



North Sea
Transition
Authority

Guidance for Carbon Storage Metering and Measurement Plans

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Introduction

The Oil and Gas Authority ('OGA') is now operating as the North Sea Transition Authority ('NSTA') and will be referred to as the NSTA in this document. The OGA remains the legal name of the company, and all licences and other legal documentation will continue to refer to the OGA.

The NSTA is the licensing authority for carbon dioxide storage in an offshore UK controlled place or English controlled place (as set out in the Energy Act 2008¹), granting Carbon dioxide Appraisal and Storage Licences ('CS Licence') and storage permits.

Anyone who wishes to explore for or use a geological feature for the long-term storage of carbon dioxide in a UK offshore area must hold a CS Licence, pursuant to section 18 of the Energy Act 2008, issued by the NSTA. A storage permit may be applied for and is required for the storage of carbon dioxide in a storage site with a view to its permanent containment during the operational phase of the CS Licence. A CS Licence is required to apply for a storage permit.

A storage permit may require that the Operator submits a Metering and Measurement Plan to the NSTA for review prior to the injection of carbon dioxide into the storage site.

¹ Energy Act 2008 ([legislation.gov.uk](https://www.legislation.gov.uk))

Scope and purpose of guidance

This document (“guidance”) outlines the NSTA’s expectations for the content and scope of a Metering and Measurement Plan (“Metering Plan”), that is (as defined by the Operator’s Storage Permit) a document (or documents) which set(s) out the Operator’s plans for metering and measuring carbon dioxide and includes (as a minimum):

- a. details of the measurement system and method(s) adopted and to be implemented by the Operator;
- b. details of the Operator’s proposed recalibration and/or re-verification strategy for such measurement system and method(s).

The relevant measurement systems are those used to determine both the quantity of carbon dioxide transported offshore, and the quantity injected into each well.

The NSTA considers that such a Plan is a useful tool for its stewardship during the development phase of a carbon storage project and the content of the Plan will be examined with that objective in mind.

This guidance is not intended as a prescriptive list of requirements. It is not a substitute for any regulation or law, and is not legal advice. The guidance will be kept under review and amended as appropriate. If the NSTA changes its guidance in a material way, it will publish a revised document.

Requirements for the content of Metering and Measurement Plans

Set out below are suggested Metering Plan section headings, together with topics that should typically be addressed in the Metering Plan. The content of the Metering Plan should be agreed with the NSTA.

The Metering Plan should set out the proposed approach to the operation and maintenance of the relevant metering stations so that the NSTA can consider whether it considers the approach to be satisfactory.

The suggested contents of the Metering Plan document are:

- Section 1: **Executive Summary**
- Section 2: **Commissioning phase**
- Section 3: **Operational phase**

For clarity, key terminology used in this guidance is defined below:

- The measurement station used to determine bulk quantities of carbon dioxide transported offshore, and the concentration of carbon dioxide in this gas, is referred to as the ‘fiscal metering station’.
- The measurement stations used to determine quantities of carbon dioxide injected at each well are referred to below as ‘injection meters’.

Further detail on the suggested content of each of these sections is set out below.

Executive Summary

This section should set out, in high-level terms, the basic features of the metering systems covered by the Metering Plan.

The following information should typically feature in this summary.

For the fiscal metering station:

- A Piping and Instrument Diagram (P&ID), indicating the pipe configuration upstream and downstream of the flow meter and the location of sample points.
- The anticipated operating pressure and temperature at the measurement station and the anticipated phase of the carbon-dioxide-rich fluid.
- The measurement technology (e.g. Coriolis, ultrasonic, orifice plate).
- The technology used to determine concentration of carbon dioxide (e.g. online gas chromatograph (GC), GC-TCD).
- The anticipated levels of contaminants.
- The intended equation of state (EOS) to be used (with supporting evidence

that the expected carbon-dioxide-rich gas composition lies within the relevant compositional envelope).

- The principles of the proposed recalibration and/or verification strategy (i.e. time-based, risk-based, integrated risk-based).
- The target relative uncertainty (mass flow rate).

For the injection meters:

- The anticipated operating pressure and temperature at the meters and the anticipated phase of the carbon-dioxide-rich fluid at each.
- The measurement technology (e.g. Venturi, ultrasonic) that is proposed.
- The principles of the proposed recalibration and/or verification strategy (i.e. time-based, risk-based, integrated risk-based).
- Piping and Instrument Diagrams (P&IDs), indicating the pipe configuration upstream and downstream of the flow meter and the location of sample points.

Commissioning Phase

For the initial commissioning of the measurement station, or of any critical elements of it during the operational phase, the plan should set out Operators' proposals for the following:

- The calibration of primary flow elements (i.e., meters).
- Factory acceptance testing ('FAT') of the measurement system (including the sampling and analysis system).

- The site acceptance testing of ('SAT') the measurement system (including the sampling and analysis system).

The plan should provide for timely invitations to NSTA to be issued, so that we may witness and/or participate in the above activities.

If it is proposed to carry out commissioning activities using a gas other than carbon dioxide, the plan should make provision for this.

Operators' proposals for FAT and SAT should feature, as a minimum, verification of the following:

- Functionality of loops.
- Communication of all required

instrumentation (primary and secondary) with stream and station flow computers.

- Flow totalisation.
- Implementation of relevant equation of state.

Operators' proposals should ensure that at the SAT, all relevant calibration certificates should be available for inspection, for instance, the following:

- primary element (flow meter).
- secondary instrumentation (e.g. temperature, pressure gauges, gas chromatograph calibration gas).

Operational Phase

The Metering Plan should include the proposed operating and reverification procedures for the respective metering stations covered by it.

Unless otherwise agreed with NSTA, all primary and secondary metering instrumentation should be traceably calibrated to the national standards of the UK or other recognised international bodies. The Operator is expected to make provision for this as part of its operating procedures.

Fiscal metering station

- For the primary flow element:
 - Methodology for continuous monitoring of meter performance

(using, e.g. meter diagnostics).

Methodology for assessing recalibration frequency. (This should generally be based on the 'Integrated Risk' method, rather than by assessing financial exposure to mismeasurement as the simple product of uncertainty and value flow. Further details are available on request from NSTA.)

- For compositional analysis²:
 - Calibration methodology for on-line analyser (e.g. gas chromatograph calibration process).

² The Metering plan should refer to the Operator's Storage Site Management Plan, regarding the action to be taken in the event that the gas composition is no longer within allowable component limits.

- Handling procedures for the calibration gas.
- Manual sampling and analysis procedures.
- For secondary instrumentation:
 - Methodology for assessing intervals between successive recalibrations (e.g. time-based, risk-based).

Injection meters

For the injection meters (if topsides):

- For the primary flow element:
 - Proposals for the operation and tuning of any ‘virtual metering’ that is proposed to help demonstrate confidence in meter performance.
 - Proposals for any opportunistic verification of topsides meters against the fiscal metering station during periods of single-injection-well operation (note – this is not straightforward and may need to take account of line-pack).
 - Methodology for continuous monitoring of meter performance (using, e.g. meter diagnostics).
 - Methodology for assessing recalibration frequency. This should be based on the ‘Integrated Risk’ method, rather than by assessing financial exposure to mismeasurement as the simple product of uncertainty and value flow (further details are available on

request from NSTA.) The process should be informed by information provided by the meter diagnostics, where these are available.

- For secondary instrumentation:
 - Methodology for assessing intervals between successive recalibrations (e.g. time-based, risk-based).

For the injection meters (if subsea):

- For the primary flow element:
 - Proposals for the operation and tuning of any ‘virtual metering’ that is proposed to help demonstrate confidence in meter performance.
 - Proposals for any opportunistic verification of subsea meters against the fiscal metering station during periods of single-injection-well operation (note – this is not straightforward and may need to take account of line-pack).
- For secondary instrumentation:
 - Proposed reverification methodology (based, for instance, on comparison between dual instrumentation).

Comparison between fiscal and injection meters

To retain confidence in the performance of the injection meters, the Operator is expected to have a plan for the routine monitoring of the discrepancy between the total mass flow rate from the fiscal meter and the sum of the mass flow rates from the individual injection meters.

The Metering and Measurement Plan should feature:

- The method for monitoring this discrepancy.
- A definition of the ‘trigger level’ for the above discrepancy at which intervention may be deemed necessary.
- The remedial action to be taken in the event of the above trigger level being reached.

The proposed use of any proposed ‘virtual metering’ technologies, numerical analysis or machine learning to aid in interpretation of the above-mentioned discrepancy. For instance, this may aid in identifying the source(s) of the discrepancy so that remedial action may be targeted appropriately.

Mismeasurement Management

The Metering Plan should make provision for the reporting of mismeasured quantities to NSTA, should these come to light.

Dispensation Management

The Metering Plan should feature procedures for managing short- or medium-term deviations from agreed standards via time-limited dispensations agreed with the NSTA.

Emissions Metering

The Metering Plan should include proposals for the maintenance and operation of metering and measurement systems used to quantify any planned releases of carbon dioxide to the atmosphere.

