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Carbon dioxide capture, transportation and geological storage (CCS) — Quantification and Verification

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 265, Carbon dioxide, capture, transportation, and geological storage, Working Group 4, Quantification and Verification.

This is the first edition.

A list of all parts in the ISO 265 series can be found on the ISO website.

Introduction

According to the Intergovernmental Panel on Climate Change (IPCC 2014), keeping average global temperature rises below 2 °C will require large scale deployment of carbon dioxide capture, transportation, and geological storage (CCS) technologies to reduce carbon dioxide emissions from the electrical sector, various industries, and other large sources where there are no viable alternatives. Central to this ambition will be accurate accounting of emission reductions (UNFCCC, 2015).

ISO Technical Committee 265 (TC265) was established to develop technical standards for the design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities, for CCS projects. A full chain CCS project includes “capture systems”, “transportation systems” and “geological storage systems”. CCS projects could also include various combinations of single or multiple systems.

This document provides minimum requirements and recommendations for the quantification and verification of CO_2 streams captured, transported, and geologically stored, and specifically addresses losses from each capture system, transportation system and geological storage system. The document complements other documents in the ISO TC265 catalogue by providing for the quantification and verification of CO_2 to the extent not covered in those documents (refer to list of TC265 publications below).

Quantification of CO_2 stored in association with EOR is addressed by ISO 27916 Carbon dioxide capture, transportation and geological storage – Carbon dioxide storage using enhanced oil recovery (CO_2 - EOR), the results from which could be combined with quantifications generated in accordance with this document to produce a total quantification for a CCS project chain that includes one or more CO_2-EOR projects.

The document follows a technology-neutral approach; a risk management approach; and recognises uncertainty and knowledge gaps.

Information obtained from the application of quantification and verification methods specified in this document could be used as inputs to other standards, protocols or programs for determination of greenhouse gas emissions, or mitigation, or for the quantification and verification of emission reductions over the entire carbon dioxide capture, transportation and storage chain as described in ISO/TR 27915 for Quantification & Verification. However, this document does not directly address greenhouse gas reporting, define methodologies for life cycle assessment or define methodologies for emission reductions. Greenhouse gas reporting is addressed in the ISO 14064 series; life cycle assessments are addressed in the ISO 14040 series. These documents are referenced in the bibliography at the end of this document.

TC265 publications to 2019

This document was preceded by ISO publications from the six working groups (WGs) reporting to TC265, as listed here:

ISO/TC 265 Working Group 1 — Capture systems

ISO/TR 27912:2016 Carbon dioxide capture — Carbon dioxide capture systems, technologies and processes

ISO 27919-1:2018 — Part 1: Performance evaluation methods for post-combustion CO_2 capture integrated with a power plant

ISO/TC 265 Working Group 2 — Pipeline transportation systems

ISO 27913:2016 Carbon dioxide capture, transportation and geological storage — Pipeline transportation systems

ISO/TC 265 Working Group 3 — Geological storage

ISO 27914:2017 Carbon dioxide capture, transportation and geological storage — Geological storage

ISO/TC 265 Working Group 4 — Quantification and verification

ISO/TR 27915:2017 Carbon dioxide capture, transportation and geological storage — Quantification and verification

ISO/TC 265 Working Group 5 — Cross-cutting issues

ISO 27917:2017 Carbon dioxide capture, transportation and geological storage — Vocabulary — cross cutting terms

ISO/TR 27918:2018 Lifecycle risk management for integrated CCS projects

ISO/TC 265 Working Group 6 — CO_2 storage using enhanced oil recovery (EOR)

ISO 27916:2019 Carbon dioxide capture, transportation and geological storage — Carbon dioxide storage using enhanced oil recovery (CO_2 - EOR)

Carbon dioxide capture, transportation and geological storage (CCS) — Quantification and Verification

1 Scope

1.1 General

This document provides minimum requirements and recommendations for quantification and verification of carbon dioxide (CO_2) streams captured, transported, and geologically stored to the extent not covered by ISO standards in the TC265 series. The quantification may cover one or more of the systems that comprise a CCS project, and the same entity may not operate all of the systems included in the quantification.

NOTE Quantification and verification of CO_2 storage using enhanced oil recovery (EOR) are addressed in ISO 27916.

1.2 Applicability

This document applies to the quantification and verification of CO_2 for CCS projects that include one or more of:

a) systems for capture of CO_2 from source gas for geological storage;

b) systems for transportation of CO_2 streams for geological storage; and

c) systems for geological storage of CO_2 streams.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Note that ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
baseline
reference basis for comparison against which project status or performance is monitored or measured

[SOURCE: SOURCE: ISO 27917:2017, 3.3.2, and ISO 21500:2012(E), 2.3 modified to add “status or” and to change “and controlled” to “or measured”]

3.2
carbon dioxide capture and storage (CCS)
process consisting of the separation of CO_2 from industrial and energy related sources, transportation, and injection into a geological formation, resulting in safe, long-term storage

[SOURCE: ISO 27917:2017, 3.1.1 modified to change “long term isolation from the atmosphere” to “safe, long-term storage”]

3.3
carbon dioxide capture and storage (CCS) project
project consisting of CO_2 capture systems, CO_2 transportation systems, and CO_2 geological storage systems

Note 1 to entry: Each system (capture, transportation, or storage) could be operated by independent operators.

Note 2 to entry: Refer to Clause 6 for descriptions of systems and system boundaries.

Note 3 to entry: Use of this document does not exclude quantification for a single system.

3.4
CO_2 stream
stream consisting overwhelmingly of carbon dioxide

Note 1 to entry: The CO_2 stream typically includes impurities and could include substances added to the stream to improve performance of CCS or to enable CO_2 detection.

[SOURCE: ISO 27917:2017, 3.2.10]

3.5
CO_2 stream composition
fraction of each component of the CO_2 stream

Note 1 to entry: The CO_2 stream composition is usually subject to regulatory oversight and approval.

3.6
detection threshold
smallest value of a property of a substance that can be reliably detected by a specified measuring method in a specific context

[SOURCE: ISO 27917:2017, 3.3.3, modified to change “detection limit” to “detection threshold”]

3.7
emission factor
normalized measure of emissions in terms of activity which can be used to convert activity data into emissions data

Note 1 to entry: For example, tonnes of emissions per tonne of fuel consumed. Valves and other such equipment might have typical leakage rates based on measurement from similar equipment. Emission factors can be applied based on experience for such equipment.

[SOURCE: Annex II of the IPCC special report on CCS, 2005]

3.8
emissions
CO_2 stream releases to the atmosphere

[SOURCE: adapted from ISO 14064-2:2019, 3.1.5]

3.9
geological storage complex
subsurface geological volume, extending vertically to comprise storage units and identified seals, and extending laterally to the defined limits of the CO_2 storage system

Note 1 to entry: Limits are defined by natural geological boundaries, regulation or legal rights.

Note 2 to entry: Some jurisdictions could allow boundaries to be redefined if CO_2 moves outside the original boundary yet still achieves safe, long term containment.

[SOURCE: ISO 27917:2017, 3.1.9, similar to ISO 27914:2017, 3.54]

3.10
CO_2 leakage
unintended release of CO_2 from the system(s) being quantified

Note 1 to entry: In the context of this document, leakage does not refer to the concept through which efforts to reduce emissions in one place shift emissions to another location or sector where they remain uncontrolled or not counted. Specific regulations at the national or sub-national level may further define leakage within specific contexts.

Note 2 to entry: Refer to Clause 6 for explanation of system(s).

[SOURCE: ISO 27917:2017, 3.2.14]

3.11
loss
collective term that encompasses emission, leakage, intended release, venting, and transfer of CO_2 to outside of the CCS project defined boundary

Note 1 to entry: Transfer in the context of loss is CO_2 that leaves the system for some other use that might or might not result in release to the atmosphere.

Note 2 to entry: Loss includes CO_2 that escapes containment without entering the atmosphere, such as CO_2 that escapes a geological storage complex without moving into the atmosphere.

Note 3 to entry: Losses include CO_2 released from maintenance and emergency responses.

3.12
measurement
determination of quantities using physical devices

Note 1 to entry: Examples of measurements are temperature, pressure, flow, concentrations, length, distance, etc. Measurement may be direct (e.g. length with a meter) or indirect. Indirect measurements may require two steps, firstly sampling and then analysis. Indirect measures may also use a model to convert the measurement of a given quantity into the measurement of another one - e.g. from velocity to flow rate, taking into account the pipe and fluid characteristics.

3.13
monitoring
continuous or repeated checking, supervising, critically observing, measuring, or determining the status of a system to identify change from a baseline or variance from an expected performance level

[SOURCE: ISO 27917:2017, 3.3.1; and ISO 27914:2017, 3.27]

3.14
operator
person or entity that is responsible for a CCS project or system