Leakage and Permanence in regards to the MUS Carbon Capture and Storage (CCS) CDM Methodology

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METI Workshop on CCS-CDM

20-21 April 2006

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Leakage and Permanence

- Under NM0167, the reservoir is included in the project boundary, and any loss of stored CO_2 (hereafter called seepage) is treated as project emissions

- After the crediting period, the project boundary would cease to exist, but seepage may still need to be addressed (if it occurs at above negligible amounts)

Applicability Conditions and Seepage

- Strict applicability conditions through a detailed set of minimum standards for oil reservoir selection and confirmations of its integrity - NM0167 will only be applicable to projects that have reservoirs with high integrity
- Minimum standards for monitoring of the oil reservoir and wells
- Minimum standards for wells and strategies for keeping the seals intact

Risk of Seepage

- The applicability conditions should ensure a very high ratio of CO_2 retention

- However it is necessary to monitor for confirmation of:

a) Adherence to minimum standards

b) Seepage does not exceed a negligible level

Reservoir Data Required for Site Selection

Data/information to be submitted

a) The type of structure that makes up the reservoir

b) Forecasted storage capacity of the reservoir

c) The extent, nature and sealing ability of caprock (rock capping the reservoir)

d) Reservoir thickness

e) Physical properties of the reservoir, including overpressure and rock yield strengths

Reservoir Data Required for Site Selection - continued

f) Lithography and geological structure expected

g) Faulting in the storage area (If faulting is present, estimate the sealing properties of the faults.)

h) Information on tectonic and seismic stability of the area

i) Identification of any potable water aquifers that overlie the storage area

j) Confirmation that all abandoned wells or mines in the area that are likely to affect storage of CO_2 in the reservoir are adequately sealed

Reservoir Model(s)

- A reservoir model(s) shall be produced to help predict how the reservoir will react to the injection.
- The model(s) will be used to justify the assumption that not more than a negligible level of release is expected for the sequestered CO_2.

Reservoir Data and Model(s) - continued

The models are to incorporate the following elements, based on IEA recommendations (2003).

a) Main mechanisms which are likely to affect reservoir behaviour.

b) Location, depth and extent of potential injection disposal zones.

c) List all assumption in regards to permeability, porosity, tc., which were used in the model

d) Location and extent of other bottom or lateral bounding ormations.

e) Natural fluid flow rates and direction.

Reservoir Data and Model(s) - continued

f) The impact of any density driven flow

g) Phase behaviour of fluids and any long-term mass transport phenomena

h) Location of existing or abandoned wells or mines in the area that are likely to affect storage of CO_2 in the reservoir

i) Identification of potential spill points

j) Comment on the uncertainty of the model(s) and conduct sensitivity analysis to test whether it is robust to reasonable variation in the assumptions

Monitoring

1) Monitoring for adherence to operational related minimum standards

a) Actual well-head injection pressure to ensure that the maximum injection pressure is not exceeded (weekly)

b) Temperature and pressure of the reservoir (weekly)

c) Annular pressure (monthly)

d) Tubing pressure (monthly)

e) Map the location of sample points, location/number, etc. (First year and at the end of each crediting period)

f) Well abandonment carried out in strict compliance to regulations

Monitoring - continued

2) Monitoring for seepage

a) Soil gas analysis or direct water analysis (first year and at the end of each crediting period)

b) Time lapse 3D seismic data for updating the reservoir model (end of each crediting period)

c) Vertical seismic profile of injection/production well (end of each crediting period)

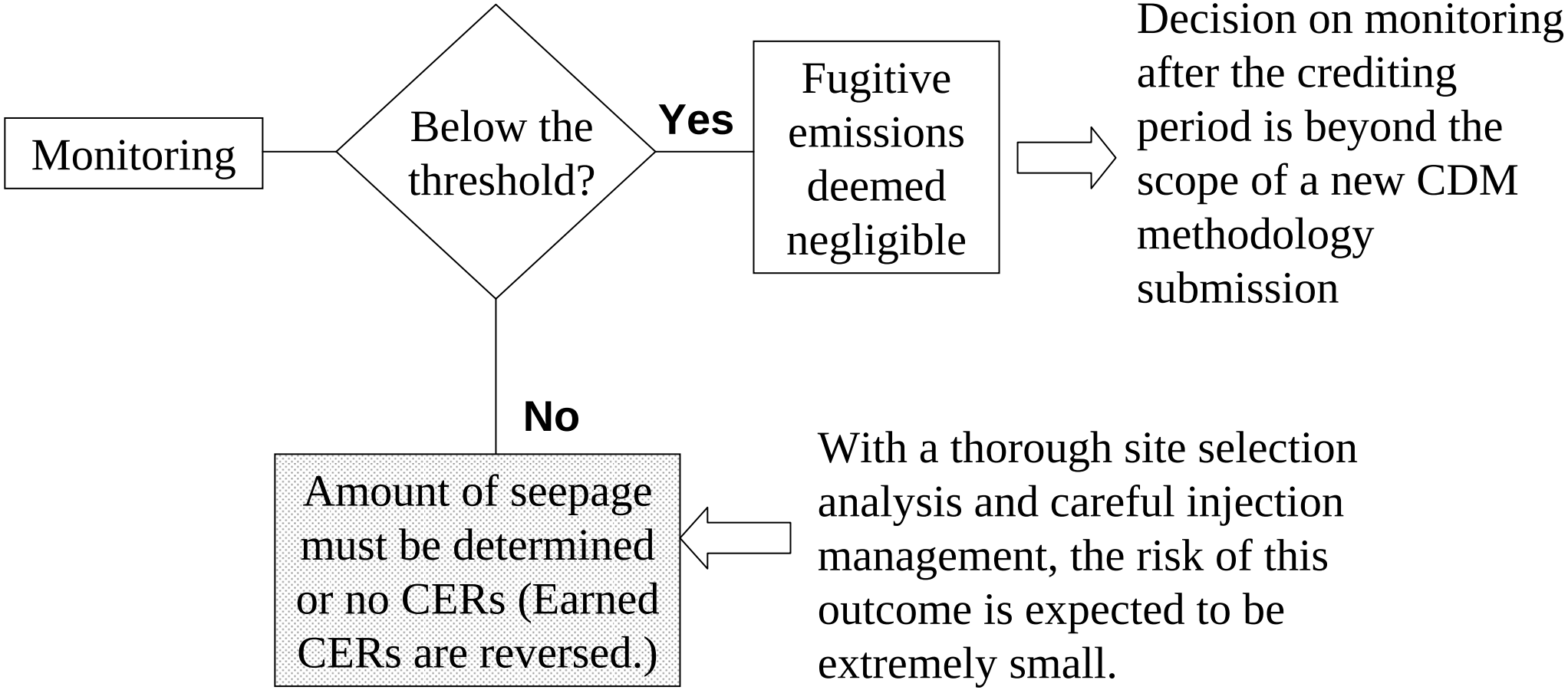
d) Gas “bubble” using repeat 4D seismic surveys (end of each crediting period)

Seepage of CO_2 from the Reservoir

- Ideally, the amount of seepage should be measured and deducted from the project's GHG mitigation contribution
- However, the precise determination of this value is difficult, particularly when the amount is small
- An exact discount factor may be difficult to justify and susceptible to being projected (1000 years – accepted duration for permanence) into the the future

Seepage of CO_2 from the Reservoir

The approach adopted by the MUS methodology is to set a threshold which will be applied in the following manner:



Seepage of CO_2 from the Reservoir

- The threshold selected is 0.7%/7 years (i.e. an average of 0.1% annually).

  a) Seven years is based on the length of the crediting period as well as the monitoring interval that corresponds to it.

  b) An annual average of 0.1% loss represents the level at which 90% of the sequestered CO_2 will remain after 100 years.