Upscaling CCS: How In Salah can inform Tomakomai

Iain Wright, Program Manager In Salah JIP (retired)

CO_2 Capture and geological Storage (CCS) has the potential to solve a fifth of the Climate Change problem. All the elements required to capture, transport and geologically store CO2 at industrial-scale are in operation somewhere in the world today and a great deal of research has been undertaken on the topic. The three existing industrial-scale CCS projects (Sleipner, Weyburn and In Salah) are all in the oil and gas sector and represent significant diversity:

- The Sleipner CCS project is economically viable because it avoids Norwegian offshore CO_2 tax. It is regulated under Norwegian Petroleum Law and a separate research project monitors the disposition of the stored CO_2.
- The Weyburn Enhanced Oil Recovery uses anthropogenic CO_2 (recycled through multiple patterns) to recover oil. It is economically viable because the value of oil recovered exceeds the cost of CO_2 injected. It is regulated under Canadian Petroleum Law and a separate research project monitors the disposition of the stored CO_2.
- The In Salah CCS project was initiated in expectation of credit under the Kyoto Protocol and shut-down when it became clear that such credit would not be realised. It is regulated under Algerian Petroleum Law and a separate research project monitored the disposition of the stored CO_2.

The Tomakomai project will be one-tenth the scale of the In Salah project and can build the technical confidence required to construct an industrial-scale CCS project in Japan. Lessons we learnt at In Salah – that I would like to hand-over to the Tomakomai project include:

1. **Careful site selection is essential**
   Careful site selection, characterisation and management are essential requirements for secure CO_2 storage and determine the success of the subsequent monitoring programme. It is essential to acquire high-quality baseline data.

2. **Monitoring techniques must be site specific**
   The CO_2 stored at In Salah was monitored to assess site-specific leakage risks identified during site selection, development and operation. Technologies for monitoring stored CO_2 at one site may not work at all for other sites. There is no "one size fits all" monitoring programme.

3. **Storage sites share common leak risks**
   The main leakage risks for most CO_2 geological storage sites are governed by:
   a. Legacy well-bore integrity
   b. Cap-rock integrity
   c. CO_2 plume migration direction

4. **Quantified Risk Assessments (QRA) – should inform operations**
   QRAs should be carried out periodically and used to manage leakage risk by informing operations and monitoring strategies. Several assessment methodologies are available, but there is no regulatory agreement on acceptable levels of risk.

5. **Injection rates and pressures need ongoing management**
   CO_2 injection rates and pressures need to be linked to geo-mechanical modelling and must be continuously monitored and managed. CO_2 plume development is not homogeneous: requiring high-resolution data for reservoir characterization and modelling. Advanced geo-mechanical modelling requires further work - focusing on the coupled effects of fluid-dynamics, rock mechanics, geo-chemistry and temperature.