Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide

Guidance Document 3

Criteria for Transfer of Responsibility to the Competent Authority

Climate Action

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Table of Contents

List of Tables

List of Figures

Purpose of Guidance Document

This Guidance Document (GD) is part of the following set of Guidance Documents:

- Guidance Document 1: CO_2 Storage Life Cycle Risk Management Framework
- Guidance Document 2: Characterisation of the Storage Complex, CO_2 Stream Composition, Monitoring and Corrective Measures
- Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority
- Guidance Document 4: Financial security (Art. 19) and Financial Mechanism (Art. 20)

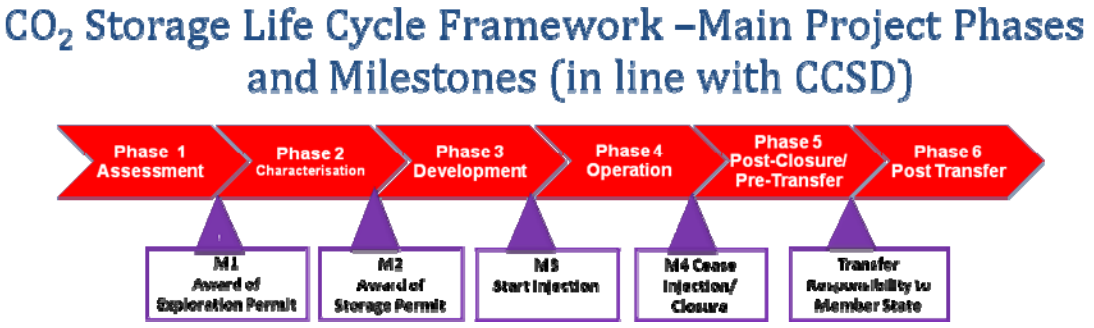
The purpose of this set of Guidance Documents is to assist stakeholders to implement Directive 2009/31/EC on the geological storage of CO_2 (so-called CCS Directive) in order to promote a coherent implementation of the CCS Directive throughout the European Union (EU). The guidance does not represent an official position of the Commission and is not legally binding. Final judgments concerning the interpretation of the CCS Directive can only be made by the European Court of Justice.

This Guidance Document 3 (GD3) addresses the issue of transfer of responsibility for all legal obligations from a site operator to the Competent Authority or Authorities (CA or CAs). Article 18 of the CCS Directive specifies the conditions under which all legal obligations can be transferred to the CA of the Member State. It is important to recognize that the scientific basis for CCS is evolving, as more information is gained through the ongoing global research and development efforts. Thus, the scientific knowledge-base on issues associated with transfer of responsibility will improve over time.

1. Legislative Context

As noted in GD1, the lifecycle of a storage project can be subdivided into six main phases, separated by five major project or regulatory milestones (Figure 1). This GD is focused mostly on the milestone "transfer of responsibility".

Figure 1: Summary of Life Cycle Phases and Milestones



Article 18 of the CCS Directive states that when a storage site has been closed (as per the conditions in the Article 17(a) and (b)[1], i.e. that the conditions of the storage permit have been met or that the substantiated request for closure by the operator has been authorised by the CA), the responsibility for all legal obligations can be transferred to the CA of the Member State subject to several conditions noted in Article 18(1):

- all available evidence indicates that the stored CO_2 will be completely and permanently contained;
- a minimum period after closure, to be determined by the CA has elapsed. This minimum period shall be no shorter than 20 years, unless the CA is convinced that the first condition above is fulfilled;
- the financial obligations under Article 20 have been fulfilled (see also GD4); and
- the site has been sealed and the injection facilities have been removed.

The operator is expected to prepare and submit a report (hereby referred to as “transfer report”), documenting that the stored CO_2 will be completely and permanently contained by demonstrating at least the following three items noted in Article 18(2):

[1] Art. 17(c) stipulates that the CA can withdraw the storage permit pursuant to Art. 11(3).

a. The conformity of the actual behaviour of the injected CO_2 with the modelled behaviour;

b. The absence of any detectable leakage;

c. That the storage site is evolving towards a situation of long-term stability.

Once the CA is satisfied with the submitted transfer report that there is sufficient evidence for complete and permanent containment of the stored CO_2, i.e., that the condition referred to in Article 18(1)(a) is met, it shall prepare a draft decision of approval of the transfer of responsibility. If the CA considers that the conditions are not met, it will inform the operator of its reasons. Draft decisions and available reports used for the draft decision shall be submitted to the Commission. Within four months after receiving the draft decision of approval, the Commission may issue a non-binding opinion. Once the CA is satisfied that there all conditions referred to in Article 18(1) are met, it shall adopt the final decision of approval of transfer of responsibility.

Under Article 18 the transfer of responsibility includes “all legal obligations relating to monitoring and corrective measures pursuant to the requirements laid down in the CCS Directive, the surrender of allowances in the event of leakages pursuant to the ETS Directive (2003/87/EC) and preventive and remedial action pursuant to Articles 5(1) and 6(1) of the Environmental Liability Directive (2004/35/EC)”. The term "transfer of responsibility", as used in the guidance documents, includes all of these legal obligations.

In case of a withdrawal of the storage permit based on Article 17(1)(c), Article 18(8) notes that the transfer of responsibility is deemed to take place if and when all evidence indicates that the stored CO_2 is completely and permanently contained, and after the site has been sealed and the injection facilities have been removed. In this case the financial security shall remain valid and effective until transfer of responsibility and the obligations under Article 20 have been fulfilled (see Article 19(3)(b)(ii)).

Specific procedures for transferring the responsibility (such as deadlines for the CA to approve particular reports, administrative decisions, etc.) are to be defined by each MS, and the operator continues to remain responsible for all legal obligations until the transfer has formally taken place.

2. Transfer of Responsibility

The transfer of responsibility is a final milestone for the operator in the life cycle of a CO_2 storage project. Successful transfer is contingent upon the approved terms in the storage permit and the safe operation of the storage through the project life. Effective monitoring and inspections, regular reporting, and updating

the storage permit (as needed) play a critical role in providing assurance to the CA that the storage site has met its objectives. The transfer process begins when the developer submits the "transfer report" to the CA documenting that the stored CO_2 is indeed completely and permanently contained based on all available evidence. The contents of the transfer report, as well as the submission of site-related data are discussed below. Once the CA is satisfied with the submitted transfer report that there is sufficient evidence for complete and permanent containment of the stored CO_2, it shall prepare a draft decision of approval, inform the Commission thereof, and make available to the Commission all reports relevant for the preparation of the draft decision. This draft decision will include details on the method that is to be used for determining that the site has been sealed and for the removal of injection facilities, as well as any updated requirements thereof (e.g., transfer of data and any other legal issues). If the CA considers that the conditions are not met, it will inform the operator of its reasons. If the CA is satisfied that all conditions referred to in Article 18(1) are fulfilled, it shall adopt a final decision, and notify the operator and the Commission.

2.1 Evidence for Complete and Permanent Containment

The CCS Directive calls for the operator to demonstrate that “all available evidence indicates that the stored CO_2 will be completely and permanently contained”. The CCS Directive suggests that operators can demonstrate permanent containment by meeting at least the three conditions noted in Article 18(2):

a. The conformity of the actual behaviour of the injected CO_2 with the modelled behaviour;

b. The absence of any detectable leakage;

c. That the storage site is evolving towards a situation of long-term stability.

2.1.1 Conformity with Models

Any assessment of permanency will be based on models; hence the validity and reliability of the static and dynamic modelling (see GD 2) of the storage complex are critical. A model can be considered as being reliable and valid if the final geological models’ backcast predictions are consistent (i.e., within a reasonable error bar) with the observed behaviour throughout the project life.

However, it is important to recognise that assessing the conformity of models for geological storage for regulatory purposes is an emerging area of practice. Hence, learning by doing is a key part of this process, and it is difficult at this

stage to provide detailed standards which will be possible only if there is operating history and experience to use as a benchmark.

The models used for the transfer of responsibility should be based on the models that were originally used for complex characterisation and monitoring plan, which would have been approved by the CA as part of the storage permit and subsequent updates (see GD2). These models will likely also have evolved and improved over time. As part of the monitoring obligation, complex characterisation and modelling (as discussed in GD1 and GD2) are both ongoing processes through the project life cycle. Where there is a significant deviation (see section 2.8.3 of GD2) between the observed geological data and the predicted behaviour from the static 3D models, the 3-D models shall be recalibrated to reflect the observed behaviour. Such a recalibration shall be based on the data observation during injection and from the monitoring activities (see section 2.8.3 of GD2 for more details). The key parameters that should be compared include pressures in the storage complex, chemical composition of the fluids in the injection reservoir and caprock, and any other parameter deemed to be important to the specific site.

These modelling projections should demonstrate that the CO_2 will remain contained through various trapping mechanisms in the storage complex over the modelled time period. The geochemistry modelling of the fluids and rocks, along with monitoring evidence during the post-closure period, should demonstrate that there is no significant risk for caprock and well integrity being compromised in the future.

If necessary to provide confidence in the recalibration process, additional monitoring data may be obtained. It is likely that site specific characteristics, as well as monitoring data (including error bars or confidence intervals for the observed data and measurements), will play a role in determining the modelling precision.

It is expected that most of the changes to the geological models will be done at early stages of injection (see section 2.8.3 of GD2). For instance, as noted by DNV (2010), new seismic data that significantly improves the image of the structure may require the rebuilding of a static model, starting with a reinterpretation of the reservoir structure. Given that only a very small part of the storage complex is directly measured through coring, the injection history itself provides additional information that needs to be used to describe the complex. Therefore, changes to the models to match history should not be thought of as “corrections” as much as “incorporating more data as it is compiled.” Given that injection could typically last around 30-40 years, any consequential changes to the geological model will likely be done at a very early stage of operation. The recalibration process and subsequent changes to the geological model can be part of the routine monitoring and reporting requirements.

To assure that the model's projections of eventual stabilisation are credible, the CA should review the changes made to the model and the model's projections over the last several years before the transfer to assure itself that the model has been able to match recent history without undergoing significant changes to its geologic characterization (i.e., the static geologic model underlying the dynamic model). Significant changes to the static geologic model would include altering important geologic parameters such that the values of the parameters are outside of the range of uncertainty previously thought to exist. Significant changes would not, for example, include altering grid cell values within the existing range or uncertainty to account for improved knowledge of reservoir heterogeneities. This Guidance recommends a continuous five year period before the transfer to be considered as reasonable for the number of years for which the static geologic model should be well known and remain significantly unchanged. However, the CA must make the final judgement based on the characteristics of the individual storage complex, the specific nature of any changes made to geologic model and the evolving state of scientific knowledge about site characterization and dynamic modelling.

As the CO2QUALSTORE report (DNV, 2010) suggests, the operator would need to demonstrate a trend showing that predictions match observations within acceptable limits, and that the continued need to recalibrate static and dynamic models in order to achieve an adequate history match is reduced or eliminated. The CA should be confident that the model can effectively characterise both past and the future behaviour of CO_2 in the site. In most cases, the "goodness of fit" of the models is expected to improve over time.

Conformity with the model can be defined as the consistency (within a reasonable error bar) between modelled and observed data. Therefore, an indication of a good final model would be that it matches nearly all historical flow/pressure data to within X% of actual data and that all of its parameters have not been significantly changed for a considerable time (e.g. five years). The choice of the percentage would be determined by the CA and different ranges of tolerances can be specified for each particular measured parameter in order to determine conformity. The CA should specify the applicable percentages for various parameters for each storage site at the time of the storage permit, taking account of site specific characteristics. As for the pressure in the storage complex, it might be expected that modelled pressure values are within 5% of the measured value.

Credibility of the changes to the model would be lower if there were substantial changes during the late injection period and certainly in the post-closure pre-transfer period. The updated post-closure plan should be based on the latest most accurate modelling.

Conformity of the model simulations to observed behaviour may be defined as:

a) For at least five years before the transfer, the 3D static geological model does not need any significant recalibration of the geological characteristics. Recalibration of heterogeneity factors (within the expected range) in the targeted reservoir (see GD2, section 2.5.1) that may be needed to calibrate observed plume migration paths at the plume edge should not be considered as significant. Note that there may be other changes to model for exogenous reasons such as software updates or the inclusion of information regarding an additional storage facility being operated in a nearby region.

b) The model results simulating the operation of the storage site over the entire life of the project are within the confidence interval of the monitored parameters over the entire life of the project. It is also important to recognize that the measured or estimated parameter values will have different sizes of the confidence intervals depending on the monitoring methodology and technology (see Chapter 4 of GD2).

Such comparisons to history are crucial to ensure that the forecast (rather than just recalibrated backcasts) of the model has been correct.

At the time of transfer, an operator can show the following to indicate the predictive capability of the models and history matching for the site:

a. Documentation on how monitoring data have been collected and interpreted, including measurement errors and confidence intervals for all monitored parameters;

b. Documentation on how the site-specific geological model(s), and the associated geomechanical and flow simulation model(s), have been calibrated through history matching and other adjustments; including

    - What was learnt from the variations in terms of data, science or the software and algorithms used and how it can benefit future storage operations, and

c. Documentation of how site performance evolved relative to the predictions, based on available monitored data. Depending on specific site characteristics and monitoring plan, such documentation could include: (1) injection pressures and volumes at each injection well, (2) the measured pressures throughout the storage complex, (3) the vertical and horizontal location and movements of the CO_2 plume and mixtures of CO_2 and formation fluids, (4) the chemical composition and structure of fluids and rocks in the storage complex, (5) active processes such as dissolution and mineralisation, and (6) any land bulging, subsidence or movement. The

key data for history matching should be carefully chosen to provide as robust a match as possible, and the data should be obtained without jeopardizing the long term safety of the storage site.

d. Description of how the models project those conditions into the future.

2.1.2 Absence of Any Detectable Leakage

A key aspect of containment is that there are no detectable leaks from the storage complex, including leakage through geological or man-made structure (see GD1). There should be no observed leakages from any existing or abandoned wells. This may be assessed by the operator demonstrating that the there are no leakages for a continuous 10 year period immediately before the time of transfer. If a successful corrective measure has taken place (as result of leakage), the 'clock' for the ten year time period would start over from the point in time when the corrective measure has been proven successful. This would allow the CA to have sufficient confidence that the site would not leak again.

As noted in GD2, the definition of leakage is contingent on the geological strata that are considered to be part of the storage complex, which would have been defined in the storage permit. The absence of detectable leakages can be established through the approved monitoring plan, defined at the time of the storage permit, as described in GD2, subject to any updates based on operational history and corrective measures undertaken. The following list provides an illustration of the kinds of metrics that could be used by operators to assess the absence of detectable leakages:

- Mechanical integrity test of wells: well materials are shown to be in good shape, no unusual conditions or leaks detected by well logs (e.g., noise logs do not detect flows along boreholes);
- Pressure, temperature, resistivity monitoring of injection zone and storage complex: position of plume and pressures conform to expectations that all CO_2 is within the storage complex, and there are no unexpected movements of CO_2. Such monitoring should be reasonable and practical, and should not jeopardize the storage integrity.
- Pressure, temperature, resistivity monitoring of zones above caprocks of the storage complex: no sign of abnormal or unexpected pressure or other conditions associated with leaks outside of the storage complex;
- Periodic seismic survey (where suitable and included in the monitoring plan): no detection of plume outside of storage complex or outside of any structural barrier within storage complex;

- Groundwater, soil and air monitoring: no detection of CO_2 above expected natural levels; and

- Geochemical tests: any chemical or structural changes to rocks in the storage complex are progressing as expected and there are no current or foreseeable future threats to the integrity of the caprock.[2]

The specific selection of metrics for determining the absence of leakage from the storage complex would need to be decided by the CA, in consultation with the operator, at the time of the storage permit based on the site specific characteristics, with any subsequent changes in the metrics being based on operational experience (e.g., assessing any corrective measures, updating of monitoring plan, etc.).

2.1.3 Evolution Towards Long Term Stability

Evolution towards a situation of long term stability may be indicated when:

a) the models project eventual stability of the CO_2 plume within the storage complex (i.e., the plume will be completely and permanently contained, with no expectations of future leakage).

b) key monitored parameters should be within a predetermined range to the future stable values (as predicted by modelling)—see Figure 2,

c) the rate of change in key monitored parameters is small and declining, and

d) the backcasted values from the modelling are within the confidence intervals of the historical monitored parameters.

The key monitored parameters that should be considered for assessing evolution towards long term stability are:

- Pressure within the storage complex;

- Movement of the plume;

- Geochemical changes in the storage complex and the wells; and

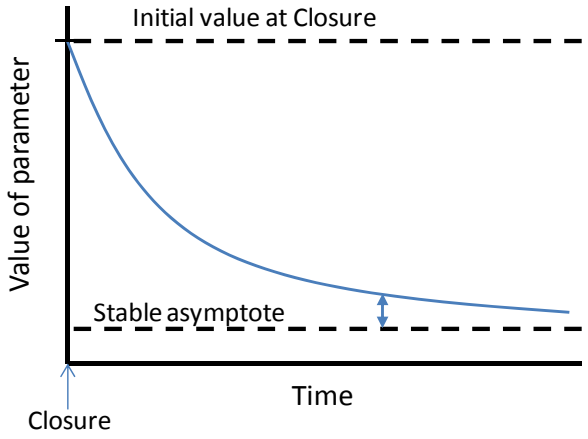
[2] Samples of caprock for testing integrity should be done using side-core samples, where the characteristics of injected fluids pose unusually high risks for the caprock integrity.

- Integrity of materials used to construct or abandon the wells.

The long term stable values of the key parameters would be determined by modelling. For example, the stable value of a parameter can be defined as when the model simulations show less than a defined percent change in key parameter values over a 1,000 simulation years or more for a specific complex. The expectation of future leakage can be assessed by running the models with both the expected value and the potential range of variations from this expected value for parameters that affect the likelihood of leakage (see GD2 2.8.3). For model scenarios that show leakage, the value of the parameters (or combination of parameters) that may cause a leak should be far (e.g. two standard deviations) from expected values.

Figure 2 illustrates how the measured values of the key monitored parameters could approach the stable values. It is expected that many of the parameter values would decrease from its initial value at the time of closure to a stable value over time—i.e., approach an asymptote. The CA needs to define a specific percentage deviation (5 to 10%, depending on geological characteristics) from the stable value (and/or a defined percentage drop from the initial value at closure) for each monitored parameter (see arrow in Figure 2), and such definitions need to be noted at the time of the storage permit, subject to any required changes based on actual operational history (i.e., to account for any corrective measures, updates, etc.). The percentage deviations should be defined on a site specific basis, and not be generalised. As indicated in Figure 2, there is no time specified for meeting this criterion.

Figure 2: Schematic indicating evolution towards stability



It is important to recognize here that evolution towards long term stability could still result in some movement of CO_2 plume. Processes that take place in CO_2 storage complexes at very slow rates are acceptable as long as they do not pose significant risks of leakage.

These include the following situations that can be anticipated in different storage scenarios:

- It allows for Migration Assisted Storage (MAS) trapping, as the CO_2 plume can indeed be migrating horizontally or laterally at slow rates (less than a millimetre to metres per year depending on the hydrodynamic system, and is thus effectively permanently stored.[3]
- If the CO_2 is migrating vertically through an interbedded non-conventional seal succession (thick interval of fine sand and silt and shale; known as a "waste zone" which also may be full of baffles), and it may take 100,000 years to migrate through the seal and in the process 90% may be dissolved or be lost as residual gas saturation[4] prior to it entering another reservoir/seal pair (with a conventional seal) (Bradshaw et al, 2009).
- Where CO_2 is physically contained by buoyancy processes within a structural trap, although some movement and trapping by dissolution and mineralisation is still taking place.

Therefore, evolution towards a situation of long term stability includes situations where the CO_2 can be migrating slowly, dispersed, and dissolved, and imaging and measuring every drop of CO_2 at all times is unfeasible. This approach provides a pragmatic approach, and would allow for developers to commence geological storage operations with a clear idea of their ultimate storage requirements and objectives.

It is also important any corrective measures undertaken during the operation and post-closure periods continue to remain effective in the post-transfer phase. Evidence for such continued effectiveness of the corrective measures needs to be provided to the CA at least as part of the regular report at a frequency determined by the CA.

2.2 Transfer Report

The transfer report should include an exposition of all the monitored parameters during the post-closure pre-transfer period and would also be based on the updated post-closure monitoring plan (see GD1). Table 1 below shows

[3] In addition to any horizontal migration, vertical migration of the CO_2 plume may occur due to gravity at a rate of 100+ meters per year for a 1% dip aquifer.

[4] Such intervals in the oil and gas industry are described as waste zones. If oil and gas is generated and liberated from the source rock and begins to migrate into carrier beds (reservoirs) and it enters such waste zones, a large volume of oil and gas will be retained in such zones or migrate extremely slowly (on geological timeframes) through them, and will be trapped physico-chemically.

documentation that CA may require operators to supply as part of the transfer report to document that the condition referred to in Article 18(1)(a) has been met.

Table 1: Possible Requirements in a Transfer Report

Evidence for complete and permanent storage	Required documentation from the operator
Conformity with Models	1) For at least a continuous five year period immediately before the transfer, there has been no need to significantly change the 3D static geological model assumptions for the characteristics of the storage complex during history matching exercises incorporating monitored parameters from monitoring taking place over regular intervals. 2) Results of the backcasting with the final model are within or close to the confidence interval of the monitored parameters over the entire life of the project.
Absence of Any Detectable Leakage	For at least a continuous 10 year period immediately before transfer, show that: 1) Integrity of all wells (monitoring and injection) remains in a good shape without any leaks or unexpected deterioration or damage 2) Regular and periodically monitored data based on the approved monitoring plan indicates that the CO_2 plume has remained within the storage complex, i.e., there are no leakages 3) Regular and periodic geochemical analyses indicate that all measured and imputed data is consistent with the geochemical modeling
Evolution towards Long Term Stability	1) Show that the final models run out into the future project an eventual stability of CO2 plume within the storage complex. 2) The monitored parameters have moved close to the expected stable values, as determined by modelling (e.g., by providing a table or graph of differences between the monitored and stable values) 3) Graphs and tables showing that the rate of change in the monitored parameters is small and declining.

The time frames noted in the table above (i.e., the five and ten year periods) are not sequential, and can occur in parallel. In any case, they are indicative and need to be determined by the CA. The time periods in question can start before the closure of the site. It is expected that these timeframes are sufficient for the CA to be confident that the risk of leakage is very small, and that the modelling is accurate enough to be used for determining conformity

In addition to the documentation listed in Table 1, the transfer report may contain documentation on at least the following items for posterity, in order to provide the

CA a final summary of the geological storage activities that has taken place in the storage complex (based on Chadwick et al., 2006):

- Narrative history of the site, including site characterisation, operations, leakage events and anomalies, corrective measures, and summary of monitoring results. This history should cover the entire CCS lifecycle phases (as discussed in GD1);
- History of injection facility construction and what activities were undertaken in the closure and post-closure periods;
- A revised finalized complex characterisation report, including information from the final static and dynamic models;
- Narrative history of modelling processes, results from modelling and simulation activities, changes made to the models as a result of new data and history matching, and the corresponding uncertainty analysis;
- Description of how uncertainties have been analysed and managed, and review key decisions made under uncertainty in retrospect[5];
- An updated project risk assessment showing how all individual risks that were identified have evolved throughout the project life;
- Explanations for upgrading or downgrading risks during the life of the project; and
- Proof of site sealing and removal of injection facilities.

Many of the items listed above may be reported to the CA as part of the annual reporting as required under Article 14. In that case, the transfer report could refer to the appropriate annual reports (put in an annex).

2.3 Minimum Period for Post-Closure Monitoring

As noted in the Directive, the post-closure pre-transfer phase should be at least 20 years to ensure that the evidence for complete and permanent containment (as discussed above) can be obtained, unless the CA is convinced that all available evidence indicates that the stored CO_2 will be completely and permanently contained (the criterion of Article 18.1(a) of the Directive). Section 3.2 of this guidance document, which deals with compliance with the three criteria specified in Article 18(2) of the Directive, addresses the issue of when the competent authority may consider that this latter condition is indeed met. It is

[5] For instance, if a non-optimal decision was made, would current knowledge and understanding have provided the basis for a better decision?

important to note that despite the reference to the 20 year time period in the Directive, the transfer of responsibility is based on a criteria-based approach because as provided for in Article 18(1), the 20 year period before transfer can be adjusted downwards if the CA is convinced that the condition in Article 18(1)(a) is met before the end of this period. On the other hand, the CA is always at liberty to determine a longer period than 20 years if it considers this appropriate.

Article 18(2) of the Directive requests that this guidance document should also highlight any implications for the technical criteria relevant to the determination of the minimum periods referred to in Article 18(1)(b). In the Commission's view, there are at this stage no such implications. This may change in the future, based for instance on empirical evidence regarding the average time elapsing between cessation of injection and compliance with the criteria provided in Section 3.2. If the evidence showed that this time was (for instance) substantially longer or shorter than 20 years, or differed substantially for different categories of site, then that could provide a basis for setting a different minimum period than 20 years for some or all installations.

2.4 Site Sealing and Removal of Injection Facilities

The updated post-closure plan should contain details on how a site should be sealed and how injection facilities at the site should be removed. However, the transfer report can note any additional changes to this updated plan based on any new information that may be gathered on the approach for the site sealing and removal of the facilities.

The draft decision of approval of the transfer of responsibility needs to include details on the method that is to be used for determining that the site has been sealed and for the removal of injection facilities, as well as any updated requirements thereof (e.g., transfer of data and any other legal issues). The CA may consult with the operator and approve a method suggested by the operator if the CA considers it as suitable for determining that the conditions referred to in Article 18(1)(d) have been met, as well as any updated requirements for the sealing of the storage site and for the removal of injection facilities.

, All injection facilities should be removed and the site be sealed to meet the updated requirements by the CA. It can be expected that most of the monitoring facilities will be removed and the surface areas reclaimed. Any well that will not be used for post-transfer monitoring should be plugged and abandoned using appropriate best practices and materials. MS can review and use existing abandonment procedures for oil and gas wells,[6] if they are deemed sufficient.

However, a CA could require certain monitoring facilities to be maintained beyond the transfer, in order to continue monitoring beyond transfer or for other nearby storage sites. Such post-transfer monitoring will have to be based on the final risk assessment and would be site specific (see also GD2 4.2.3). The CA will be responsible for the operational performance of any post-transfer monitoring. The financial contribution (see GD4) shall cover at least the cost of any such monitoring for a period of 30 years.

As with the closure phase, wells should be plugged with cements that are resistant to the acidic composition of the injected CO_2 stream (see GD2).

2.5 Linkages with Financial Contribution

As discussed above, the amount of financial contribution would have to be available to the CA before the transfer. Specific details about the calculation and payment of the financial contribution are discussed in GD4.

2.6 Transfer of Data

As a consequence of the transfer of responsibility, the operator, in addition to the information in the transfer report, will also have to transfer data about the site to the CA. As discussed in GD2 section 4.5.2, there are no specific provisions for data retention and ownership mentioned in the CCS Directive, and this issue would need to be addressed by the CA in each MS. Some data and analysis will be provided to the CA as part of the regular reporting requirement, however, once the responsibility is transferred to the CA, it is expected that the operator will transfer all of the relevant raw data (including core samples, drill cuts, construction material samples, and other key material samples extracted from the site) and documents related to the site to the CA. Such a handover will be

[6] For a list of existing abandonment procedures within different MS, see: Van der Kuip et al., "High-level integrity assessment of abandoned wells", GHGT10 Conference Proceedings (to be published in 2011).

necessary in order for the CA to monitor the site and take corrective measures as needed, beyond the transfer of responsibility. As discussed in GD2, issues regarding proprietary data and ownership of data will need to be resolved by each MS, and should be delineated in the storage permit. In setting timeframes for proprietary ownership of data, MS could balance the rights of the operator against the potential to contribute to improved knowledge of reservoirs and their performance over time, based on commercial rules and/or applicable practice in the oil and gas industry. Within the EU, the CAs in each MS could also consider data exchange with each other in order to learn from experiences in each country.

3. Summary

This Guidance Document addresses the various issues related to the transfer of responsibility for all legal obligations from the operator to the Competent Authority (CA), and as such expands on the provisions in Article 18 of the CCS Directive. As noted in the Directive, the key criterion that allows for such a transfer of responsibility is when the operator can show to the CA that all available evidence indicates that the stored CO_2 is (and will continue to be) completely and permanently contained. Such evidence will be based on:

- whether the actual behaviour of CO_2, as determined by monitoring, conforms with the updated models. Key parameters for the CA to consider include (measured and modelled) pressures in the storage complex, chemical composition of the fluids in the injection reservoir and caprock, and any other parameter deemed to be important to the specific site;

- whether there is the absence of any detectable leakage; and

- whether the site is evolving towards a situation of long-term stability—i.e., that the rate of change in key parameters (either measured or imputed from modelling) is very small and declining, and in line with the predicted values from the modelling.

Upon the elapse of sufficient post-closure monitoring period, during which the evidence for the above is gathered, an operator submits a transfer report to the CA. Once the CA is satisfied with the submitted transfer report that there is sufficient evidence for complete and permanent containment of the stored CO_2, i.e., that the condition referred to in Article 18(1)(a) is met, it shall prepare a draft decision of approval of the transfer of responsibility. If the CA considers that the conditions are not met, it will inform the operator of its reasons. Draft decisions and available reports used for the draft decision shall be submitted to the Commission. Within four months after receiving the draft decision of approval, the Commission may issue a non-binding opinion. Once the CA is satisfied that

there all conditions referred to in Article 18(1) are met, it shall adopt the final decision of approval of transfer of responsibility.

Beyond the transfer, the CA may not recover any costs from the operator unless there are leakages or significant irregularities as a result of operator's negligence, concealment of data, wilful deceit or failure to exercise due diligence.

4. Acronyms

CA or CAs	Competent Authority or Competent Authorities
CCS	Carbon Dioxide Capture and Storage
CCS Directive	Directive on the Geological Storage of Carbon Dioxide (2009/31/EC)
CO_2	Carbon dioxide
DNV	Det Norske Veritas
e.g.	For example
etc.	Et Cetera (Latin: And So Forth)
EU	European Union
GD	Guidance Document
i.e.	Id est (Latin: that is)
MAS	Migration Assisted Storage
UK	United Kingdom
USA	United States of America

5. References

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