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POLICY GROUP
TECHNICAL GROUP

Risk and Liability Assessment for Geologic Storage of Carbon Dioxide

A Proposed Work Plan for the CSLF

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RISK AND LIABILITY ASSESSMENT FOR GEOLOGIC STORAGE OF CARBON DIOXIDE

A PROPOSED WORK PLAN FOR THE CSLF

Note by the Secretariat

Background

Actual, calculated or perceived risks of geologic storage and the liabilities that result from those risks will be central to the legal framework for CCS; to business decisions about whether and where to proceed with CCS projects; and to the design, operation and closure of those projects. At the Joint Meeting of the CSLF Policy and Technical Groups in October 2010, there was consensus that a new joint Policy Group / Technical Group Task Force be formed to examine the link between risk and liability. This paper presents a proposed work plan for the new Task Force.

Action Requested

The Policy Group and Technical Group are requested to review and consider the proposed work plan for the CSLF Risk and Liability Task Force.

Risk and Liability Assessment for Geologic Storage of Carbon Dioxide

A Proposed Work Plan for the CSLF

The Risk Assessment Task Force (RATF) of the CSLF Technical Group has been evaluating geologic risk methodologies since the RATF was formed in 2006. This work is continuing. The RATF consists of technical experts, many in the geological sciences. The RATF has recognized the importance of understanding the link between risk and liability. For this reason, the RATF has requested that the Policy Group recognize and consider the link between risk assessment and liability.

This issue paper briefly explains risk and liability definitions relevant to geologic storage, describes work underway within the CSLF and by others to address these risk and liability concepts, and proposes an approach to guide future CSLF work in this area.

Significance

The relationship between geologic risk and financial liability is critical to the commercialization of Carbon Capture and Storage (CCS). Actual, calculated or perceived risks of geologic storage and the liabilities that result from those risks will be central to the legal framework for CCS; to business decisions about whether and where to proceed with CCS projects; and to the design, operation and closure of those projects. The relationship between risk and liability, however, is at present often poorly defined or understood and this, in itself, adds its own layer of risk for CCS project developers and public policy decision makers.

Some Definitions

Before one can evaluate the relationship between risk and liability, it is necessary to have a clear understanding of what the terms *risk* and *liability* and related terms such as *risk assessment* and *damages* mean in the context of geologic storage.

Risk has many definitions, depending on the context and who is expected to bear that risk. Regardless, however, all definitions share the common characteristic of being measures of uncertain expectations about the future. Risk can either be calculated explicitly (in a variety of different ways) or be just a subjective feeling—even for the same event. Moreover, the same event can have different risks for different parties. Perspective can thus vary widely. The RATF does not explicitly define what it means by risk, but it comes close with the statement, "CO_2 storage at a particular site will inherently embody some uncertainty regarding the site's eventual performance (including its capacity, injectivity, ability to contain CO_2 and other fluids, etc.)."[1] This statement is most relevant to a party planning the design or operation of a geologic storage site. By contrast, a definition from the financial industry is, "the degree of uncertainty of future net returns."[2] It is often calculated as the standard deviation of the return on total investment. This definition, including the long-term post-closure risks, is perhaps most relevant to the businesses that will undertake CCS projects. The insurance industry has a similar definition, "uncertainty arising from the possible

[1] CSLF Risk Assessment Task Force, "Phase I Final Report from CSLF Risk Assessment Task Force," Page 4, October 2009.
[2] JPMorgan/Reuters, Risk Metrics Technical Document, Fourth Edition, New York, December 1996.

occurrence of given events."[3] A definition of environmental risk is, "the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor."[4] A considerable body of work has been developed on risk perception by the public. While this body of work yields no specific definition, it has identified the factors that influence perceptions of risk. These include level of familiarity and understanding, level of dread, identity of potential victims (especially children), media attention, voluntariness and others.[5] All of these differing definitions of risk have relevance to CCS because they each will influence decisions made about CCS. (They are, however, not unique definitions in their areas).

Risk Assessment typically means hazard identification, hazard characterization or dose-response assessment, exposure assessment and risk characterization.[6] Risk is frequently calculated by risk analysts as the probability multiplied by a measure of the impact (e.g., harm to the environment or people or unplanned financial obligations). In the context of geologic storage, it is the process by which potential impacts and risks posed by a geologic storage operation may be evaluated. The RATF has identified a number of different risk assessment methodologies used for geologic storage of CO_2. These all share the common attribute of defining risks in terms of the physical or chemical impacts of CO_2.

Damages are an attempt within a legal system to measure in financial terms the extent of harm a party (which could be the public) has suffered because of another party's actions. Depending on the applicable laws, financial damages may also be punitive. One clear gap is an accepted way to convert the potential physical or chemical impacts of geologic storage as determined by geologic storage risk assessment into potential damages.

Liability is a legal, accounting and financial concept for a responsibility, duty or obligation. It could be money owed (e.g., to compensate for financial damages) or the obligation to do something (e.g., remediate a release of CO_2 from a storage operation), or both. Liability may arise from contracts, either express or implied, from torts (i.e. wrongful acts) committed, or from the provisions of legislation or regulation. Key issues for CO_2 storage are how large is the potential liability, its probability and who bears that liability. In the case of geologic storage, liability will in most cases be set primarily by legislation and regulation that will be based on perceptions and assessments of risks as well as other factors such as perceptions of equity among various stakeholders and the public. Companies look at the impact of uncertain liabilities on their overall evaluation of an investment and its impact on their projected financial statements. The level of uncertainty in the investment decision may be quantitatively or non-quantitatively evaluated. A number of tools for evaluating this type of decision problem such as "real options" or Monte Carlo analysis have been used for similar decision making purposes, but methods for evaluating uncertain financial liabilities and tolerances for those uncertainties vary.

[3] http://www.irmi.com/online/insurance-glossary/terms/r/risk.aspx accessed on September 16, 2010.
[4] http://epa.gov/riskassessment/basicinformation.htm#risk accessed on September 16, 2010.
[5] Regina Lundgren and Andrea Makin, Risk Communication, A Handbook for Communicating Environmental, Safety and Health Risks, Third Edition, Battelle Press, Columbus, 2004.
[6] National Research Council, "Scientific Review of the Proposed Risk Assessment Bulletin from the Office of Management and Budget." Washington, DC, 2007.

Prior Work by the CSLF

Relevant work has been undertaken by both the Technical and Policy Group.

Technical Group Risk Assessment Task Force (RATF)

The RATF has now completed its Phase I activities, which centered on examination of risk-assessment standards, procedures, and research activities relevant to unique risks associated with the injection and long-term storage of CO_2. Risks associated with CO_2 near-term injection processes include predicting the stress state of the reservoir, while risks associated with long-term processes relate to impacts of CO_2 storage include health, safety, and environmental risks, potential impact on natural resources (such as groundwater, mineral resources, etc.), and return of CO_2 to the atmosphere. The RATF's Phase I Report is online at the CSLF website.

One of the RATF's recommendations from its Phase I work was that risk assessment should be considered in the context of stakeholder outreach and communication. To that end, the CSLF Policy Group's Communications Task Force has set up a working group focused on risk assessment, and that working group has prepared a set of five "inFocus Carbon Capture and Storage" outreach documents, now posted at the CSLF website, that provide information about the safety of CCS to a non-technical audience. These five documents were reviewed and approved by the RATF prior to their publication. The RATF also suggested that the Communications Task Force consider preparing an additional "inFocus" document to clarify the distinction between geologic storage and natural CO_2 leakage scenarios, including Lake Nyos in Cameroon; in response, the Communications Task Force has indicated it will develop this document at a later date, if needed.

RATF Phase II activities, authorized by the Technical Group at the London Ministerial meeting in October 2009, will include (1) a gap assessment to identify CCS-specific tools and methodologies that will be needed to support risk assessment, and (2) a feasibility assessment of developing general technical guidelines for risk assessment that could be adapted to specific sites and local needs. The RATF intends to leverage its activities with those of the IEA GHG Risk Assessment Network to facilitate the completion of these two assessments.

Relevant Policy Group Activities

The CSLF Policy Group has not directly addressed the issues of the relationship between risk and liability, but its work on the financing of CCS projects has highlighted the importance of addressing long-term liability. In particular, since 2004, the Policy Group has held a series of workshops on financing CCS projects and, in each, the importance of unresolved long-term liability for geologic storage has been highlighted. Several roundtables and workshops have been held by the CSLF Financing Task Force. Industry stakeholders have stated clearly that this issue must be resolved before they can invest in geologic storage projects. In addition, as noted above, the Policy Group's Task Force on Communications has prepared a series of outreach documents that touch on the safety of geologic storage.

The CSLF-IEA recommendations to the G8 developed in Calgary in 2007 and approved by the G8 heads of state in July 2008 contained the following recommendation regarding liability:[7]

[7] CSLF and IEA, "Results from the Calgary Workshop, November 27 & 28 2007, 3rd Workshop, Near-Term Opportunities for Carbon Capture and Storage," December 2007.

b. Long Term Liability: Priority – 2010

A framework addressing liability is required for the injection and post-injection phases of a storage project. This includes, but is not limited to, sub-surface property rights, joint liability where there are several operators injecting into the same formation, processes for assessing and resolving potential conflict between CO_2 injection and hydrocarbon production, transboundary movement of CO_2, and timeframes associated with liability.

7. *Governments should clearly define a liability regime for the operational, closure and post-closure phases of a storage project. The regime should also address:*
   - *Government assumption of long term liability to Governments for the post-closure phase.*
   - *The timing of the transfer of liability to Governments for the post-closure phase.*
   - *Implications for surface and sub-surface transboundary movement of carbon dioxide.*

8. *Governments should develop clear licensing and permitting systems for storage projects. Such regulations should address procedures and responsibilities to ensure safe closure and provisions for post-closure monitoring, and remediation, if necessary.*

Other Relevant Work

Numerous geologic storage risk assessment activities are taking place in many countries. Work on risk assessment for geologic storage was identified and reviewed in detail by the Risk Assessment Task Force in its Phase I final report.[8] Work to communicate the safety of geologic storage is also underway in many countries and this work relies on geologic information.

Long-term liability for geologic storage has also been an issue of concern and research by several insurance companies, including Swiss Re, Zurich Re, and Marsh.[9] Each appears to have a somewhat different approach. It has also been the subject of research by organizations such as the World Resources Institute.[10]

The basis for liability depends on the legal framework and these frameworks vary by jurisdiction. Legislation on long-term liability for storage has been enacted in a number of jurisdictions, including the European Union, Australia, the Australian states of Queensland, Victoria and Western Australia and the U.S. states of Illinois, Louisiana, North Dakota and Texas.[11] In general, this legislation involves government assumption of long-term liability after a defined post-closure period or certain conditions for ensuring secure storage have been met.

Proposed Work Plan

The linkage between geologic estimates of risk and liability concepts needs to be better understood. Stakeholders including government policy makers and regulators, private-sector interests such as project developers and the financial industry and the general public all require such information. Yet, bridging his gap between risk and liability is difficult and complex.

[8] CSLF Risk Assessment Task Force, *op. cit.*
[9] For example, Swiss Re Centre for Global Dialogue, Conference on Regulating and Financing Carbon Capture and Storage, 7-8 November 2007.
[10] World Resources Institute, Guidelines for Carbon Dioxide Capture, Transport, and Storage, Washington DC:WRI, 2008.
[11] CSLF Incentives Registry, third revision, draft under development, September 2010.

In practical terms, geologists and need to know what information to produce and decisions makers need to know what to ask for and how to interpret it. A clear gap exists because neither geologists nor decision makers yet appears to understand what is needed from the other. Bridging this may involve creating the ability to readily translate among the different professional languages and into the language of public discourse. Perhaps it may involve new types of analyses or communications materials. Regardless, this is truly a multidisciplinary effort requiring expertise and interaction among multiple disciplines that may not often communicate with each other, including:

- Geosciences
- Engineering
- Corporate Finance
- Insurance
- Business Strategy
- Risk Management
- Law and Regulation
- Communications

The proposed work plan includes these interactions and creative analyses to bridge the gap:

1. Establish a CSLF Risk and Liability Task Force composed of representatives of the Policy Group Financing Task Force and the Technical Group Risk Assessment Task Force to carry out work in this area. It will also involve participants from the needed diverse disciplines.
2. Perform analyses including (a) a critical review of prior work on liability, and (b) a comparison of liability frameworks that have so far been established.
3. Interview a sample of key experts from the different disciplines to identify their perspectives on risk, damages and liability. Evaluate the similarities and differences among these stakeholders.
4. Conduct facilitated workshops to identify gaps and methods of fulfilling them. These workshops should build on the information gathered by the prior analyses described in 2 and 3 above as well as other prior work. These events will each be working sessions of perhaps about 30 working experts from diverse fields, not elaborate conferences. Each will have a specific goal. They will be facilitated to provide a basis for productive discussion. At least two workshops are anticipated with as many as the same participants as possible in each. The first will define the issues and explain the diverse perspectives to the participants—what each discipline thinks and what expects of the other. The second workshop should identify methods of bridging the gaps among them. Depending on funding, more workshops of the first type could be held to enable input from greater geographic diversity in perspectives.
5. Prepare a report to the Policy and Technical Groups proposing a path forward based on the results of the workshops. This report should be presented at the 2012 Joint Meeting of the Policy and Technical Groups.