



Environmental regulations of subsea geological storage of CO₂ in Norway

Author: Anne-G.Kolstad, the Norwegian Environment Agency



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NEAs history on CCS

- Has supported CCS since it was first deployed at the Sleipner field (1996)
- Has argued for deployment of CCS on gas power plants if these should be built in Norway the last 20 years
- Considers Sleipner and Snøhvit to be excellent demo cases for promotion of geological storage of CO₂
- Has actively engaged in international work to develop regulations in order to enable CCS
- Revised the environmental permits for Sleipner and Snøhvit in 2016

Environmental Regulatory framework - Norway

- The Pollution Control Act (March 13, 1981) stipulates that all activities that may entail pollution or risk of pollution need to have a permit to pollute
- Subsea injection of CO₂ is defined as pollution, hence a permit is required
- Permits (pursuant to the Pollution Control Act) were issued for Sleipner (1996) and Snøhvit (permit issued 2004)
- Environmental Impact Assessment (EIA) is required by law for CO₂ storage (Petroleum Act)

Norwegian regulations vs EU-regulations and other international commitments

- The EU-directive 2009/31 EC on geological storage of CO₂ was transposed into Norwegian legislation on Dec 5, 2014
- Norway joined the EU-ETS (Greenhouse Gas Emission Trading System, (EU-directive 2003/87/EC) in 2008
- CCS was included in the EU-ETS system from Jan 1, 2013. The EU-directive 2007/589/EC on monitoring, reporting and verification of emissions applies for CCS
- Norway is Contracting Party to OSPAR and to the London Protocol. Decisions and Recommendations are observed.

The EU-directive on geological storage of CO₂

- The responsibility for implementing the provisions of the EU-directive on geological storage is shared between
 - the Norwegian Petroleum Directorate (NPD)
 - the Norwegian Environment Agency (NEA)
- NPD issues a storage permit pursuant to the Petroleum Act (or, alternatively «The Act related to exploitation of subsea natural resources other than petroleum»)
- NEA issues an environmental storage permit pursuant to the Pollution Control Act

Key elements in an application for a CO₂-storage permit

- Environmental risk in case of leakages has to be assessed
 - Leakage scenarios
 - Mapping natural resources in the influence area for leakage scenarios and assess the impact
- Monitoring program
- Financial security and financial mechanism

Provisions in the environmental permits

The regulations require that an environmental permit for CO₂ storage shall comprise :

- The total quantity of CO₂ authorized to be stored, injection rate, **injection pressure and pressure in the reservoir**
- The composition of the CO₂-stream and the procedure for receiving CO₂ for storage
- Any other measures necessary to prevent irregularities
- **The monitoring plan** and criteria for updating the plan
- Reporting procedures
- The establishment of a **plan for corrective measures** in case of leakages
- Procedures regarding closing down of the storage site and a plan for the post operational phase
- **The establishment and maintaining of financial security**

Monitoring program

The purpose is

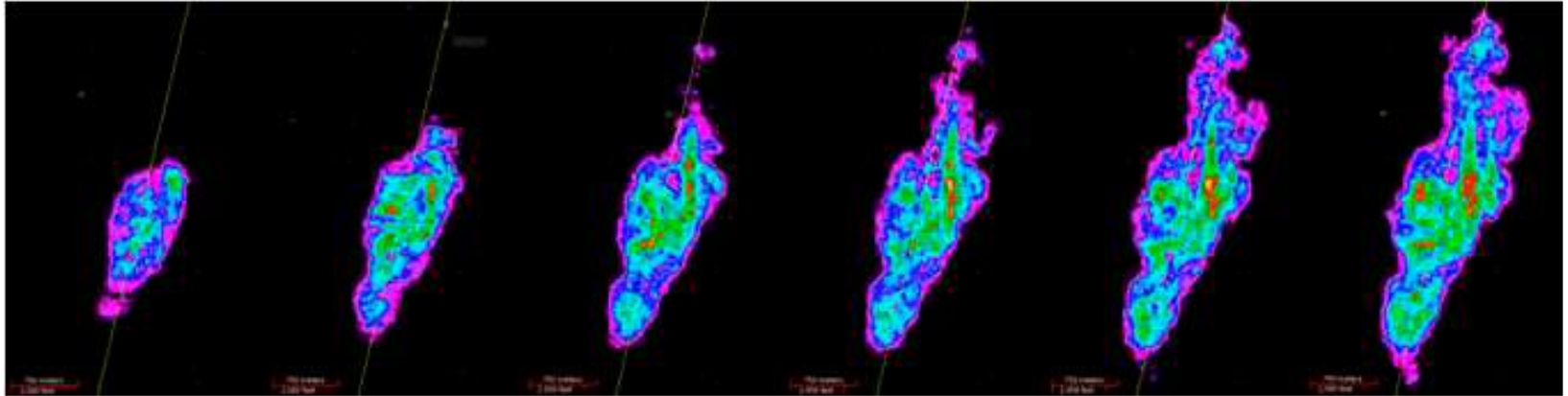
- to verify that CO₂ behaves as predicted (and with no risk of leakages)
- to detect and quantify leakages and to implement corrective measures

The program shall run throughout the injection phase, during the close down phase and in the post-injection phase as long as the State finds it necessary (in any case > 20 years)

Monitoring Program

- Pre-injection
 - Establish baseline (seismic/chemistry/biota/marine resources)
- Injection phase
 - Continuously monitoring of p, t of CO₂ at the wellhead
 - 4 D seismic survey at regular intervals
 - Gravimetry (to verify seismic interpretation)
- Close down phase
 - 4 D seismic survey
- Post-injection phase
 - 4 D seismic survey at defined intervals (declining frequency)

4-D Seismic – Image of injected CO₂ in the Utsira formation



Temperature and pressure data– wellhead Sleipner

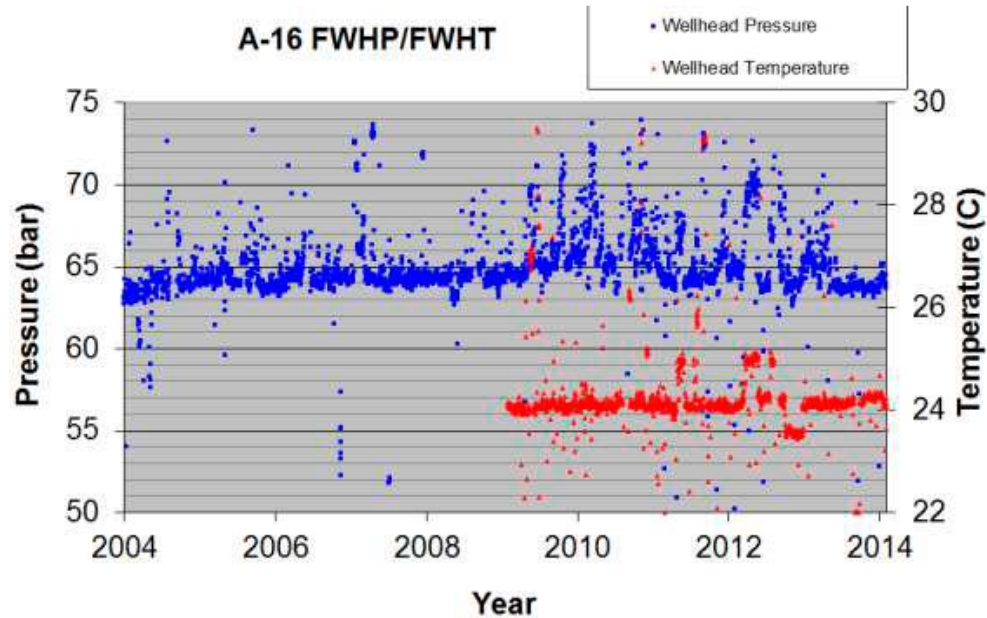


Figure: Statoil

Monitoring methods need to be developed

- 4-D Seismic provides excellent images of CO₂-movements in the formation, but
 - Cannot meet the requirement in the ETS on quantifying leakages with a certain accuracy
 - Missed CO₂ cannot be detected if not in the order of Mt
 - Seismic surveys not **economically** feasible to undertake more frequently than every 2. or 3. year ?

Financial security

- The financial security shall ensure that all permit obligations can be met
- These permit obligations include:
 - monitoring program
 - corrective measures
 - closure of the storage site
 - post-operational monitoring
 - surrender of allowances for any emissions from the site, including leakages, pursuant to ETS Directive
- The decision on what kind of Financial Security that can be accepted, will be decided on a case-by-case basis in a joint decision by the Ministry of Climate and Environment and the Ministry of Petroleum and Energy.

Thank you for the attention!

For detailed questions and more information,
please contact

Anne-Grethe Kolstad, Norwegian Environmental Agency

anne-grethe.kolstad@miljodir.no



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