Systematic FEP and Scenario Analysis to Provide a Framework for Assessing Long-term Performance of the Krechba CCS System at In Salah

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Assessments of the likely performance of CCS systems over operational, monitoring and longer term time-frames are necessarily complex. A wide variety of data concerning the nature of such systems' engineered and environmental components must be obtained and evaluated to attain sufficient confidence that performance will be acceptable. Computer simulations and risk assessment models are needed to help understand what the data means and to predict CO_2 migration and the temporal evolution of other aspects of the system. There will be significant uncertainties associated with the outcomes, even if underpinning data sets are of good quality.

An integrated approach is required to consider together all these complex sources of information and understand what they really mean for long-term performance of a CCS site, given remaining uncertainties. Development and application of systematic qualitative framework methodologies can help in this regard. The primary aim of such approaches is to recognise those aspects of the system that are key to performance, and how those aspects might evolve with time, in order to identify and assess the associated risks. Use of a best-practice systematic approach also helps build confidence in the outcomes by demonstrating completeness and transparency.

The first stage is normally to analyse the system and its knowledge base to identify and understand the main risks associated with the storage system. The final stage is to collate all the knowledge necessary to estimate those risks and to address potential performance issues. Outputs then provide either a final statement on performance or can be used to help prioritise further data collation or assessment work. What happens in between these stages depends upon the complexity of the assessment required. However the evidence sources required to evaluate CCS system performance and to identify and to minimise uncertainties will typically include actual site data, and outputs of complex analyses such as geomechanical and reservoir models, and well seal evolution models. Additional information comes from systems level models and integration tools. The former explore remaining uncertainties by investigating the impacts of coupled processes within simplified geometries. Integration tools include decision support tools, such as those that implement Evidence Support Logic (ESL), and "bow tie" analysis and presentation approaches. These tools can help to determine the implications of different information sources for system performance, and aid the identification and bounding of remaining uncertainties.

This paper describes the development and application of such a structured approach to the CCS site at Krechba, in the In Salah area of gas fields in Algeria. A detailed programme of work is being undertaken by the CO2ReMoVe programme to determine the long-term performance of the Krechba CCS system. The aim is to use a thorough and systematic process to define the system and associated assessment objectives and hence to integrate all work that is relevant to assessing system performance. The process included identification of the important the Features, Events and Processes (FEPs) that together describe the system and its likely evolution. An 'expected evolution' scenario was identified on the basis of existing knowledge. Scenarios describing potential situations that could involve alternative evolution mechanisms were also identified; these included consideration of mechanisms that could in principal lead to containment failure. These scenarios need to be explored to show that they are either unlikely to occur, or will be of limited impact and so do not represent threats to adequate performance. Key uncertainties that need to be addressed through further data collation or modelling analyses were identified and prioritised.

After audit against Quintessa's freely available generic online CO_2 FEP database to ensure and demonstrate comprehensiveness, the site-specific scenarios identified and the associated list of remaining uncertainties, were used to prioritise future (e.g. systems modelling) work. The outcomes of this and other data analysis and modelling programmes were in turn used to update the FEP and scenario descriptions. These outputs were then used to inform the application of an ESL-based performance integration tool (CO2-TeslaExcel) to assess overall performance and to understand the sensitivity of the outcomes to remaining uncertainties.