

# IEA CCS Regulators Network

## What is required for site handover? – Questions & Answers

1. Q: Do you anticipate a different definition of leakage for reservoir that is rigidly confined geologically vs. one that is not (e.g. broad saline aquifer).

**Andy Chadwick (BGS) – No. Leakage is defined as migration of CO<sub>2</sub> out of the Storage Complex irrespective of the type of storage reservoir.**

2. Q: Pascal. Why does the lateral movement of the gas phase stop at 2km? Also, do these models include the influence of rock heterogeneity, which could allow more facile migration?

**Pascal Audigane (BRGM) – The lateral extension of the gas phase is controlled by the competition of several processes: buoyancy of the gas phase (upward migration, tendency to spread at the top of the aquifer), dissolution of the CO<sub>2</sub> in the brine (tendency to stop the extension), residual and capillary forces (tendency to stop the extension).**

**We did not include rock heterogeneity in the model (except horizontal semi-permeable shale layers in the sandy aquifer), as well as no dip of the aquifer which would also considerably modify the symmetry and the magnitude of this lateral extension.**

3. Q: Andy. You showed the ability of the model to estimate flow with higher permeability. I assume this was homogeneous permeability estimates. Can you also model the effect of higher permeability zones? That is modelling the effect of small thief zones?

**Andy Chadwick (BGS) – We used anisotropic permeability to simulate N\_S oriented thief zones. Highest permeabilities used were around 20 Darcies. Fault/fracture related thief zones in the sands are considered to be unlikely.**

4. Q: Andy or Pascal. How much of the experimental variance at Sleipner do present models account for?

**Andy Chadwick (BGS) – Not all. Present models tend to assume uniform porosity for example. Also lab measurements are from a single core, so may be not representative.**

5. Q: If we would stop Sleipner now, what time would be needed to reach a stable situation such that we can close?

**Andy Chadwick (BGS) – Depends on expert judgement as to the reliability of the predictive simulations.**

6. Q: Pascal, What level of simulation is appropriate for site stewardship transfer from developer to host Nation, following closure?

**Pascal Audigane (BRGM) – The level of simulation would differ from one aspect to another. History matching is crucial to make sure that we clearly understand what is happening. Like in oil industry, companies try to reproduce correctly well production and reservoir pressure evolution. In the context of CCS, being able to reproduce with a reasonable degree of uncertainty the gas bubble extension (according to proper monitoring data), and this during injection and let say some tens of years after injection will comfort the point that we are able to predict some evolution of the system with confidence after closure. Once the gas bubble migration is correctly calculated (which is already not an easy task), the dissolution and associated geochemical impact would be difficult to measure for a complete degree of calibration of your model (except if you have wells in vicinity the injector in order to complete the monitoring). Therefore at this stage, a good history matching of the gas bubble and pressure increase is one of the appropriate levels of simulation.**