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# The Role of Storage Standards in the Deployment of CCS

## **Workshop report**

Calgary, Alberta, Canada. 6 June 2013

## Introduction

This one-day workshop was part of the Global CCS Institute's Americas knowledge sharing program. There were more than 20 participants from industry, government and academia. The appendices contain the agenda and speaker biographies. Presentations are available on the [Institute website](#).

Prior to the workshop, participants were asked to identify some key issues:

- How will the standard inform public engagement?
- Will the standard be harmonized with US?
- How will the standard be implemented, especially by governments?
- How will the standard be updated?
- Will the standard impact storage capacity?
- Will the standard address the source of CO<sub>2</sub> should it leak?
- How rigorous is the site screening? Will there be a third party review?

## Presentations

Victor Der, Chief Representative and General Manager - The Americas of the Global CCS Institute, provided opening remarks highlighting knowledge sharing as one of the principle activities of the Institute, and the fact that standards need to be clear, workable and defensible.

### **Session: CSA Z741 Geological Storage of CO<sub>2</sub>**

*Discussion Lead - Jeff Walker, Project Manager, Sustainability Group – CSA Group*

Jeff provided background information on the Canadian Standards Association, a definition of a standard and the various types of standards. At CSA, standards are developed through a consensus process, which requires agreement but not unanimity. Expert committees from industry, government, academia and NGOs drafted the storage standard (CSA Z741). CSA provided secretariat and logistic support to the process. Some of the benefits of standards are enhanced knowledge sharing, support for financing projects, and acceptability.

The storage standard (CSA Z741), published in November 2012, was a Canada-U.S. venture, with funding from IPAC-CO<sub>2</sub>. It is not highly prescriptive. The main sections cover management systems, site screening, risk management, well construction, monitoring and verification, and site closure.

The experience of EOR projects operating in Canada and the US as well as CCS projects under development provided much input to the standard. Although Z741 is not specifically aimed at enhanced oil recovery projects, there are parts of the standard that are applicable.

CSA Z741 will be the seed document for a new international standard (ISO TC 265) on the geological storage of CO<sub>2</sub>. In addition to storage, ISO TC 265 will also cover standards for capture and transportation of CO<sub>2</sub>. Publication of the ISO standard is expected in three to four years.

## **Session 2: Impact of Z741 on public engagement and safety**

*Discussion Lead- Jacqueline Chan (Sharp), Managing Partner - Navius Research Inc.*

The presentation challenged: *Who is the public, and what is engagement?*

Key points from this session were:

- Engagement spans from: Inform, Consult, Involve, Collaborate to Empower. Typically, engagement is most useful with the middle three (Involve to Collaborate). Effective public engagement is a key risk mitigation tool. It can reduce the risk of project delays, enhance the approval process, improve the project, and reflect positively on the reputation of the proponent. Public stakeholders include the general public, local community, NGOs, and sometimes employees, shareholders, and/or customers.
- Z741 advises operators to identify project stakeholders early and engage them during all phases of the project. Operators should be open and transparent, develop and implement a local stakeholder advisory strategy, and report on all major events. Public communications should start early and be frequent; come from a designated individual; involve public meetings, notices, site visits, and other channels; and clearly share scientific, technical and economic information that is relevant to local stakeholders. Stakeholder views should be considered in the risk management process, and stakeholder needs should be met to the extent practicable.
- The public engagement principles in Z741 generally reflect best practices, but little detail is provided on how to implement them. Workshop participants believed this was due to the importance of keeping engagement efforts locally relevant. Operators should refer to the excellent CCS public engagement guides that are available. Some specific and important additions to Z741 would be strong recommendations for operators to undertake a social site characterization very early in the project, and to start public engagement before on-site characterization work (such as seismic surveys) begins.

*Safety:*

- Z741 prescribes that health, safety, and environmental protection for workers and local communities should be a project's highest priorities. The safety risks associated with CCS are low, and are addressed through detailed standards for site characterization and assessment, risk assessment and mitigation, and well materials and construction.
- Perceived safety risk is the real issue. Effective risk communication needs to convincingly address the probability of adverse events occurring, and address misperceptions about the severity of their consequences. Z741 identifies risk communication objectives, but does not specify how to conduct effective risk communication. Best practices include being open and honest, using language and contexts that are meaningful to the audience, partnering with trusted messengers (such as academics and researchers), acknowledging information gaps, and making extensive project information available.

- The effectiveness of Z741 at improving perceptions about safety will depend on public trust in the CSA process and the standard compared with existing regulations.

### **Session 3: Impact of Z741 on project costs**

*Discussion Lead: Allan Greeves, Manager, Weyburn - Cenovus Energy Inc.*

Allan was part of the team that developed Z741, having multiple disciplines (operators, regulators, and stakeholders) provided different perspectives that enhanced the quality of the product.)

Some key points from this session:

- The inclusion of a continuous improvement loop will lead to a better standard and lower costs to storage project operators.
- The Western Canada Sedimentary Basin (WCSB) has a great deal of data available for storage projects, which may not be as comprehensive in other geological settings.
- Project costs tend to start relatively low in the site selection/site characterization process, accelerate through the development phase, and slow during the operation and closure phases. During the site screening/characterization phases, the standard focuses on models of the storage complex as a tool to predict its performance. Geologic, Flow, Geochemical and Geo-mechanical models should be used. Allocation of resources among the models needs investigation and will depend on site- specific conditions.
- Well design must be CO<sub>2</sub> compliant to address corrosion resistant casing (chrome or stainless steel) and other components and CO<sub>2</sub>-resistant cements. The design must take into account the composition of the CO<sub>2</sub> stream, as it may contain other contaminants such as H<sub>2</sub>S, SO<sub>x</sub> and NO<sub>x</sub>. Moisture removal from the CO<sub>2</sub> stream is important, as moisture makes CO<sub>2</sub> highly corrosive, particularly for the wellhead design.
- The monitoring system needs to include provision for access at future dates to provide data over long time periods.
- About one-third of the costs are for casing and cement, one-third for the drill rig and support, and one-third for the mud system, logging and other services.
- The MMV system must start with a comprehensive data baseline. It must be able to demonstrate containment of the CO<sub>2</sub>, be used to verify the performance of the models, and lead to adjustment of the models if required. A suite of approaches is required for comprehensive MMV, such as: seismic, observation well, injection rates, pressure and temperature data and CO<sub>2</sub> composition.
- The standard has the potential to reduce regulatory time periods, improve project understanding, apply best practices and integrate risk assessment with MMV process.

#### **Session 4: Will Z741 mitigate project risks?**

*Discussion Lead: Rob Bioletti, Director, CCS Policy, Electricity and Sustainable Energy Division - Alberta Energy*

Key points from the session:

- The storage standard is important to Alberta as it can provide assurances for safety, enhances awareness of CCS, and provides a knowledge-sharing forum. Sections 5 (site screening/characterization), 6 (risk management), 7 (well infrastructure) and 8 (MMV) are particularly helpful as the technical aspects are well defined.
- Other risk elements that need consideration are Environmental, Economic and Social. The iterative process in Z741 provides a system to manage the risk, but does not identify the risk elements.
- This session included an entertaining, informative, and enlightening group exercise that showed the difficulties in reaching agreement and the weighting of various risk elements as perceived by the various stakeholders.

#### **Session 5: Panel and Open Facilitated Discussion: Legal, Liability and Commercial Issues**

*Panelists:*

- *Bob Page, Director, Enbridge Centre for Corporate Sustainability – University of Calgary*
- *Robert Craig, Director, Strategy and Technology - Integrated CO<sub>2</sub> Network (ICO<sub>2</sub>N).*
- *J-P. Jepp, Advisor, Emerging Regulatory Issues - Shell Canada*

The salient points made by the panelists and workshop participants include:

- In general, standards help to define best practices. Z741 has a risk focus, which provides some degree of comfort to lenders and shareholders when addressing the financial and commercial aspects of CCS projects. For example, the McKenzie Valley pipeline hearing would have benefitted from a standard that addressed construction in permafrost, potentially reducing the time to undertake that hearing.
- Standards assist with the introduction of new technologies such as CCS by showing the steps to manage risk, design, and costs. It is becoming clearer that governments are finding it increasingly challenging to meet public expectations on some environmental issues. Standards may help bridge that gap in ways that voluntary industry actions might not. A carbon price of \$40 per tonne was thought to be the floor price necessary to incentivise significant CO<sub>2</sub> reductions, although CCS would likely require a much higher mitigation price.
- There is a need for a higher carbon price to incentivise CCS, but it should be phased in from the current \$15 in Alberta. ICO<sub>2</sub>N's work on CCS costs indicates that capture is about 80% of the cost, transport 15%, and storage 5%. The latter allocation seems low in light of recent findings and should be revisited.
- Currently, lenders are sceptical of CCS projects and may require a premium due to actual and perceived risks. The storage standard may reduce some of their concerns.

- Regulatory applications for the Quest Project were a good learning experience that informed some of the regulatory, liability and commercial issues in Alberta's Regulatory Framework Assessment, which in turn were transposed into Z741.
- The standard also provides some comfort level and assurance for costs and public acceptability, as it sets a level of expectation for the performance of CCS projects and identifies CCS as a viable GHG mitigation technology.

### *General Discussion*

Z741 is a useful piece of work, as it sets out the elements of storage in a reasoned fashion. The assumption of long-term liability would have been a showstopper, but Alberta removed it from consideration by taking on this liability. Therefore, the standard did not have to address this issue. The post-closure stewardship fund is a highly site-specific issue and, therefore, many felt that it should not be included in the standard. The scope of the standard is about right in terms of being workable and should not go beyond site closure. However, as experience is gained, the closure section can be expanded. The U.S. EPA might find justification for reconsidering the 50-year monitoring period to a shorter time period in its regulation.

### **Session 6: Wrap-up**

*Victor Der, Chief Representative and General Manager, The Americas – Global CCS Institute*

An informal survey of the participants indicated that the workshop was a qualified success, and there was general agreement that its format and content were very good.

Suggested areas for potential improvement:

- Would be good to be able to attract a larger audience with a catchier workshop title/theme on standards, although discussion of standards can be rather esoteric. There is not much concern over standards when they are successfully implemented and lacking in issues or controversy.
- Getting more visibility for Z741 and providing a high level summary of the standard.
- The workshop output should be more specific.
- Include a panel on the development process of the standard.
- Case studies of the use of the standard would be a good addition.
- It was emphasized by the Global CCS Institute workshop organisers that there is value in sharing knowledge gained from Z741 and CCS projects generally. The participants were invited to join the Institute's CCS network on a voluntary basis, as this would encourage familiarity among the CCS players, and generate issues and ideas for research and discussion. The Institute's website would be the forum, along with workshops and other communication media. Follow-up emails will be sent out.

The participants were thanked for their time and contribution to this workshop.

### **Concluding Comments**

- The standard is a positive step and thus enhances the credibility of storage projects.
- The inclusion of social site characterization and risk communication techniques would improve the standard.
- Although the standard was developed jointly with US, at present it does not seem likely that the EPA will harmonize it with its current regulations.
- The general sense was that when governments adopt Z741, it should be adopted in its entirety, rather than piecemeal.
- There is an appetite among the participants of the standards workshop to join an informal voluntary network to exchange ideas and address issues on this standard and other CCS issues.

Prepared by Ian Hayhow

June 2013

## Appendix 1: Agenda



THE ROLE OF STORAGE STANDARDS IN THE DEPLOYMENT OF CCS  
WESTIN CALGARY, 320 4<sup>TH</sup> ST. NW, CALGARY, AB CANADA

### AGENDA

<b>TIME</b>	<b>THURSDAY JULY 6, 2013</b>
8:00 AM	<b>Registration and Continental Breakfast</b>
9:00 AM	<b>Welcome and Introductions</b> Presenter and Discussion Leader: Victor Der, General Manager, The Americas – Global CCS Institute
9:20 AM	<b>Session 1: CSA Z741 Geological Storage of CO<sub>2</sub></b> <b>Main points and purpose of the standard (site selection, risk management, well design and MMV)</b> Presenter: Jeff Walker, Project Manager, Sustainability Group - CSA Group
10:00 AM	<b>Session 2: Impact of Z741 on Public Engagement and Safety</b> Presenter: Jacqueline Sharp, Managing Partner - Navius Research Inc.
10:40 AM	<b>Break (and networking opportunity)</b>
11:00 AM	<b>Session 3: Impact of Z741 on Project Costs</b> Presenter: Allan Greeves - Cenovus Inc.
12:00 PM	<b>Lunch (and networking opportunity)</b>
1:00 PM	<b>Session 4: Will Z741 Mitigate Project Risks?</b> Presenter: Rob Bioletti, Director, CCS Policy – Electricity and Sustainable Energy Division - Alberta Energy
2:00 PM	<b>Break (and networking opportunity)</b>
2:30 PM	<b>Session 5: Panel and Open Facilitated Discussion - Legal, Liability and Commercial Issues</b> <b>What have we learned? Have there been more questions raised than answered?</b> <b>What is the way forward? How will regional (or in-country, e.g. CSA) standards square with international standards (e.g. ISO) – or do they have to?</b> Panelists: Bob Page, Director, Enbridge Centre for Corporate Sustainability - University of Calgary, Rob Craig, Director, Strategy and Technology - ICO <sub>2</sub> N, and J-P Jepp, Advisor, Emerging Regulatory Issues - Shell Oil Company Discussion Leader: Victor Der - Global CCS Institute Rapporteur: Ian Hayhow - Global CCS Institute
4:00 PM	<b>Wrap Up</b> Victor Der, Global CCS Institute

## Appendix 2: Speaker biographies

### Session 1: Jeff Walker, Project Manager, Sustainability Group – CSA Group

Jeff joined the CSA Group in 2005, and is responsible for standards development support for North American and International standards in a variety of fields. Jeff was engaged in CSA's Canada-USA standard Z741 for the Geological Storage of Carbon Dioxide. He is now the Secretary for ISO TC265, the ISO committee for Carbon Dioxide Capture, Transportation, and Geological Storage. Jeff has a M. Eng. in Civil Engineering, and also holds an MBA.

### Session 2: Jacqueline Chan (Sharp), Managing Partner - Navius Research Inc.

Jacqueline leads the Communications and Stakeholder Engagement Group. She has developed public and stakeholder engagement strategies, conducted opinion research and developed communication and consultation materials for clients in government, industry, labour, academia and the non-profit sector. Jacqueline has particular expertise in public and stakeholder engagement related to carbon capture and storage, and has been conducting research and assisting clients in this field since 2003.

Jacqueline holds a Bachelor of Commerce degree from Queen's University and a Master of Resource and Environmental Management degree from Simon Fraser University. She continues to conduct academic research and supervise graduate students through SFU's Energy and Materials Research Group.

### Session 3: Allan Greeves, Manager, Weyburn - Cenovus Energy Inc

Allan is currently the Manager of Cenovus's Weyburn CO<sub>2</sub> miscible flood operation. Prior to his leadership of the Weyburn asset, Allan was manager for Cenovus's Pelican Lake project, a polymer flood EOR project in northeastern Alberta. Allan's background also includes coal bed methane and shale gas evaluation and development. Allan is a graduate of the University of Alberta with a degree in Petroleum Engineering. He is registered as a professional engineer in Alberta, Saskatchewan and British Columbia.

### Session 4: Rob Bioletti, Director, CCS Policy, Electricity and Sustainable Energy Division - Alberta Energy

Rob Bioletti is the Director of Carbon Capture and Storage (CCS) Policy in the Electricity and Sustainable Energy Division of the Alberta Department of Energy. Rob was one of the leaders for Alberta's CCS Regulatory Framework Assessment in 2012. He has fifteen years of experience in policy development, air emissions inventories, alternative energy technologies and process simulation. Rob is a chemical engineer who graduated from the University of Alberta. He worked at Syncrude Canada, the Alberta Research Council and Alberta Environment before joining Alberta Energy in 2010.

**Session 5: Rob Craig, Director, Strategy and Technology - Integrated CO<sub>2</sub> Network (ICO<sub>2</sub>N).**

Rob has undertaken challenging roles in conventional energy, pipelines, and carbon management in the energy sector for 25 years. He has lead ICO<sub>2</sub>N's efforts to evaluate capture technologies and costs, advanced multi-stakeholder industry projects, and lead discussions on CCS policy and regulation in Canada. He has participated on the Alberta Carbon Capture and Storage Development Council and the Environmental working group of the Alberta Regulatory Framework assessment. Throughout these roles he has promoted a vision for efficient CCS transportation networks in Western Canada. Rob sits on the Environmental Committee of the Calgary Chamber of Commerce and Chairs the Alberta CO<sub>2</sub> Purity Project.

**Bob Page, Director, Enbridge Centre Corporate Sustainability – University of Calgary**

Dr. Page has 25 years of experience in exploring sustainability challenges and the means for corporate execution. Before joining the Centre in November 2012, Dr. Page was TransAlta Professor of Environment and Sustainability in the Institute for Sustainable Energy, Environment, and Economy (2007- 2012) at the University of Calgary. In 1997 he became Vice President, Sustainable Development for the TransAlta Corporation, where he achieved the number one ranking in the world by the Dow Jones Sustainability Index for electrical utilities. He serves on three non-profit boards for NGO and research organizations. He is the current chair of the ISO 14,000 international environmental standards body in Geneva, and a former Chair of the National Round Table on Environment and Economy. In December 2012, Bob was awarded the Queen's Diamond Jubilee Medal for his contribution to Canadian environmental management.

**Jon-Paul Jepp, Advisor, Emerging Regulatory Issues - Shell Oil Company**

From 2008 to 2012, J.P. was the Regulatory Coordinator for the Shell Quest CCS Project. J.P. was project coordinator for the development and delivery of Alberta's first Carbon Sequestration Lease Application and all regulatory applications. He was a lead liaison with governments and regulators on gaps in the legislative and regulatory framework for CCS in Alberta, was a member of the Regulatory Working Group in the Government of Alberta CCS Regulatory Framework Assessment Process, and is leading in the development of the Alberta CCS Offset Protocol. J.P. has recently moved on to a new role with Shell Corporate Regulatory Affairs, and is now responsible for cross cutting emerging regulatory policy, with a focus on the upcoming federal and provincial GHG regulations.