to the ability of that confinement to prevent migration of CO_2 beyond the proposed storage reservoir. The evaluation shall also identify any productive oil and natural gas zones occurring stratigraphically above, below, or within the GSU and any freshwater-bearing horizons known to be developed in the immediate vicinity of the GSU. The evaluation shall include exhibits and plan view maps showing the following:

(i) All wells, including but not limited to, water, oil, and natural gas exploration and development wells, and other man-made subsurface

structures and activities, including coal mines, within one mile of the outside boundary of the GSU;
(ii) All manmade surface structures that are intended for temporary or permanent human occupancy within the GSU and within one mile of the outside boundary of the GSU;
(iii) Any regional or local faulting;
(iv) An isopach map of the proposed CO_2 storage reservoir or reservoirs;
(v) An isopach map of the primary and any secondary containment barrier;
(vi) A structure map of the top and base of the storage reservoir or reservoirs;
(vii) Identification of all structural spill points or stratigraphic discontinuities controlling the isolation of stored CO_2 or associated fluids;
(viii) An evaluation of the potential displacement of in situ water and the potential impact on groundwater resources, if any; and
(ix) Structural and stratigraphic cross-sections that describe the geologic conditions at the reservoir.

A geologist or engineer shall conduct the geologic and hydrogeologic evaluation required under this paragraph. As appropriate, existing geologic, geophysical, or engineering data available on the proposed GSU may be incorporated into the evaluation;

(D) A review of the data of public record for all wells within the CSP Permit, which penetrate the reservoir or primary and/or secondary seals overlying the reservoir designated as the CO_2 storage reservoir, and those wells that penetrate the geologic CO_2 storage reservoir within one mile, or any other distance as deemed necessary by SRA, of the boundary of the GSU. This review shall determine if all abandoned wells have been plugged in a manner that prevents the movement of CO_2 or associated fluids from the geologic CO_2 storage reservoir. A geologist or engineer shall conduct the review required under this paragraph;

(E) The proposed calculated maximum volume and areal extent for the proposed GSU using a method acceptable to and filed with SRA;

(F) The proposed maximum bottom hole injection pressure to be utilized at the reservoir. The maximum allowed injection pressure, measured in psig, shall be no greater than 90 percent or other injection pressures approved by SRA of the formation fracture pressure as determined by a step-rate test or other method approved by SRA. The GSU shall not be subjected to injection pressures in excess of the calculated fracture pressure even for short periods of time. Higher operating pressures may be allowed if approved by SRA. The application, if approved by SRA, shall be subject to any conditions established by SRA;

(G) The proposed maximum long-term GSU pressure and the necessary technical data to support the proposed GSU storage pressure request.

(3) The extent of the CO_2, determined by utilizing all available geologic and reservoir engineering information, and the projected response and storage capacity of the GSU;

(4) A detailed description of the proposed CF public safety and emergency response plan. The plan shall detail the safety procedures concerning the facility and residential, commercial, and public land use within one mile, or any other distance as deemed necessary by SRA, of the outside boundary of the CSP Permit. The public safety and emergency response procedures shall include contingency plans for CO_2 leakage from any well, flow lines, or other permitted facility. The public safety and emergency response procedures also shall identify specific contractors and equipment vendors capable of providing necessary services and equipment to respond to such CO_2 injection well leaks or loss of containment from CO_2 injection wells or the CO_2 storage reservoir.

These emergency response procedures should be updated as necessary throughout the operational life of the permitted storage facilities.

(5) A detailed worker safety plan that addresses CO_2 safety training and safe working procedures at the CF;

(6) A corrosion monitoring and prevention plan for all wells and surface facilities;

(7) A CF leak detection and monitoring plan for all wells and surface facilities. The approved leak detection and monitoring plan shall address:

(A) Identification of potential release to the atmosphere;

(B) Identification of potential degradation of groundwater resources with particular emphasis on USDWs; and

(C) Identification of potential migration of CO_2 into any overlying oil and natural gas reservoirs.

(8) A GSU leak detection and monitoring plan utilizing subsurface observation wells to monitor any movement of the CO_2 volume outside of the permitted GSU. This may include the collection of baseline information of CO_2 background concentrations in groundwater, surface soils, and chemical composition of in situ waters within the GSU. The approved subsurface leak detection and monitoring plan shall be dictated by the site characteristics as documented by materials submitted in support of the application with regard to CO_2 containment and address:

(A) Identification of potential release to the atmosphere;

(B) Identification of potential degradation of groundwater resources with particular emphasis on USDWs; and

(C) Identification of potential migration of CO_2 into any overlying oil and natural gas reservoirs.

(9) The proposed well casing and cementing program detailing compliance with Section 6.0;

(10) A performance bond covering the surface facility to SRA in an amount established by SRA. The amount of the bond shall be sufficient to provide financial assurance to SRA to cover the abandonment of the CSP or remediation of facility leaks should the CSP operator not perform as required or cease to exist. The CSP bond shall be maintained for 10 years after closure of the facility in accordance with Section 9.0 below;

(11) A performance bond for each CO_2 injection and subsurface observation well to SRA in an amount established by SRA. The amount of the bond shall be sufficient to provide financial assurance to SRA to cover the plugging and abandonment or the remediation of a CO_2 injection and/or subsurface observation well should the CSP operator not perform as required in accordance with the permit or cease to exist;

(12) The payment of the application fee;

(13) Any other information that SRA requires; and

(14) A closure plan.

Section 4.2. Amendment to CSP Permit

(a) The following changes to the original CSP permit conditions will require compliance with all the provisions of Section 4.1 above:

(1) Any change in the original areal extent of the CSP permit;

(2) Utilization of other reservoirs not specified in the original CSP permit;

(3) Any proposed increase in the permitted CO_2 storage volume; and

(4) Any change in the chemical composition of the injected CO_2 from the CO_2 composition at the time of permitting.

(b) Other significant changes to approved operational parameters contained in the original CSP permit will require compliance with Section 4.1 (b).

Section 5.0. Amalgamation of Subsurface Rights to Operate GSU

(a) Each application required under Section 4 above shall include a public hearing before SRA for the purposes of joining the necessary property ownership rights, as defined by the state or before the state regulatory agency responsible for amalgamating these rights. These hearings at the discretion of the state regulatory agencies may be combined and heard simultaneously.
(b) Each applicant for a CSP shall give notice of the filing of an application on or before the date the application is filed with SRA by mailing notice via first class mail to the following:

(1) Each operator of hydrocarbon or other mineral extraction activities, or mineral lessee of record within one-half mile external to the boundary of the proposed CSP Permit;
(2) Each owner of record of the surface property and minerals within the boundaries of the proposed CSP Permit;
(3) Each owner of record of the surface property and minerals within one-half mile external to the boundary of the proposed CSP Permit; and
(4) Any other parties as required by SRA.

(c) The above notice shall contain a legal description of the proposed CSP Permit along with the date, time, and place of the hearing before SRA and include notice of the right to file comments.
(d) In addition to mail notice of the above parties, public notice via publication shall be required. The public notice shall indicate that an application has been filed with SRA for a CSP and indicate the location of the proposed project and the date, time, and place of the hearing before SRA to determine issuance of the application. Publication shall be in a newspaper of statewide circulation and in a local newspaper in a county or parish newspaper of each county/parish in which the CSP is located. The notice shall indicate that objections may be filed within 15 days of the date of publication.
(e) Objections received by SRA shall be in writing and specify the nature of the objection.
(f) Upon review of the application submitted in accordance with Section 4 above and following the Rights Amalgamation Hearing specified in this section, authorization to commence construction of the CSP shall be issued following approval by SRA.

Section 6.0. CSP Wells

Section 6.1. CSP Well Permit Application Requirements

(a) Following receipt of authorization to commence the CSP issued by SRA in accordance with Section 4 above, the applicant shall submit applications to drill, convert, or, upon demonstration of mechanical integrity, re-enter a previously plugged and abandoned well for CO_2 storage purposes.
(b) Application for permits to drill, deepen, convert, re-enter (drill out a previously plugged well) or operate a well shall be submitted on a form prescribed by SRA and shall include at a minimum:

(1) A plat prepared by a licensed land surveyor showing the location of the proposed CO_2 injection or subsurface observation well. The plat shall be drawn to the scale of one (1) inch equals one thousand (1,000) feet, unless otherwise stipulated by SRA and shall show distances from the proposed well to the nearest GSU boundary. The plat shall show the latitude and longitude of the well in decimal degrees to five (5) significant digits. The plat shall also show the location and status of all other wells that have been drilled within one-fourth (1/4) mile, or any other distance deemed necessary by SRA, of the proposed CO_2 injection or subsurface observation well;
(2) A prognosis specifying the drilling, completion, or conversion procedures for the proposed CO_2 injection or subsurface observation well;

(3) A well bore schematic showing the name, description, and depth of the proposed reservoir and the depth of the deepest USDW; a description of the casing in the CO_2 injection or subsurface observation well, or the proposed casing program, including a full description of cement already in place or as proposed; and the proposed method of testing casing before use of the CO_2 injection well;

(4) A geophysical log, if available, through the reservoir to be penetrated by the proposed CO_2 injection well or if a CO_2 injection or subsurface observation well is to be drilled, a complete log through the reservoir from a nearby well is permissible. Such log shall be annotated to identify the estimated location of the base of the deepest USDW, showing the stratigraphic position and thickness of all confining strata above the reservoir and the stratigraphic position and thickness of the reservoir.

(c) No later than the conclusion of well drilling and completion activities, a permit application shall be submitted to operate a CO_2 injection well and shall include at a minimum:

(1) A schematic diagram of the surface injection system and its appurtenances;

(2) A final well bore diagram showing the name, description, and depths of the reservoir and the base of the deepest USDW; a diagram of the CO_2 injection well depicting the casing, cementing, perforation, tubing, and plug and packer records associated with the construction of the CO_2 injection well;

(3) A complete dual induction or equivalent log through the reservoir of the CO_2 injection well. Such log for wells drilled for CO_2 injection operations shall be run prior to the setting of casing through the CO_2 storage reservoir. Logs shall be annotated to identify the estimated location of the base of the deepest USDW, showing the stratigraphic position and thickness of all confining strata above the reservoir and the stratigraphic position and thickness of the reservoir unless previously submitted. When approved in advance by SRA, this information can be demonstrated with a dual induction or equivalent log run in a nearby well or by such other method acceptable to SRA;

(4) An affidavit specifying the chemical constituents of the injection stream other than CO_2 and their relative proportions;

(5) Proof that the long string of casing of the CO_2 injection well is cemented adequately so that the CO_2 is confined to the GSU. Such proof shall be provided in the form of a cement bond log or the results of a fluid movement study or such other method specified by SRA; and

(6) The results of a mechanical-integrity test, if applicable to well type, of the casing in accordance with the pressure test requirements, of this section, if a test was run within one calendar year preceding the request for issuance of a conversion permit for a previously drilled well.

Section 6.2. Permit Issuance

(a) Upon review and approval of the application to drill, deepen, convert, re-enter, (drill out a previously plugged well) or operate a CO_2 injection well, submitted in accordance with Section 6.1, SRA shall issue permits to drill and operate.

(b) A permit shall expire twelve (12) months from the date of issuance if the permitted well has not been drilled or converted.

Section 6.3. CSP Well Operational Standards

(a) Surface casing in all newly drilled CO_2 injection and subsurface observation wells drilled below the USDW shall be set 100 feet below the lowest USDW and cemented to the surface or other protective measures as deemed appropriate by SRA.

(b) The long-string casing in all CO_2 injection and subsurface observation wells shall be cemented with a sufficient volume of cement to fill the annular space to a point 500 feet above the top of the storage reservoir.
(c) Any liner set in the well bore shall be cemented with a sufficient volume of cement to fill the annular space to the surface.
(d) All cements used in the cementing of casings in CO_2 injection and subsurface observation wells shall be of sufficient quality to maintain well integrity in the CO_2 injection environment.
(e) All casings shall meet the standards specified in either of the following documents, which are hereby adopted by reference:

(1) "The most recent American Petroleum Institute (API) Bulletin on performance properties of casing, tubing, and drill pipe; or

(2) "Specification for casing and tubing (U.S. customary units)," API specification 5CT, as published by the API in October 1998; or

(3) Other casing as approved by SRA.

(f) All casings used in new wells shall be new casing or reconditioned casing of equivalent quality that has been pressure-tested in accordance with the requirements of paragraph (e). For new casings, the pressure test conducted at the manufacturing mill or fabrication plant may be used to fulfill the requirements of paragraph (e).
(g) The location and amount of cement behind casings shall be verified by a cement bond log, cement evaluation log, or any other evaluation method approved by SRA.
(h) All CO_2 injection wells shall be completed with and injection shall be through tubing and packer.
(i) All tubing strings shall meet the standards contained in paragraph (e) of this regulation. All tubing shall be new tubing or reconditioned tubing of equivalent quality that has been pressure-tested. For new tubing, the pressure test conducted at the manufacturing mill or fabrication plant may be used to fulfill this requirement.
(j) All wellhead components, including the casing head and tubing head, valves, and fittings, shall be made of steel having operating pressure ratings sufficient to exceed the maximum injection pressures computed at the wellhead and to withstand the corrosive nature of CO_2. Each flow line connected to the wellhead shall be equipped with a manually operated positive shutoff valve located on or near the wellhead.
(k) All packers, packer elements, or similar equipment critical to the containment of CO_2 shall be of a quality to withstand exposure to CO_2.
(l) An accurate, operating pressure gauge or pressure recording device shall be available at all times, and all injection wells shall be equipped for installation and operation of such gauge or device. Gauges shall be calibrated as required by SRA and evidence of such calibration shall be available to SRA upon request.
(m) All newly drilled wells shall establish internal and external mechanical integrity as specified by SRA and demonstrate continued mechanical integrity through periodic testing as determined by SRA. All other existing wells to be used as CO_2 injection wells will demonstrate mechanical integrity as specified by SRA prior to use for CO_2 injection and be tested on an ongoing basis as determined by SRA using these methods:

(1) Pressure tests. CO_2 injection wells, equipped with tubing and packer as required, shall be pressure tested as required by SRA. A testing plan shall be submitted to SRA for prior approval. At a minimum, the pressure shall be applied to the tubing casing annulus at the surface for a period of 30 minutes and shall have no decrease in pressure greater than 10 percent of the required minimum test pressure. The packer shall be set at a depth at which the packer will be opposite a cemented interval of the long string casing and shall be set no more than 50 feet above the uppermost perforation or open hole for the CO_2 storage reservoir; and

(2) SRA may require additional testing such as bottom hole temperature and pressure measurements, tracer survey, temperature survey, gamma ray log, neutron log, noise log, casing inspection log, or a combination of two or more of these surveys and logs, to demonstrate mechanical integrity.

(n) Supervision of mechanical integrity testing. SRA may witness all mechanical integrity tests conducted by each CSP operator for regulatory purposes.

(o) If a CO_2 injection well fails to demonstrate mechanical integrity by an approved method, the operator of the well shall immediately shut in the well, report the failure to SRA, and commence isolation and repair of the leak. The operator shall, within 90 days or as otherwise directed by SRA, perform one of the following:

(1) Repair and re-test the well to demonstrate mechanical integrity;

(2) Plug the well in accordance with state requirements; or

(3) Comply with alternative plan as approved by SRA.

(p) All CO_2 injection wells shall be equipped with down-hole safety shutoff valves.

(q) Additional requirements may be required by SRA to address specific circumstances and types of projects not specified in these rules.

Section 6.4. Amendment to CSP Well Permits

(a) An amendment to the CSP Well Permit for: (1) a change in injection formation, and/or (2) a modification of maximum allowable injection rate and pressure, shall comply with the provisions of Section 6.1 (c)(5) and (6), 6.3 (b), (g), (h), (i), (l) and (m) above.

(b) Modification of well construction shall comply with the provisions of Section 6.1 (b)(3) and 6.3 (m).

Section 7.0. CSP Operational Standards

Section 7.1. Safety Plans

Each operator of a CSP shall implement a SRA-approved CF public safety and emergency response plan and the worker safety plan proposed in Section 4. This plan shall include emergency response and security procedures. The plans, including revision of the list of contractors and equipment vendors, shall be updated as necessary or as SRA requires. Copies of the plans shall be available at the CF and at the nearest operational office of the holder of the CSP Permit.

Section 7.2. Leak Detection and Reporting

(a) Leak detectors or other approved leak detection methodologies shall be placed at the wellhead of all CO_2 injection and subsurface observation wells. Leak detectors shall be integrated, where applicable, with automated warning systems and shall be inspected and tested on a semi-annual basis and if defective, shall be repaired or replaced within 10 days. Each repaired or replaced detector shall be re-tested if required by SRA. An extension of time for repair or replacement of a leak detector may be granted upon a showing of good cause by the operator of the CSP. A record of each inspection, which shall include the inspection results, shall be maintained by the operator for at least five years and shall be made available to the state oil and natural gas regulatory agency upon request.

(b) The operator of a CSP shall immediately report to SRA any leaks detected at the surface facility and associated well equipment specified in (a) above.

(c) The operator of a CSP shall immediately report to SRA any pressure changes or other monitoring data from subsurface observation wells that indicate the presence of leaks in the GSU indicating the lack of confinement within the reservoir of the CO_2.
(d) The operator of a CSP shall immediately report to SRA any other indication of lack of containment of CO_2 to the reservoir not associated with wells and surface equipment.

Section 7.3. Other General Requirements

(a) Each operator shall be required to conduct a corrosion monitoring and prevention program approved by SRA.
(b) Identification signs shall be placed at each facility in a centralized location and at each well site and show the name of the operator, the facility name, and the emergency response number to contact the operator.

Section 8.0. Reporting Requirements

(a) The volume of CO_2 injected into and/or withdrawn since the last reporting, the average injection rate, average composition of the CO_2 stream, wellhead and down hole temperature and pressure data and/or other pertinent operational parameters as required by SRA shall be reported quarterly or as required by SRA.
(b) These quarterly reports shall be compiled and summarized annually to provide updated projections of the response and storage capacity of the GSU. The projections shall be based on actual GSU operational experience, including all new geologic data and information. All anomalies in predicted behavior as indicated in the most current permit conditions shall be explained and, if necessary, the permit conditions amended in accordance with Section 4.1.

Section 9.0. CSP Closure

(a) Prior to the conclusion of the operational period, the time period to be determined by SRA, the CSP permit holder shall provide an assessment of the operations conducted during the operational period, including but not limited to the volumes injected, extracted, any and all chemical analyses conducted, summary of all monitoring efforts, etc. The report shall also document the position and characteristics of the areal extent of the CO_2 and a prediction of the extent and movement of the CO_2 volume anticipated during the CSP closure period.
(b) The permittee shall submit a monitoring plan for the CSP closure period for approval by SRA, including but not limited to a review and final approval of which wells will be plugged and which wells will remain unplugged to be used as CSP closure and post closure period subsurface observation wells.
(c) Following well plugging, all associated surface equipment shall be removed and the well site returned to its original land use to the extent possible.
(d) The well casing shall be cut off at a depth of 5 feet below the surface and a steel plate welded on top identifying well name and that it was used for CO_2 injection.
(e) SRA shall develop in conjunction with the permittee a continuing monitoring plan for the CSP post closure period including but not limited to a review and final approval of which wells shall be plugged. SRA shall have full control of and responsibility for the remaining unplugged wells to be used by SRA as CSP post closure period subsurface observation wells or for other purposes as deemed necessary by SRA.
(f) Upon CSP closure, all wells so designated by SRA shall be properly plugged and abandoned, all CF equipment and facilities shall be removed, and the CSP site reclaimed in accordance with SRA requirements.

(g) All subsurface observation and groundwater monitoring wells as approved in the CSP closure period monitoring plan shall remain in place for continued monitoring during CSP closure period.
(h) Upon termination of the CSP closure period, the permittee shall provide a final assessment of the subsurface position and the characteristics of the CO_2 volume within the GSU including the future movement and position of the CO_2 volume within the GSU.
(i) Wells other than those deemed as subsurface observation wells per paragraph (e) above, shall be plugged by the permittee in accordance with paragraph (c) above.
(j) At the conclusion of the CSP closure period, the CSP performance bond maintained by the CSP operator shall be released, and continued monitoring of the site, remediation of any well leakage, including wells previously plugged and abandoned by the CSP operator, shall become the responsibility of designated state or federal agency programs and the CSP operator and generator of the CO_2 shall be released from further SRA regulatory liability relating to the CF.

Appendix III: Bibliography of Cases and References on Property Rights Issues Related to Underground Space Used for Geologic Storage of Carbon Dioxide

Cases

Cent. Ky. Natural Gas Co. v. Smallwood, 252 S.W.2d 866, 868 (Ky. Ct. App. 1952).

Chance v. BP Chemicals, Inc., 670 N.E.2d 985 (Ohio 1996).

Dep't of Transp. v. Goike, 560 N.W.2d 365, 366 (Mich. Ct. App. 1996).

Ellis v. Ark. La. Gas Co., 609 F.2d 436, 439 (10th Cir. 1979).

Emeny v. United States, 412 F.2d 1319 (Ct. Cl. 1969).

Humble Oil & Refining Co. v. West, 508 S.W.2d 812 (Tex. 1974).

Mapco, Inc. v. Carter, 808 S.W.2d 262 (Tex. App.—Beaumont 1991), *rev'd in part*, 817 S.W.2d 686 (Tex. 1991).

Mission Res., Inc. v. Garza Energy Trust, 166 S.W.3d 301, 310 (Tex. App.—Corpus Christi 2005, review granted.

Mongrue v. Monsanto Co., 249 F.3d 422, 433 n. 17 (5th Cir. 2001).

R.R. Comm'n of Tex. v. Manziel, 361 S.W.2d 560, 568 (Tex. 1962)

Tate v. United Fuel Gas Co., 71 S.E.2d 65, 72 (W. Va. 1952).

Tex. Am. Energy Corp. v. Citizens Fid. Bank & Trust Co., 736 S.W.2d 25, 28 (Ky. 1987).

United States v. 43.42 Acres of Land, 520 F.Supp. 1042, 1045 (W.D. La. 1981).

Other Authorities

Carbon Dioxide Sequestration: Interim Report on Identified Statutory & Regulatory Issues, New Mexico Energy, Minerals, Natural Resources Dep't, Oil Conservation Division, pp. 12-13 (June 27, 2007).

Elizabeth J. Wilson & Mark A. de Figueirdo, Geologic Carbon Dioxide Sequestration: An Analysis of Subsurface Property Law, 36 ELR 10114, 21 (2006).

Holland, "Underground Storage of Natural Gas: A Legal Overview," 3 Eastern Min. L. Inst. 19 – 1 at 19 – 13 (1982).

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Williams and Meyers, Oil and Gas Law Vol. 1, §222 (Matthew Bender, 2006).