Otway Demonstration Quantitative Risk Assessment Case Study

Eris O’Brien - Risk Discipline Leader


IEA GHG R&D Programme Joint Networks Meeting
New York, USA
11th – 13th June 2008
Established & supported under the Australian Government’s Cooperative Research Centres Programme

Supporting participants: Australian Gov Departments | Australian National University | LBNL | ARC | CANSYD | Meiji University | The Process Group | University of Queensland | Newcastle University | USDoE
CO2CRC Otway Project, Victoria

**Description** – Australia’s only operational storage project, involving demonstration of geological storage of CO₂ and monitoring and verification of the behaviour of the stored CO₂.

**Storage** – Depleted gas field at 2000m depth
- **Storage Commence** – April 2, 2008
- **Storage Rate** – 100,000 tonnes total over 1-2 years (Stage 1)

**Cost** – $A 40M plus

**Partners** – CO2CRC, Industry, Government and Researchers (Universities, CSIRO, GA, LBNL, ARC, GNS, KIGAM),

**Participating countries** Australia, New Zealand, USA, Korea, Canada
Monitoring and verification: key components of the Otway project
Otway QRA Risk Methodology

• URS’s trademark RISQUE methodology in conjunction with CO2CRC expertise to come up with a quantified risk assessment.
• Risk process was a structured 2 day workshop (July 2007).
• An expert panel was used and regulators were in attendance for learnings, which aided project approvals.
• Expert panel considered the data gathered since the 2005 initial risk assessment and updated the risk assessment for the pilot project.
• Concentrated on containment in (and leakage from) intended storage site and not leakage into overlying formations or surface
CO2CRC Otway Project has provided important learnings on Regulatory issues

Onshore activities are regulated in Australia by the State authorities, but there is currently no CCS legislation in place. Therefore to enable the Otway Project to proceed, CO2CRC has worked with the Victorian State regulators, to meet statutory environmental, health and safety standards relevant to a CCS project, using existing legislation including:

- Petroleum legislation
- Water legislation
- RD&D provisions of the EPA
- Planning scheme exemptions
- Compulsory land acquisition
- Health and safety
- Biodiversity legislation (EPBC)
RISQUE Method* Explained

*(Risk Identification and Strategy using Quantitative Evaluation)*

- **Quantitative**: Risk = Probability x Cost (measured in some common currency)
- **Use Expert Panel**: eg. Geology, Geophysics, Geomechanics, Geochemistry, Simulations, Hydrogeology, RA Technology
- **Panel identifies**:
  - risk events, their likelihood, and costs
  - options, their costs and benefits
- **Assess each potential alternative**:
  - Estimate risk quotient
  - Estimate risk cost (reasonable cost due to risk event)
  - Determine benefit – cost
  - Use outputs to formulate strategy

*Described in book: Triple Line Risk Management*
<table>
<thead>
<tr>
<th>The Risk Register (1)</th>
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<tbody>
<tr>
<td>Permeable zones in seals</td>
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<tr>
<td>Faults through seals</td>
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<tr>
<td>Injection and monitoring wells</td>
</tr>
<tr>
<td>Regional scale over pressurisation</td>
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<tr>
<td>Risk Factor</td>
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<td>-------------------------------------------</td>
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<tr>
<td>Local scale over pressurisation</td>
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<tr>
<td>Exceeding the spill point of the storage site</td>
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<td>Earthquake induced fractures</td>
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<td>Incorrectly predicting the migration direction</td>
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Results

At a planning confidence level of 80% it was seen that:
- No single risk event exceeded acceptable risk quotient.
- Total risk events quotient less than acceptable target (1% leakage over 1000 years) (LOW RISK)

Major risk events are:
- Leakage from existing faults
- Leakage from wells – in particular damage to cement.
Final step – analyse the consequence of leakage from primary containment.

- Leakage into secondary containment would have negligible impact to human health, safety, the environment or to any natural resources in the area.
- Risk of leakage from secondary containment considered almost impossible*.
- Risk of leakage into freshwater aquifers or to surface considered almost impossible.
- Migration of heavy metals out of primary containment considered almost impossible.

* Almost impossible – 1 in $10^{-6}$
Acknowledgements

- CO2CRC Study team – Max Watson, Andy Rigg, the Expert Panel & Adrian Bowden (URS)
- CO2CRC Sponsors and Research Collaborators:
Context

Otway Basin Pilot Project

- CO2 sourced from a nearby CO2-rich gas field (Buttress) and transported via pipeline to the injection site (CRC-1) located to the east of and downdip from a depleted gas field (Naylor) in the Port Campbell region of the onshore Otway Basin.

- The injection volume is fixed at 3 MMscf/d for a period of 2 years for a total of 100,000t stored.

- The single well used as the injector is the CRC-1 well, located ~300m from the crest of the structure. The existing Naylor-1 well is the monitoring well. Both wells to be in contact with the CO2 plume throughout the ‘risked’ 1000 year period.