CCS in the CDM

One approach to developing modalities and procedures in 2011

DNV believes that the risks associated with CCS are well understood and can be effectively managed within a CDM context by an adaptive risk-based approach.

Following the COP 16/CMP 6 conference in Cancun, DNV welcomes the UNFCCC decision that carbon dioxide capture and storage (CCS) will be eligible as project activities under the clean development mechanism (CDM).

DNV considers that CCS is a strategically important technology for upholding sustainable growth whilst reducing carbon dioxide emissions. Whilst technical challenges remain, DNV believes that the main barriers to wide scale CCS deployment lie in the regulatory and financial gaps that must be closed to enable commercial operations. Inclusion of CCS in the CDM has the potential to meet a number of these challenges if a robust set of modalities and procedures can be developed based on best practice to date.

Safety, environmental protection, monitoring, verification and accounting are some of the key issues that will need rigorous treatment in the modalities and procedures to be developed. These are specifically referred to in the UNFCCC draft decision from Cancun (-/CMP.16) and DNV recognises the importance of reaching consensus on these topics, but does not believe that any major technological breakthroughs are required. The body of technical and regulatory experience held within the upstream oil and gas industry should be drawn upon in this process.

Further, DNV believes that the elaboration of modalities and procedures to address these issues should be a manageable task ahead of COP 17/CMP 7 in December 2011 given the extent of industrial and regulatory experience to date.

The UNFCCC draft decision from Cancun (-/CMP.16, §3j) states that the modalities and procedures to be developed by the Subsidiary Body for Scientific and Technological Advice (SBSTA) shall specify a methodology for safety and risk assessment of the geological storage of carbon dioxide.

This is to be welcomed and DNV would advocate consistency with the ISO31000 international standard for risk management.

ABOUT DNV

DNV is an independent foundation with the objective of safeguarding life, property and the environment through the commercial services that we provide. Services related to climate change mitigation are of particular importance. DNV is also a designated operational entity (DOE) accredited by the UNFCCC for the validation and verification of CDM project activities and has been involved in the risk assessment of CCS technology for over ten years, funded by regulators, research grants and industry.

GUIDELINES AND REGULATORY FRAMEWORKS HAVE BEEN DEVELOPED

Validation of geological storage is a feasible objective.

Regulation of carbon dioxide storage in geological formations needs to be robust and flexible enough to account for large natural variations in the subsurface.

A robust methodology that can provide assurance to all stakeholders, while being flexible enough to apply on a site-specific basis, will be the key to success. A number of regulatory frameworks for carbon dioxide storage in geological formations that reflect this objective are now emerging around the world. DNV would strongly advocate the use of site-specific and risk-based procedures for managing geological storage within the CDM, based on experience with a number of joint industry and regulatory initiatives.

A SITE-SPECIFIC AND RISK-BASED APPROACH TO SITE SELECTION, MONITORING AND VERIFICATION IS REQUIRED. Due to large variability in the characteristics of prospective sites for geological storage of carbon dioxide it is important to apply procedures for site selection that can be tailored to the unique characteristics of each site. To accommodate this it will be necessary to adopt performance based regulations in combination with a risk-based assessment process. This will provide a more robust alternative to prescriptive regulations (see fact box) which sets requirements to physical parameters (depth, lithology, etc) when it comes to validation and verification within the CDM. Such an approach ensures that the burden of proof resides with each project developer in the context of large natural variations in storage site geology.

This concept, here referred to as a site-specific approach, is consistent with usual practice for exploration, appraisal and engineering concept selection in the upstream oil and gas industry. Furthermore, to stimulate a drive towards continuous risk reduction throughout all stages of a carbon dioxide geological storage project it is important that decisions with regard to site selection and development are risk-based. This implies the following points:

- storage sites should be chosen to minimize exposure to any inherent natural risks;
- monitoring and verification programs should be tailored to each individual site;
- project developers should demonstrate repeatedly during the life time of a project that any remaining inherent risks or engineered systems are properly controlled and managed in compliance with applicable regulations, concurrent best engineering practice and best available technology;
- modalities and procedures for CCS in the CDM may require the role of an Expert Panel to consider independently the technical merits of CCS project applications. Such a panel could be based on existing organisational structures.

THE CO2QUALSTORE GUIDELINE PROVIDES A FRAMEWORK FOR SYSTEMATIC SITE-SPECIFIC AND RISK-BASED IMPLEMENTATION OF CARBON DIOXIDE GEOLOGICAL STORAGE PROJECTS. This guideline was published in 2010 after being developed by DNV in collaboration with industry partners, the IEA GHG R&D Programme and representatives from Norwegian authorities. A key intention of the guideline is to harmonize implementation of carbon dioxide geological storage in compliance with regulations, international standards and directives.

To achieve this, the guideline outlines generic workflows reflective of a site-specific and risk-based approach that, if followed, should contribute to enhanced traceability and efficient and streamlined implementation across projects. The approach reflects the current understanding of best industry practice and is exemplified in a number of case studies that are described in an accompanying workbook. The guideline and supporting documentation are available from www.dnv.com/co2qualstore.

GUIDELINES FOR CARBON DIOXIDE STORAGE INVENTORY ACCOUNTING HAVE BEEN DEVELOPED. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Vol. 2, Chapter 5 Carbon Dioxide Transport, Injection and Geological Storage) provides a basis for developing a CDM accounting framework for carbon dioxide geological storage projects. Indeed, several CDM methodologies for geological storage have already been proposed that build on the 2006 IPCC Guidelines. The European Commission has also utilized the principles of the 2006 IPCC Guidelines to develop an accounting framework for the European Emissions Trading Scheme.

THE KEY COMPONENTS OF A CDM METHODOLOGY ARE IN PLACE. NO MAJOR BARRIERS REMAIN. DNV does not believe that any major technical or regulatory barriers exist that prevent carbon dioxide geological storage from becoming part of the CDM. The combination of a robust site selection and development approach and an accounting framework tailored to geological storage are the key components of a CDM methodology, and guidelines for each of these components exist today.

PRESCRIPTIVE REGULATIONS
address how a technology shall be designed, constructed and operated in order to obtain an acceptable level of safety, often by referring to recognised codes and standards.

Prescriptive regulations are appropriate for mature technologies and well established solutions.

PERFORMANCE BASED REGULATIONS
address stakeholders' interests which the designer, constructor and operator of technology shall safeguard, e.g. by specifying performance targets.

Performance based regulations are particularly appropriate for technologies for which application and solutions vary from case to case. They allow for adopting different technical solutions to solve case specific challenges.

RISK-BASED ASSESSMENT
is a systematic approach to identify, evaluate and mitigate potential threats including failure to fulfil specified performance targets.

KEY INPUT FROM THE CO2QUALSTORE GUIDELINE TO DEVELOPMENT OF MODALITIES AND PROCEDURES FOR APPROVING CARBON DIOXIDE STORAGE SITES IN THE CDM

DEFINING AN ACCEPTABLE LEVEL OF RISK

The CO2QUALSTORE guideline proposes a methodology for regulators to determine what are acceptable and un-acceptable risk levels of the geological storage site. This methodology is based on the concept of 'performance targets'. Performance targets for a geological storage site are defined as "target levels of risk/uncertainty reduction achieved through implementation of a defined safeguard, or range of safeguards". The performance targets specify the risk and/or uncertainty – reducing measures that shall be implemented in order to reduce the risk to an acceptable level.

Performance targets shall be tailored to the unique characteristics of each site. Project specific performance targets are regarded as a key instrument to reach consensus on conditions for granting of relevant permits. This may include defining project specific conditions for granting of the initial storage permit, project specific conditions for site closure, as well as requirements to demonstrate responsible operation and project development in accordance with previously agreed performance targets.

The CO2QUALSTORE guideline will help those directly involved in the implementation and permitting of individual carbon dioxide storage projects to reach agreement in key areas. The CO2QUALSTORE guideline is aimed at individual project developers, operators and local authorities, as well as regulators and policy makers at national and international level.

Operators are provided with:

- a transparent basis for examination and decision-making to meet internal milestones and decision gates;
- a guide to set performance targets that will enable the granting of relevant permits for individual sites, including permits for Exploration, Storage and Transfer of Responsibility;
- the basis for establishing predictable operating conditions and consistency and efficiency in project development based on regulatory frameworks, best engineering practice and best available technology.

Regulators and national authorities are provided with:

- a guide to verify that sites have been selected and assessed to be suitable for geological storage of carbon dioxide in line with a standardised and globally recognised procedure;
- a standardised reference for permitting and verification;
- a technical basis for development of national regulations for storage of carbon dioxide aligned with industry best practice and national regulations.

Public and third parties are provided with:

- assurance that a verified storage site is selected based on a recognised process, that it will be safely and responsibly managed according to recommended practices for sustainable carbon dioxide storage, and that it is in compliance with regulations, codes and standards.

SITE SELECTION STEPS RELEVANT FOR CDM

The CO2QUALSTORE guideline provides a procedural framework to support communication between operators, regulators and other stakeholders in all stages of the lifecycle of a carbon dioxide geological storage project. Activities and deliverables associated with each stage are explained and defined.

DNV proposes that a project developer carry out the site selection activities based on the following steps derived from the CO2QUALSTORE guideline that cover the period from project initiation to granting of a storage permit and validation within the CDM:

- Define the required containment criteria according to local regulations. Examples from Annex 1 countries that could be used:
  - EU – complete and permanent storage within the storage complex in supercritical phase;
  - US – Area of Review delineation;
  - Australia – definition of the 'fundamental suitability determinants'.
- Review of available data and identification of potential sites that meet containment criteria.
- Estimate capacity of candidate sites
- Assess the risks for each candidate site following the ISO31000 standard, including, but not limited to:
  - Containment risks:
- Existing plugged and abandoned wells
- Existing suspended, shut-in and active wells
- Faults and fractures
- Seal permeability and geochemical stability
- Presence of secondary seals
- Geomechanical strength of reservoir and seals
  - Capacity and injectivity risks:
- Connected pore volume
- Sweep efficiency
- Maximum allowable pressure increase
  - Measurement, Verification, Accounting and Reporting (MVAR) risks:
- Potential for unreliable base line data
- Potential for unreliable monitoring data
- Potential for inaccurate accounting
- Document the risk assessment results in full.
- Shortlist candidate sites by comparison of risk assessment and capacity estimation results with the containment and project criteria.
- Acquire additional subsurface data as required under the terms of a local exploration permit, for example well data and seismic data.
- Re-assess the risks for remaining candidate sites in light of new data. Identify additional data needs.
- Collect additional data if required.
- If necessary, iterate risk assessment process to meet the site selection criteria with an acceptable level of certainty.
- Select final site to develop further.
- Initiate baseline monitoring of site as early as feasible to achieve longest possible timeline before start of injection.
- Specify operational and site closure performance targets that shall be approved by local regulators (to obtain a storage permit) and by the UNFCCC (to obtain CDM credits). The performance targets specified should relate to the results of the preceding risk assessment.
- Submit a carbon dioxide storage development plan including the following components:
  - Site Characterization Report
  - Injection and Operating Plan
  - Storage Performance Forecast
  - Environmental Impact Assessment
  - Risk Management Plan, including:
- Impact Hypothesis
- Contingency Plan
  - Monitoring, Verification, Accounting and Reporting Plan
- Obtain a storage permit from local regulator
- Obtain a validation certificate from a Designated Operating Entity under the UNFCCC.

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