

## Summary and Analysis of European Commission CCS Directive Guidance Documents

### Guidance Document 3: Criteria for Transfer of Responsibility to the Competent Authority

Guidance Document 3 (GD 3) speaks of ‘expanding on’ the provisions in Article 18 of the CCS Directive, concerning the transfer of responsibility from the storage operator to the competent authority of the Member State after active operations have ceased. It attempts to give ways in which the key conditions that have to be met by the operator can be implemented in practice.

#### The legislative context

Article 18(1) states that, when a storage site has been closed in accordance with the closure requirements set out in Article 17(1)(a) or (b), all legal obligations relating to monitoring and corrective measures under the CCS Directive, surrender of allowances under the Emissions Trading (ETS) Directive, and preventive and remedial action under the Environmental Liability Directive (ELD), are to be transferred to the competent authority, either on its own initiative or at the request of the operator, provided certain conditions are met. Four conditions are specified:

- (a) all available evidence indicates that the stored CO<sub>2</sub> will be completely and permanently contained;
- (b) a minimum period after closure, to be determined by the competent authority, has elapsed – that minimum to be no less than 20 years, unless the authority is convinced that condition (a) has been met sooner than that;
- (c) financial obligations in Article 20, requiring the operator to contribute to a financial mechanism to pay for the competent authority’s post-transfer costs, have been met; and
- (d) the site has been sealed and the injection facilities removed.

Article 18(2) then requires the operator, as part of the application for transfer, to prepare a report documenting how it has fulfilled condition (a) above (complete and permanent containment), with that report demonstrating at least three factors:

- (a) conformity of the actual behaviour of the injected CO<sub>2</sub> with the modelled behaviour;
- (b) absence of any detectable leakage; and
- (c) evolution of the storage site towards a situation of long-term stability.

Article 18(2) also allows the European Commission to adopt guidelines on the assessment of the three factors to be covered in the operator’s report, highlighting in so

doing any implications for the most appropriate minimum period that competent authorities should require, after closure, before moving to transfer of responsibility.

## **Guidance**

Guidance Document 3 focuses mostly on the first of the transfer conditions, complete and permanent containment, and the three obligatory elements to be included in the operator's report as proof that that condition has been met. Shorter comments are included towards the end on conditions (b) and (d) (minimum period and site sealing, etc), while condition (c), the financial contribution towards post-transfer costs, is left to Guidance Document 4.

## **Transfer of responsibility**

A few general comments are made at the beginning about transfer of responsibility, which is described as 'a final milestone for the operator in the life cycle of a CO<sub>2</sub> storage project'. Among other things, it is suggested that successful transfer will depend upon both fulfilment of the terms of the storage permit and 'the safe operation of the storage through the project life'. Some emphasis is given to the need to fulfil basic requirements throughout the operational and post-closure phases of a project, such as monitoring and inspections, regular reporting and, where necessary, updating of the permit, since effective completion of these 'will play a critical role in providing assurance to the competent authority that the storage site has met its objectives'.

When describing the nature of the transfer of responsibility, the guidance document frequently uses the short-hand phrase 'all legal obligations' (as in 'the responsibility for all legal obligations can be transferred to the CA'). A box near the beginning, however, confirms that this is intended to mean only obligations under the CCS Directive itself, the ETS Directive and the ELD. It does not include obligations and liabilities that the operator might incur, after transfer, under other legal regimes, such as civil and common law, other EU statutes, Member State laws and contractual agreements, although some Member States may choose to extend legal protection to some or all of those areas.

## **Complete and permanent containment**

Although the document cites the Directive's requirement in condition (a) of Article 18(1), that 'all available evidence' indicates complete and permanent containment of the injected CO<sub>2</sub>, it also speaks of the competent authority needing to see in the operator's report 'sufficient evidence' of such containment. This seems to be an acknowledgement that a pragmatic approach will be needed to the 'all available evidence' test if the condition is ever to be met.

## **Conformity with models**

The document recognises that assessing conformity of models of geological storage for regulatory purposes is 'an emerging area of practice' and that 'learning by doing is a key part of the process'. Given the immature nature of this practice, it concedes that '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’.

Nevertheless, models are seen as central to any assessment of permanence, making the validity and reliability of static and dynamic modelling critical to the fulfilment of this transfer test. When the time comes for transfer, the models used to demonstrate containment should be based on the models used for characterising the storage complex and creating the monitoring plan at the time of the original permit approval, together with subsequent updates in the light of monitoring and inspection data.

It is acknowledged that the models will have evolved and improved during the operational and post-closure periods, involving some recalibration of the parameters where the observed results differ from predicted behaviour. Such recalibrations, the document argues, should not be seen as ‘corrections’, but rather as ‘incorporating more data as it is compiled’, because pre-operational site surveys can never fully describe the storage complex. Most of the recalibrations, however, are expected to come during the early stages of injection, as active operations provide hard evidence of the site’s behaviour. Once the transfer stage is reached, the competent authority should be looking for evidence that the model has stabilised over the last several years, such that it ‘has been able to match recent history without undergoing significant changes’. ‘Significant changes’ as are said to include altering important geological parameters to the extent that their values are ‘outside the range of uncertainty previously thought to exist’.

The guidance recommends that there be a continuous five-year period before transfer during which the static geological model should be well known and ‘remain significantly unchanged’. It concedes that the competent authority will have to make the final judgment on this, based on the characteristics of each complex, the nature of any model changes and the evolving state of scientific knowledge. Operators will need to demonstrate a trend that model predictions match observed behaviour within acceptable limits (‘within a reasonable error bar’) and that continued need to recalibrate the models is either reduced or eliminated. The competent authority needs to be confident that the model can effectively characterise both the past and future behaviour of the CO<sub>2</sub> at the site. The credibility of a model should be seen as significantly lower if substantial changes have had to be made during the late injection period ‘and certainly in the post-closure pre-transfer period’.

The document proposes that, to establish the reliability of a model, ‘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’. 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 significant parameters have not been significantly changed for a considerable time (e.g. five years)’. The competent authority should specify applicable percentages for various parameters at the time of storage permit approval, taking account of site characteristics. The document also accepts that the confidence intervals for particular parameter values will differ according to the monitoring methods and technologies used.

At the time of transfer, it is suggested that operators support the predictive capability of the models and history matching for the site by providing documentation on: how data has been collected and interpreted; how models have been calibrated through history matching (including what was learned from variations); how performance evolved relative to predictions; and how models project conditions into the future.

### **Absence of any detectable leakage**

The CCS Directive defines leakage as ‘any release of CO<sub>2</sub> from the storage complex’, which entails escape, not simply beyond the boundaries of the defined storage site, but out of the ‘surrounding geological domain’ which provides secondary containment (although not necessarily into the atmosphere or above the surface). With that in mind, on the second condition for transfer, the absence of any detectable leakage, the guidance document observes that what counts as leakage will depend upon the geological strata that are considered to be part of the storage complex. That, it says, should be specified in the storage permit.

It argues that there should be no detectable leaks through either geological or man-made structures, describing this as a key aspect of containment. To meet this requirement, it suggests that the operator should demonstrate that there have been ‘no leakages for a continuous 10 year period immediately before the time of transfer’. Where a corrective measure has been carried out, in order to address a leak, the clock for the ten-year time period should be re-set to start from ‘the point in time when the corrective measure has been proven successful’, in order to give the competent authority sufficient confidence that the site will not leak again.

Data on this can be produced from the approved monitoring plan, together with any updates based on operational history and corrective measures that have occurred. The document says that it will be up to the competent authority, in consultation with the operator, to decide which measurement techniques should be used at each site, but also provides a list of possible metrics. These include: mechanical integrity tests of wells; pressure, temperature and resistivity monitoring of the injection zone and the storage complex; similar monitoring of zones above caprocks at the complex; periodic seismic surveys; groundwater, air and soil monitoring; and geochemical tests.

### **Evolution towards long term stability**

The guidance document observes that long term stable values of the key parameters will have to be determined by modelling. As an example, it defines the stable value of a parameter as ‘when the model simulations show less than a defined per cent change in key parameter values over 1,000 simulation years or more for a specific complex’. The risk of leakage can be identified by running the models with both the expected values and a range of variations that make leakage more likely. For stability to be established, the scenarios that imply potential leakage should involve parameter values that are ‘far (eg, two standard deviations) from expected values’.

It is expected that many parameter values would decrease from an initial value at the time of closure to a stable value over time. The document suggests that the competent

authority should define a specific percentage deviation (5-10% is suggested, depending on geological characteristics) from the stable value for each monitored parameter, and/or a percentage drop from the initial value at the time of closure. Such acceptable percentage ranges should be site-specific, rather than generalised, and should be noted at the time of the storage permit, although remaining subject to change in the light of operating history.

A summary list of factors which would indicate evolution towards long term stability is included, as follows:

- (a) the models project eventual stability of the CO<sub>2</sub> plume within the storage complex (‘ie, the plume will be completely and permanently contained, with no expectations of future leakage’);
- (b) key monitored parameters should be within a pre-determined range to the future stable values, as predicted by modelling;
- (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 document proposes that the key monitored parameters that should be considered are: pressure within the storage complex; movement of the plume; geochemical changes in the complex and the wells; and integrity of materials used to construct or abandon wells.

It also emphasises that evolution towards long term stability could still involve some movement of the CO<sub>2</sub> plume. ‘Processes that take place in CO<sub>2</sub> storage complexes at very slow rates are acceptable as long as they do not pose significant risks of leakage.’ Such processes that can be anticipated in certain storage scenarios include:

- migration assisted storage (MAS) trapping, where horizontal/lateral migration is continuing at slow rates (less than a millimetre or up to a few metres per year, depending on circumstances);
- vertical migration through an interbedded non-conventional seal succession, where it would take 100,000 years to pass through the seal and 90% might be dissolved or lost in process, prior to it entering another reservoir/seal pair; and
- physical containment by buoyancy processes within a structural trap, despite some movement, dissolution trapping and mineralisation still taking place.

Evolution towards long term stability would therefore include situations where the CO<sub>2</sub> is migrating slowly, dispersed and dissolved, even where detailed imaging and measurement are not possible. The document suggests that this would represent a pragmatic approach, providing storage developers with a clear idea of the ultimate requirements and objectives.

It will also be important, however, that any corrective measures undertaken during the operational or post-closure periods will remain effective during the post-transfer phase. The document states that the evidence of that effectiveness would need to be given to

the competent authority, 'at least as part of the regular report at a frequency determined by the CA'.

### **Transfer report**

The guidance document provides a table summarising the kind of documentation that operators will need to supply to meet the requirements suggested above, for each of the three factors that make up evidence of complete and permanent containment. It suggests that the time frames specified for conformity of models (5 years) and absence of leakage (10 years): 'are not sequential, and can occur in parallel'; can start before the closure of the site; and are only indicative, the actual periods needing to be defined by the competent authority. It nevertheless defends its suggested periods, on the grounds that these timeframes can be expected to be sufficient for the authority 'to be confident that the risk of leakage is very small, and that the modelling is accurate enough to be used for determining conformity'.

Apart from the essential items listed in the table, it is also suggested that a number of other matters could be included in the transfer report, to give the authority a final summary of the storage activities that have taken place at the site. They include: a narrative history of the site; a history of injection facility construction and closure and post-closure activities; a revised complex characterisation; a history of the modelling processes (including changes made); a description of how uncertainties have been analysed and managed; an updated project risk assessment; and proof of site sealing and injection facility removal. Some of these could be covered by simple cross-reference to earlier annual reports.

### **Minimum period for post-closure monitoring**

The document notes that the default minimum of 20 years from closure, before transfer takes place, can be waived if the competent authority is convinced before then that complete and permanent containment has been established, referring to the proposals given above for making such a decision. This discretionary provision means, it argues, that transfer of responsibility under the Directive is founded on 'a criteria-based approach', rather than a fixed period. On the other hand, it observes that the authority is 'always at liberty to determine a longer period than 20 years if it considers this appropriate'.

The document argues that the guidance provided here does not, at this stage, provide any implications for the technical criteria to be used in determining the minimum period before transfer should take place.

### **Site sealing and removal of injection facilities**

The means adopted for site sealing and removal of injection facilities should be included in the operator's updated post-closure plan, although additional information can be provided in the transfer report. The competent authority's draft decision on approval of transfer, to be given to the European Commission, should include details on the methods to be used to verify the sealing and removal.

The document envisages that most of the operator's monitoring facilities will be removed, and the surface areas reclaimed, except where the authority needs them for post-transfer monitoring. Plugging and abandonment of the wells that are no longer needed should involve the use of 'appropriate best practices and materials', including acid-resistant cements. Member States can apply existing abandonment procedures for oil and gas wells, if those are deemed sufficient.

## **Transfer of data**

The guidance document notes that there are no specific provisions in the CCS Directive about data retention and data ownership. It nevertheless assumes that operators will have to transfer data to the competent authority as part of the transfer of responsibility, over and above the statutory reporting requirements. It argues that this issue will need to be dealt with by Member States and it expects that operators will transfer to the authority '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'. This, it says, will be necessary for the authority to carry out its post-transfer duties on site integrity and safety.

The intellectual property issues, it argues, should be set out in the storage permit. In dealing with the timeframes for the transfer of data, it suggests that Member States '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.' It also rather tentatively floats the idea that competent authorities in the different Member States 'could also consider data exchange with each other in order to learn from the experiences in each country.'

## **Summary – fault clause**

As well as summarising the main contents of the guidance document, the final section includes its only mention of the fault provision in Article 18(7) of the Directive, under which the competent authority has a duty to re-open the operator's liability after transfer in cases involving fault on the operator's part. In a single sentence, the document paraphrases this clause in terms of the authority not being permitted to recover any costs from the operator after transfer, 'unless there are leakages or significant irregularities as a result of the operator's negligence, concealment of data, wilful deceit or failure to exercise due diligence'.

No mention is made of the fifth, and highly ambiguous, example of faulty behaviour cited in Article 18(7), that of 'deficient data', nor of either the duty on the authority to recover in these circumstances or the absence of any requirement in the statutory wording to prove a causal connection between the operator's fault and the post-transfer costs incurred by the authority. The guidance seems to be seeking to provide a reasonable interpretation to the text in the Directive, but in so doing it appears to gloss over critical aspects of this potentially important clause.

## Key issues

- Since the guidance document is not legally binding, it remains to be seen how far its recommendations are adopted by the EU Member States in their [transposing laws and regulations](#).
- Unless Member States include some such clarifications, the wording in the CCS Directive itself on post-closure transfer of responsibility includes several aspects that are either vague or difficult to implement if taken literally, leaving the legal requirements open to a wide range of interpretations, which could lead to doubt about operators' protection from liability in the long run.
- These are genuinely difficult issues to resolve, so the recommendations in Guidance Document 3 seem to offer practical solutions to some of the ambiguities in the Directive and may provide a benchmark for policymakers in other jurisdictions trying to tackle these questions.
- The addition of detailed requirements to provisions where the Directive is vague – such as the 5 and 10 year periods recommended for model stability and absence of leakage, and the percentage limits to variation in parameter values to prove evolution towards long term stability – although relatively clear, inevitably provide extra grounds for possible refusal or postponement of transfer of responsibility, should the competent authority have doubts about site integrity, or prove otherwise unsympathetic, in the post-closure period; the document recommends that such tests are specified in the storage permit, but it also concedes that the details may be subject to change during the operating and post-closure period.
- At various points, the guidance document implies that a site's performance record over the whole of its life will have a bearing upon the competent authority's confidence in the operator's evidence to justify proceeding with transfer – this could add an extra test to the transfer approval process.
- It is possible that the pragmatic interpretation of the 'all available evidence' test suggested in the document – construing it as a 'sufficient evidence' standard – could be contested when transfer is proposed at a site, if critics submit contrary evidence that casts doubt on complete and permanent containment.
- In some cases, the 'proven successful' test for re-setting the proposed 10-year minimum period for no leakage prior to transfer, after a corrective measure has been carried out, may be difficult to complete, so could offer another basis for dispute.
- The document concedes that standards and scientific knowledge in this field are still evolving, so it has to be assumed that the detailed conditions for transfer of responsibility will continue to change, perhaps significantly, in the decades ahead, before storage sites enter their post-closure phases – the conditions set today should therefore be seen as provisional, rather than final.

- The guidance document fails to resolve important ambiguities in the fault provision in Article 18(7) of the Directive, omitting any mention of the category 'deficient data' which seems to allow the authorities unusually broad discretion to re-visit operator liability after transfer has taken place, and also overlooking the fact that the Directive imposes a duty on the authority to recover its costs in cases of fault.
- The expansive recommendations on the hand-over of operating data as part of the transfer process could be problematic for operators, not only in terms of intellectual property, but also as increasing the risk of some kind of technical fault being detected post-transfer if anything subsequently goes wrong – suggesting that difficult negotiations between operator and authority could arise on this point.
- The document is also potentially misleading in its repeated references to 'all legal obligations' being transferred to the competent authority, since the responsibilities that are transferred under the Directive are strictly defined and limited; operators will remain on risk for several key areas of liability, even after transfer, unless Member States choose to add those to the transfer process in their national laws – the guidance document contains no recommendations about that, as they seem to lie outside the EU's legal competence.