PROVING CONTAINMENT FOR CCS IN GOLDENEYE

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Cliff Lovelock
Senior Production Geologist, Shell U.K. Ltd
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AGENDA

- Brief outline of the Longannet CCS project
- How much containment do we need?
  - Cap-rock
  - Overburden
  - Beyond?
- Some other considerations
- Conclusions
THE LONGANNET TO GOLDENEYE PROJECT

- CO₂ extracted from flue gas at Scottish Power’s 2.4 GW coal-fired Longannet Power Station
- CO₂ piped to St Fergus Gas Terminal using existing National Grid gas pipeline
- CO₂ transported to Goldeneye field using existing 101 km offshore pipeline
- Carbon capture technology provided by Aker Clean Carbon, already tested on site with mobile pilot plant
- CO₂ stored in the depleted gas reservoir, injecting via existing platform wells
Can the Goldeneye site safely store a volume of CO$_2$ delivered over the proscribed time period from the power plant?

- Does it have the capacity?
- Can we transport and inject it?
- Will the CO$_2$ stay in the store?
- Can it be monitored and can corrective measures be deployed?
HOW MUCH CONTAINMENT DO WE NEED?

- Definitions taken from the EU directive

3. 'storage site' means a defined volume area within a geological formation used for the geological storage of CO₂ and associated surface and injection facilities;

5. 'leakage' means any release of CO₂ from the storage complex;

6. 'storage complex' means the storage site and surrounding geological domain which can have an effect on overall storage integrity and security; that is, secondary containment formations;

15. 'CO₂ plume' means the dispersing volume of CO₂ in the geological formation;

17. 'significant irregularity' means any irregularity in the injection or storage operations or in the condition of the storage complex itself, which implies the risk of a leakage or risk to the environment or human health;

19. 'corrective measures' means any measures taken to correct significant irregularities or to close leakages in order to prevent or stop the release of CO₂ from the storage complex;
A STORAGE COMPLEX FOR GOLDENEYE

Sea surface

Licence

Leak requiring emissions allowances

“Leakage”

Overburden

“Seal”

Hydraulically connected

Captain Lista & Dornoch

Nordland Group

Weastray & Stoney Groups

Moray Group

Lista mudstone

Montrose Group

Secondary Storage (overburden)

Chalk Group

Storage Site

Plume Mantle Frac

Captain Sandstone

Humber Frac

Plumeless Grouping

Complex Seal

Overburden

Hydraulically connected

Captain
PRIMARY BARRIER – RESERVOIR CAPROCK

From Goldeneye asset integrated geochemistry report, 2000

Marginal North Sea uplift (Alpine compression?)
NE North Sea uplift/hiatus (North Atlantic rifting)
Regional tilt (East Greenland doming)
Reservoir

STAGE III: Further burial and compression of gas 55MA till present day

STAGE IIIa: Further burial, compression of gas and oil charge 55MA till present day

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- The overburden has been mapped and modelled
- Geochemistry and Geomechanics of the caprock has been explored
Horizon slice (semblance volume) along one Eocene coal bed
MORE COMPLICATED OVERBURDEN GEOLOGY
HOW MUCH AQUIFER DO WE NEED IN THE STORAGE COMPLEX?

110km long aquifer model
Including
■ other fields
■ and aquifer extension scenarios
SOME OTHER CONSIDERATIONS

Geochemistry

- Reactive transport modelling in PHREEQC shows 0 or –ve porosity change in the caprock upon interaction with CO₂.

Geomechanics

- Modelled the effect of repressurising the field and introducing cold CO₂ into the reservoir.
- Models show that neither condition compromises caprock integrity.

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CONCLUSIONS

- Every way we have looked at the storage complex, we see no evidence that a leak is likely to occur when Goldeneye is filled with CO₂.

Specifically, we have shown:

- Goldeneye has a competent seal
  - No evidence for leakage during its life as a hydrocarbon reservoir
- Sufficient baffles and additional capacity in the overburden to contain any migration from the storage site
- Fluid chemistry and geomechanical effects do not significantly weaken the cap-rock
Thanks to:

- Department of Energy and Climate Change for supporting the project as part of the UK Demonstration competition
- Our consortium partners, ScottishPower and National Grid
- Our storage partner CO₂ Deepstore
- Team of over 120 professionals who contributed 20 man years work

Knowledge Transfer is the major product from the DECC Demo 1 Project

The detail of the work undertaken in FEED is available for all to read here:

http://www.decc.gov.uk/en/content/cms/emissions/ccs/demo_prog/feed/scottish_power/scottish_power.aspx

- 280 reports in 11 months – 75% of which have been made public!