Annex 14

Draft recommendation on the common technical/methodological and policy/legal issues from the carbon dioxide capture and storage methodologies

In assessing the proposed new methodology cases NM0167 "The White Tiger Oil Field Carbon Capture and Storage (CCS) project in Vietnam" and NM0168 "The capture of the CO_2 from the Liquefied Natural Gas (LNG) complex and its geological storage in the aquifer located in Malaysia", the Meth Panel identified a number of general methodological and accounting issues related to CCS project activities under the CDM. Given the infancy of these types of project activities, the large uncertainties, and paucity of existing standards, the review of cases NM0167 and NM0168 aided the Meth Panel to identify these issues.

The Meth Panel has distinguished between two categories of methodological issues. In the first category are methodological issues that are comparable in nature to those faced by other proposed CDM methodologies – identification of alternative scenarios and baseline selection, analysis of additionality and market leakage, calculation algorithms, sub-national project boundary questions, and so forth. The Meth Panel has addressed these "standard issues" in the context of the qualitative recommendations for NM0167 and NM0168.

Second category of issues are those that lie at the frontier of scientific knowledge and engineering practice (site selection criteria, monitoring methods) or that present unique accounting or liability challenges (permanence, i.e. implications of accidental, unanticipated or intentional future releases of stored CO_2 from the reservoir). Based on the review of NM0167 and NM0168, the Meth Panel has summarized these more general methodological issues noting how these issues arise in the submitted methodologies.

The Meth Panel is of the view that a more detailed assessment of issues, as described below, could be undertaken and requests clarification from the Board on to undertaking the assessment.

A. ***Policy or legal issues***:

- acceptable levels of long-term physical leakage (seepage) risk and uncertainty (e.g. X% seepage by year Y, or other);
- acceptable levels of uncertainty with respect to acceptable levels of long-term physical leakage risk (e.g. likelihood of X% losses by year Y);
- project boundary issues (such as reservoirs in international waters, several projects using one reservoir, etc) and national boundaries (approval procedures for projects that cross international boundaries);
- the long-term responsibility for monitoring the reservoir and any necessary remediation measures after the end of the crediting period (i.e. liability);
- accounting options for any long-term seepage from reservoirs, which (e.g. new modalities and procedures such as those for LULUCF).

The Meth Panel can, if the Board requires, outline the nature of these issues, summarize the available literature and highlight potential options, indicating potential advantages and disadvantages.

B. Issues of a largely technical and methodological nature, which require geology, petroleum engineering, and other specific expertise to address**.** These include:

- the development of criteria and a step-wise guidance for the selection of suitable storage sites with respect to the release of greenhouse gases, and how this relates to applicability conditions for methodologies;
- guidance on the development of adequate and appropriate monitoring methodologies for physical leakage from the storage site;
- guidance relating to the operation of reservoirs (e.g. well sealing and abandonment procedures) and remediation measures and how these may need to be addressed in baseline and monitoring methodologies;

It is important to emphasize that the resolution of these technical and methodological issues, in particular the suitability of storage sites, depends upon guidance with respect to policy and legal issues, in particular on acceptable levels of long-term physical leakage risk and uncertainty.

Options for the Board to progress on these issues include:

- recommending the COP to create a process to develop combined guidance on both policy/legal and technical issues, with input from the IPCC or other bodies as relevant.
- convening an expert group to develop relevant guidance on technical issues, presuming sufficient guidance on policy/legal issues noted above.
- requesting the Meth Panel to draw on further expertise to explore the nature and scope of possible guidance, including, as appropriate, further inputs from NM0167 and NM0168 project participants

General methodological issues arising from CCS project activities under the CDM

The following section describes some general methodological issues at the frontier of scientific knowledge and engineering practice or that present unique accounting or liability challenges related to CCS activities. This annex also notes how these issues arise in the submitted methodologies NM0167 and NM0168.

A. PHYSICAL LEAKAGE (SEEPAGE):

1. **Site selection criteria.** Both proposed methodologies (NM0167 and NM0168) suggest that site selection criteria be used as applicability conditions in order to limit the risk of future seepage from the reservoir. However, as currently specified, the proposed provisions are insufficient, as they do not provide a (step-wise) *procedure* for assessing the quality of a site nor do they provide clear and transparent *criteria* that could be validated by a DOE in an objective manner. NM0167 lists data that should be collected in order to assess a site but does not provide guidance how the risk of seepage should be assessed based on this data. NM0168 suggests the use of the likely amount of, expressed as a fraction of total carbon stored in the reservoir, carbon dioxide retained after 100 and 1000 years within the reservoir as a site selection criteria, based on the IPCC SRCCS.[1] However , the IPCC figures given for appropriately selected and managed geological reservoirs are not guidelines for good storage sites as these figures were not intended to be used as a guideline for good storage sites.

   The site selection criteria could be further elaborated by the PP, but it may be very difficult for the PP to arrive at acceptable standards on their own or for the Meth Panel to provide sufficient review. As a number of parties and observers have suggested, an expert group (or the IPCC) may be better equipped to deal with the key technical issues, and to achieve a reasonable balance of upfront prescription and site-specific flexibility.

2. **Monitoring methods for seepage emissions.** Reviews of NM0167 and NM0168 suggests that the proposed monitoring methodologies are insufficiently specified. For example, NM0167 contains many lists of variables that might be monitored, but little indication of how the monitored results would be used to determine project or baseline emissions. Indeed, given the ongoing evolution of CCS monitoring techniques and models, a fully elaborated monitoring methodology may be premature at this point. It may be difficult to follow the standard NM procedures, which requires a monitoring methodology sufficiently detailed that a DOE can validate and verify it. For example, effectively monitoring CCS projects might require a regularly evolving set of protocols that reflects the latest scientific and engineering knowledge.

   In summary, the monitoring CCS projects may require a process adapted to the unique, evolving circumstances of this project type, as well as the heterogeneity of storage sites. Similar to site selection criteria, developing and reviewing monitoring approaches for CCS (whether discrete methodologies or general guidance) requires specialized expertise, and a balance between general prescription (to ensure integrity) and site-specific flexibility (to recognize the evolving and diverse possibilities for monitoring techniques, and the geological uniqueness of each storage site). The role of DOEs, the level of prescription of NM/AMs, and the potential role of sectoral experts, need to be carefully considered.

[1] Special report on Carbon Capture and Storage (SRCCS)

Examples of specific issues arising in NM0167 and NM0168:

- **Anticipating post-project seepage.** With respect to NM0167, there is a nearly exclusive focus on measurable seepage during the crediting period. As noted by various experts and desk reviewers, it is important to monitor underground flows and to anticipate future seepage and not just to consider what might occur during the crediting period. (The latter is better addressed by NM0168.)
- **Difficulty of accurately assessing seepage**. According to one desk reviewer, current monitoring techniques appear unable to accurately determine seepage from a reservoir and as for NM0167, such an inability would mean that no CERs can be generated (see below). However, as noted by the same reviewer: "If a reservoir is carefully selected according to strict site selection criteria, it is highly unlikely that seepage will occur. It might therefore be better to focus on site selection rather than on monitoring techniques in the case of CCS project activities."
- **Determining appropriate monitoring methods.** NM0168 for example relies exclusively on seismic 3D surveys to monitor seepage. These surveys may assist in determining any significant movement of CO_2 and in finding potential seepage paths, but may not be sufficiently accurate to determine CO_2 volumes emitted through seepage as compared to precision with which the volumes of CO_2 injected into the reservoir. One desk review suggests that other methods may be needed, such as side-scan sonar, CO_2 buoy network in monitoring area, seabed monitoring (if stable seabed conditions), soil monitoring (onshore only), sniffing (onshore), bubble monitoring (offshore), remote sensing (aircraft or satellite). NM0167, for example, does not consider the monitoring of methane in soil gas, and impurities in the injected CO_2, and analysis of potential seepage routes. Overall, it may be difficult to generically specify which monitoring methods should be used and where.

3. **Acceptable levels of seepage emissions.** NM0167 proposes a threshold approach for seepage rates that act both as an ex-ante indicator for an acceptable level of *expected* seepage rates, and as an ex-post indicator of continued project eligibility. It is proposed that seepage of CO_2 shall not exceed 0.7% of the total stored amount in a single 7-year crediting period or 1.0% in a 10-year fixed crediting period[2]. NM0168 proposes that seepage of CO_2 "is very likely" to be less than 1% in 100 years and "is likely" to be less than 1% in 1000 years based on the IPCC SRCCS assessment. Hence, the proposed thresholds differ significantly between the two methodologies, both in their specifications and in their application.

   The Meth Panel noted that the selection of an acceptable level of expected future seepage emissions and of an acceptable level of uncertainty are difficult *policy* choices that have implications for the long-term stabilization of GHG emissions in the atmosphere and hence go far beyond other typical CDM methodological issues.

4. **Key questions related to seepage:**
   - What are reasonable site selection criteria and which entity determines what these criteria should be?

[2] According to a footnote in the methodology, these numbers are based on an assumed "accepted storage time" of 1000 years. The PPs interpret this as "All CO2 is allowed to gradually seep out of the reservoir over a period of 1000 years". This results in a seepage rate of 0.1% per year.

- What are acceptable uncertainties for expected, estimated and monitored seepage rates?
- Is the concept of seepage threshold an appropriate concept for site selection (ex ante) and/or for project eligibility (ex post), and if so, what are the appropriate threshold(s)? If not, what are the alternatives?
- How should seepage emissions that are difficult to monitor be addressed (e.g. abrupt emissions due to natural events)?

B. PERMANENCE (and liability)

The potential seepage of CO_2 from reservoir raises a number of questions related to the permanence of emission reductions from CCS project activities. There are different ways seepage emissions from the reservoir could be taken into account. In this respect, both methodologies distinguish between seepage emissions occurring during the crediting period and occurring after the end of the last crediting period.

5. **Seepage emissions during the crediting period.** NM0167 proposes that for any seepage emissions beyond the proposed threshold (0.7% during a 7-year crediting period or 1.0% during a 10-year crediting period) CERs will be replaced by project participants with other valid units. If seepage emissions cannot be determined accurately, all CERs issued shall be cancelled and those already used for compliance in previous commitment periods would be replaced with the equivalent amount of CERs, ERUs and AAUs.

   NM0168 proposes that for any seepage emissions CERs would be replaced by project participants with the equivalent amount of CER/ERU/AAU.

   The Meth Panel notes that these proposals would appear to require an amendment of accounting and registry provisions under the Kyoto Protocol.

6. **Seepage emissions after the end of the last crediting period.** NM0167 does not address how to account for CO_2 seepage emissions after the end of the final crediting period, but suggests that monitoring of seepage should continue after the end of the crediting period for those projects with a history of significant seepage of stored CO_2.

   NM0168 involves the prediction of long-term seepage emissions, e.g. over 1000 years, using the best available knowledge and data. The amount of project emissions due to long-term seepage is supposed to be determined considering a discount factor; however, this discount factor is not specified in the methodology.

   Neither methodology addresses how it would be ensured that any necessary remediation measures after the end of the crediting period would be undertaken. The Meth Panel notes that some proposals to address this issue (temporary CERs, pooled insurance) would appear to require an amendment of accounting and registry provisions under the Kyoto Protocol, while other raise questions related to legal liability.

7. **Key questions related to permanence and liability:**
   - How should (non-trivial) seepage emissions from storage reservoirs be accounted for (during and) after the end of the last crediting period? Do the uncertainties justify considering an alternative accounting metric for emission reductions through CCS?

- Who should be responsible (and liable) for any necessary remediation measures after well closure / after the end of the crediting period? How can it be ensured that necessary remediation measures are undertaken? What is the interaction with national regulation on these issues (many countries with underground or offshore operations have mining laws that regulate site abandonment and long-term liability)?

C. PROJECT BOUNDARY

8. The Meth Panel's review of NM0167 and NM0168 has identified the following issues relating to the project boundary that appear to go beyond CDM methodological issues:

- Gases may be stored in a reservoir in one country and migrate to another country.
- Storage of CO_2 may take place in geological reservoirs offshore (international waters) or in the water column of the ocean (ocean storage). In this case, it is not clear how seepage emissions would be reported in GHG inventories and which DNA would need to endorse a CDM project activity.
- Several projects may store CO2 in the same reservoir. In such cases, several issues, such as the responsibility for any seepage emissions, for monitoring and for remediation measures, may need special attention.