RISK MANAGEMENT AND MONITORING STRATEGY OFFSHORE

Peterhead CCS Project
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PETERHEAD CCS PROJECT OVERVIEW
PROPOSED PETERHEAD PROJECT AT A GLANCE

- **World First** – the first full-scale CCS project on a gas-fired power station
- **Status** – proposal currently in Front End Engineering Design phase, seeking regulatory approvals and Government funding for capital and operating expenses
- **Where** – capture at Peterhead Power Station; storage in depleted Goldeneye gas reservoir (100 KM offshore)
- **Impact** – 10 to 15 million tonnes of CO₂ captured over a 10 to 15-year period (90% CO₂ capture from one turbine)
- **Technology** – post-combustion capture using amines
Peterhead Power Station
Operating since 1982

Goldeneye Platform
568 BScf gas produced

Project Technical Line-Up

GAS TURBINE
Flue gas

ABSORBER TOWER
CO₂-rich amine

REGENERATION TOWER

CO₂

COMPRESSION AND DEHYDRATION
2.0 OFFSHORE RISK MANAGEMENT & MONITORING
Ensure Conformance to indicate long-term effectiveness of CO₂ storage
- demonstrating actual storage performance is consistent with expectations about injectivity, capacity and CO₂ behavior inside the storage complex

Ensure Containment to demonstrate the safety of CO₂ storage
- detect significant irregularities, migration and leakage of CO₂
- detect significant adverse effects to environment and human health

Verify Safeguards
- Verifying the expected effectiveness of existing safeguards created by site selection, site characterization and engineering designs
- Creating additional safeguards using monitoring systems to provide early warning to trigger timely corrective measures
MONITORING AND CORRECTIVE MEASURES FORM PART OF THE BARRIER SYSTEM

1. Sub-surface release of CO2
2. Lateral migration
3. CO2 release at seabed
4. Abandoned wells
5. Sub-surface release of CO2
6. CO2 release at seabed
7. Injection wells

Acidic fluids, Faults, fractures & features, Stress of injection, Diffusion, Abandoned wells, Injection wells

Release outside complex (subsurface) - well-related threats

CO2 released from complex

AW-01 Flow up abandoned exploration and appraisal (E&A) wellbores to near surface

B-PP Four of the wells in Goldeneye field are in contact with Captain reservoir and have good plug(s) across the primary seal. Fifth well is on the border and does not see Captain. It too has plug(s) across the primary seal.

B-ASPI Additional shallower plugs (well-specific)

Koster
Engineered
Drilling Reports
Dynamic Modelling Report

B-SH Sub-hydrostatic until re-pressurised by aquifer.

Tucker
Natural
Pressure Data (Downhole Gauges)

B-BS Squeezing shuttle can reduce annul and pack off casing

B-BS Baseline survey (check seabed around area of wells, and potentially seismic surveying) to confirm no indication of leakage. Intervene if necessary.

Susanto/Dean
Detect

B-MF Monitoring for CO2 plumes (e.g. microseismic, 4D seismic or fall off testing) and intervention (if tests showed positive signal)

Susanto/Dean
Detect

MMV

Flow could occur even when sub hydrostatic if there is a small gas leak at the top of an abandoned well bore and a large gas leak at the bottom.

B-MI Monitoring and intervention.

Susanto/Dean
Correct

Well-related release mechanisms

Geological/geomechanical release mechanisms

CO2 release at platform

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Detect

MMV

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Not all threat branches have the same impact on receptors

- Well related pathways have the ability to rapidly bring CO$_2$ to the surface or near surface
- All other paths involve significant buffering/delaying steps
PRESSURE IS REDUCED BECAUSE OF PRODUCTION, CO2 IS LOCALISED IN THE HYDROCARBON FIELD LOCATION

Different aquifer scenarios

CO2 is shown in red, hydrocarbon (gas and condensate) in green and water in blue. Original OWC and GOC are pink lines.
- Test each potential technology against valid migration scenarios for each phase of the project.
- Select a set based on tiered monitoring strategy: detect, define, delineate
FIT FOR PURPOSE MONITORING PLAN

- Established a set of monitoring technologies that
  - satisfy the conformance requirement
  - add extra barriers or controls to the existing barriers to reduce the risk of a significant irregularity even further