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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 27914

Carbon dioxide capture, transportation and geological storage — Geological storage

Capture, transport et stockage géologique du dioxyde de carbone — Stockage géologique

ICS: 13.020.40

ISO/TC 265

Secretariat: **SCC**

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2025-01-21

Voting terminates on:
2025-04-15

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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).

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This document was prepared by Technical Committee ISO/TC 265, *Carbon dioxide capture, transportation and geological storage*.

This second edition cancels and replaces the first edition (ISO 27914:2017), which has been technically revised.

The main changes are as follows:

- technical revision of the entire Standard
- The addition of a clause regarding quantification and verification

A list of all parts in the ISO 27914 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Geological storage of carbon dioxide (CO₂) is recognized as a key technology for abatement of CO₂ emissions to the atmosphere or ocean and is an essential component in the process of CO₂ capture and storage (CCS).^[1] The objective of this document is to provide recommendations for the safe and effective long-term storage of CO₂ in subsurface geologic formations through all phases of a storage project life cycle ([Figure 1](#)) and for the quantification of stored CO₂. This document applies to injection of CO₂ into geologic formations for the sole purpose of storage and does not apply to CO₂ injection for the purpose of hydrocarbon recovery, or storage of CO₂ that occurs in association with CO₂-EOR. ISO 29716:2019 addresses CO₂ storage in association with CO₂-EOR. This document is supplemented by recommended practice manuals for CO₂ storage and numerous standards and technical recommendations developed for the oil and gas industry. [See Bibliography for selected references (References [\[1\]](#) to [\[12\]](#))]. This document does not address the quantification of greenhouse gases (GHGs) other than CO₂ for CO₂ storage projects. CCS projects quantifying CO₂ in accordance with this document can address quantifying, monitoring, and reporting, and validating or verifying other GHG emissions reductions or removals through the application of ISO 14064-2:2019 and other ISO 14000-series standards as appropriate. Results from the quantification of CO₂ stored in accordance with this document can be used in compliance with ISO 14064-2:2019.

Carbon dioxide capture, transportation and geological storage — Geological storage

1 Scope

This document:

- a) establishes requirements and recommendations for the geological storage of CO₂ streams, the purpose of which is to support safe, long-term containment of CO₂ in a way that minimizes risk of CO₂ losses;
- b) is applicable for both onshore and offshore geological storage within permeable and porous geological strata including hydrocarbon reservoirs where a CO₂ stream is not being injected for the purpose of enhancing hydrocarbon production;
- c) includes activities associated with site screening and feasibility, characterization, design and development, operation of storage projects, and preparation for project termination;
- d) recognizes that the geological characteristics, physical boundaries, management, intrinsic technical risks and uncertainties, of each site are likely to be unique for each project and that intrinsic technical risk and uncertainty will be dealt with on a site-specific basis;
- e) provides requirements and recommendations for integrated project management, including elements of risk management unique to the geological storage of CO₂ streams; and
- f) establishes a methodology for quantifying the net mass of CO₂ that geological storage projects store in storage unit(s).

The life cycle of a CO₂ geological storage project covers all phases and activities of the project, from the start of the project including site screening, feasibility, characterization, assessment, engineering, permitting, and construction, through the start of injection, and proceeding through subsequent operations until cessation of injection and culminating in the post-injection phase, which concludes with project termination. [Figure 1](#) illustrates the limits of this document.

This document does not apply to:

- g) temporary storage in tanks or by other means;
- h) the post-termination phase;
- i) injection of CO₂ for enhancing production of hydrocarbons or for storage associated with CO₂-EOR;
- j) disposal of other acid gases except as considered part of the CO₂ stream;
- k) disposal of waste and other matter added for purpose of disposal; or
- l) underground storage using any form of buried container.

A CO₂-EOR project that has stored CO₂ in association with CO₂-EOR can transition to operate under this document after all production of hydrocarbons from the storage unit(s) has ceased. If production of hydrocarbons in commercial quantities begins from the storage unit(s), the storage project is outside of the scope of this document and ISO 27916 applies to CO₂ storage.

NOTE The post-injection phase in this document corresponds with the post-closure phase defined in the EU CCS Directive^[1] and with the post-injection site closure (PISC) period in the US under the Class VI rule. Termination in this document corresponds with the end of the EU Directive^[1] post-closure period.

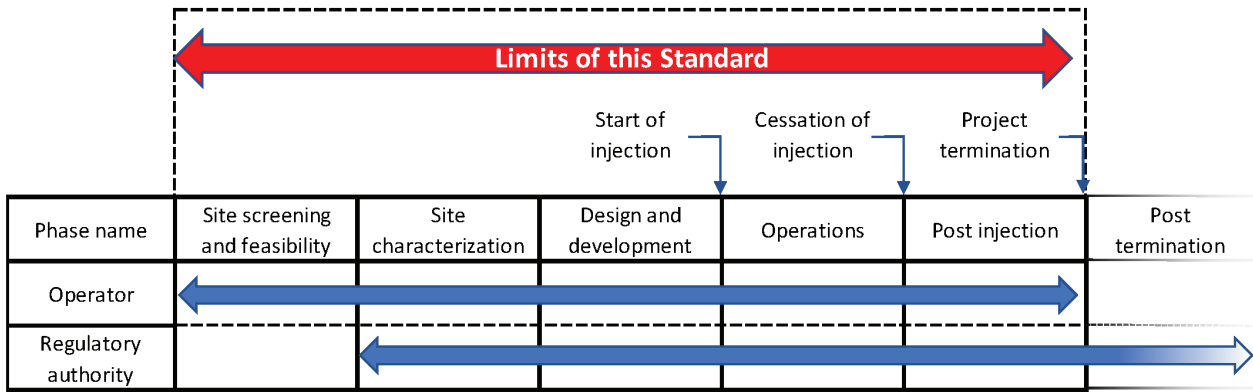


Figure 1 — Entities involved in the storage project life cycle

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.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 abandonment

process and procedures used to permanently end the operation of a well in a manner that meets project objectives

Note 1 to entry: Well abandonment is designed to eliminate the physical hazard of the well (the hole in the ground), eliminate a pathway for leakage, and prevent changes in the hydrogeologic system, such as the changes in hydraulic head and the mixing of formation fluids between hydraulically distinct strata.

3.2 area of review

geographical area(s) designated for assessment of the extent to which a storage project could affect life and human health, the environment, competitive development of other resources, or infrastructure

Note 1 to entry: The delineation of an area of review defines the outer perimeters on the land surface or seabed and water surface within which assessments will be conducted as may be required by regulatory authorities.

3.3 baseline

reference basis for comparison against which variance of a measured parameter is monitored or measured

3.4 carbon dioxide (CO₂) plume

region within geologic strata where injected CO₂ is present in free phase

3.5**carbon dioxide (CO₂) stream**

stream consisting overwhelmingly of CO₂

Note 1 to entry: The stream is a fluid mixture that may include any incidental associated substances derived from the source materials or the capture process and any substances added to the stream to enable or improve the injection process or trace substances added to assist in CO₂ migration detection.

3.6**confining unit(s)**

geological unit(s) above and below a *storage unit(s)* ([3.49](#)) that is part of a *storage complex* ([3.44](#)) and effectively restricts migration of fluids out of the storage unit(s) and *leakage* ([3.15](#)) out of the storage complex

Note 1 to entry: Described in reservoir engineering as caprock and in hydrogeology as aquitard or aquiclude.

3.7**containment**

retention of CO₂ within a *storage complex* ([3.44](#))

3.8**custody transfer meter**

measurement instrument that furnishes quantity and quality information used for quantification and the basis for a change in responsibility for the CO₂ stream.

3.9**decommission**

take an engineered system or component out of service, render it inoperative, dismantle and decontaminate it

3.10**detection threshold**

smallest value of a property of a substance that can be reliably detected by a specific method of measurement in a specified context

3.11**element of concern**

project objective for which *risk* ([3.35](#)) is evaluated and managed

3.12**elevated pressure zone**

zone within a *storage unit(s)* ([3.49](#)) where there is sufficient pressure to cause flow of formation fluids through an accessible pathway from the *storage unit(s)* ([3.49](#)) to outside the storage complex

3.13**geological storage**

safe, long-term *containment* ([3.7](#)) of *CO₂ streams* ([3.5](#)) in subsurface geological formations

Note 1 to entry: Long-term means the minimum period necessary for CO₂ geological storage to be considered an effective and environmentally safe climate change mitigation option.

Note 2 to entry: The term “sequestration” has been used by a number of countries and organizations instead of “storage” (e.g., the international “Carbon Sequestration Leadership Forum”). The two terms are considered to be synonymous, and only “storage” is used in this document.

3.14**injectivity**

sustainable rate at which fluids can be pumped into the *storage unit(s)* ([3.49](#)) given pressure constraints

3.15**leakage**

unintended release of CO₂ out of a pre-defined *containment* ([3.7](#))

[SOURCE: ISO 27917:2017, 3.2.14]

3.16

legacy well

pre-existing well within the *area of review* (3.2) of a CO₂ *storage project* (3.46)

3.17

likelihood

chance of something happening, expressed qualitatively or quantitatively

3.18

loss

emissions, *leakage* (3.15), intended releases, and transfers of the CO₂ stream to outside of the *storage site* (3.48)

Note 1 to entry: Refer to 10.3 for the usage within quantification.

3.19

management of change

process used when making changes to equipment or procedures, including risk management, technical assurance, documentation, and the communication of change to relevant personnel and stakeholders

3.20

mechanical integrity

mechanical condition of a well, such that its ability to function properly and safely is maintained

3.21

mechanical integrity test

MIT

test performed on a well to confirm that it maintains *mechanical integrity* (3.20)

Note 1 to entry: MITs are a means of measuring the adequacy of the construction of a well and a way to detect problems within the well system.

3.22

monitoring

continuous or periodic checking, supervising, observing, measuring or determining the status of a system to identify change from *baseline* (3.3)

3.23

native CO₂

CO₂ present and indigenous within the *storage unit(s)* (3.49) prior to any CO₂ injection

[SOURCE: ISO27916:2019]

Note 1 to entry: Native CO₂ is also known as “*in situ* CO₂”.

3.24

operations phase

time and activities from CO₂ stream first entering the wellhead for storage until injection ceases

3.25

overburden

geological material between the top of the *storage complex* (3.44) and the ground surface or seabed

3.26

project well

a newly constructed well or a converted legacy well that is operated in support of the storage project

3.27

post injection phase

time and activities between the cessation of injection and the demonstration of compliance with the criteria for *project termination* (3.32)

3.28**post termination phase**

time and activities that begin after the demonstration of compliance with the criteria for *project termination* ([3.32](#))

3.29**project objective(s)**

specific goal(s) the *project operator* ([3.30](#)) pursues towards ensuring the safe, long-term *containment* ([3.7](#)) of stored CO₂.

Note 1 to entry: Objectives can have different aspects (such as financial, health and safety, and environmental goals, research, technology development, public engagement and job creation) and can apply at different levels (such as strategic, organization-wide, project, product and process).

3.30**project operator**

entity that is legally responsible for the CO₂ *storage project* ([3.46](#))

3.31**project personnel**

person or persons employed by the *project operator* ([3.30](#)), or other anyone acting under the project operator's control or on behalf of the *project operator* ([3.30](#))

3.32**project termination**

end of the *post injection phase* ([3.27](#)), which occurs when the *project operator* ([3.30](#)) has demonstrated compliance with criteria in [11.2](#)

3.33**protected groundwater**

water found beneath the water table in fully saturated soils and geologic formations that is used for human consumption, agricultural, or industrial uses or is protected from contamination by legislation or regulation

3.34**regulatory authority**

entity or entities that have the authority to permit, approve, and/or otherwise authorize one or more *storage project* ([3.46](#)) activities, or monitor compliance with the terms of a permit

3.35**risk**

effect of uncertainty on project objectives

Note 1 to entry: Level of risk is commonly expressed in terms of the severity of consequences (negative impacts) of an event and the associated likelihood of their occurrence.

Note 2 to entry: An effect is a deviation from the expected and can be either positive or negative.

3.36**risk assessment**

process of identifying, analysing, and evaluating *risk scenarios* ([3.39](#))

3.37**risk control**

measure that maintains or modifies *risk* ([3.35](#))

[SOURCE: ISO 31000:2018 (control)]

3.38**risk evaluation criteria**

terms of reference used to define the magnitude of *risk* ([3.35](#))

3.39**risk scenario**

combination of circumstances that can cause negative impacts on *elements of concern* (3.11)

3.40**risk treatment**

process of using *risk controls* (3.37) to reduce a specified *risk* (3.35)

3.41**site characterization**

detailed evaluation of one or more candidate *storage sites* (3.48) for CO₂ storage identified in the screening and feasibility stage of a CO₂ *storage project* (3.46) to confirm and refine *storage complex* (3.44) integrity, *storage resource* (3.47), and *injectivity* (3.14)

3.42**site screening and feasibility**

evaluation of the suitability of candidate *storage sites* (3.48) by identifying, assessing, and possibly comparing candidate storage formations or sites

3.43**stakeholder**

individual, group of individuals, or organization whose interests are or could be affected by a *storage project* (3.46)

[SOURCE: ISO 27917:2017 3.5.1]

3.44**storage complex**

subsurface geological system extending vertically to comprise *storage unit(s)* (3.49) and *confining unit(s)* (3.6), and extending laterally to the defined limits of the CO₂ *storage site* (3.48)

3.45**storage facility**

infrastructure and equipment, including surface facilities, wells and monitoring equipment, that are used for the geological storage of CO₂ within the *storage site* (3.48).

3.46**storage project**

sequence of activities associated with the development of a *storage facility* (3.45), that includes site feasibility and characterization as well as design, construction, operation and termination

3.47**storage resource**

estimated ultimate storage capacity, in units of mass, for a CO₂ stream in a *storage unit(s)* (3.49) at *project termination* (3.32)

3.48**storage site**

physical space that includes the surface area within the *area of review* (3.2), *storage unit(s)* (3.49) and the subsurface volume extending from the surface to beneath the *storage complex* (3.44)

3.49**storage unit**

geological stratum (or strata) into which CO₂ is injected or contained for the purpose of *geological storage* (3.13)

3.50**verification**

confirmation by examination and provision of objective evidence that specified criteria are met

3.51

verifier

person or entity with responsibility for performing and reporting on the verification process

[SOURCE: ISO 14064-2:2006, 2.36]

3.52

well barrier

an engineered feature or element installed or constructed in the well to prevent leakage of fluid or pressure

3.53

well operations

any activity during the lifecycle of a well, including drilling, cementing, operation, maintenance, and abandonment

4 Integrated project management

4.1 General

The lifecycle of a geological storage project is a series of integrated phases ([Figure 1](#)). This document describes the processes and requirements within each phase. Integrated project management connects project activities through the project phases and provides an auditable trail of decisions, processes, procedures and records. Integrated project management is essential for the implementation and public credibility of geological storage projects and processes. Successful management systems are flexible, enabling the project operator to adapt to changes that occur during the project and robust enough to meet site-specific project and regulatory needs.

4.2 Storage project

4.2.1 Project phases

Geological storage projects follow a sequence of phases as shown in [Figure 1](#):

- a) site screening and feasibility ([Clause 5](#));
- b) characterization of the storage site ([Clause 5](#));
- c) storage facility design and development ([Clause 7](#));
- d) injection operations ([Clause 8](#)); and
- e) post injection to project termination ([Clause 11](#)).

4.2.2 Project activities that run across multiple phases

Within each project phase, activities may be undertaken simultaneously, in sequence or iteratively. Activities that transcend project phases, include:

- a) integrated project management ([Clause 4](#));
- b) assessment and treatment of risk ([Clause 6](#));
- c) monitoring and verification ([Clause 9](#));
- d) quantification and verification of the injected CO₂ stream ([Clause 10](#)); and
- e) information management ([4.4](#)).

4.2.3 Site screening and feasibility phase

The purpose of site screening and feasibility ([Figure 1](#)) is to identify a prospective storage site, or sites, from available options, in a manner consistent with [5.2](#), and to eliminate sites that do not meet storage project objectives. Site feasibility involves assessment of the subsurface and surface characteristics of prospective sites to determine their feasibility for geological storage of CO₂ and for an initial assessment of risks ([5.3](#)). One or more potential sites may be selected for characterization ([5.4](#)).

4.2.4 Site characterization phase

The purpose of site characterization is to determine the extent, and CO₂ storage potential, of the storage complex, to inform the design of the storage project and to support development.

Activities undertaken during site characterization include:

- a) delineation of the storage complex and the area of review;
- b) determination of the geological and hydrogeological properties of the storage unit(s) ([5.4.2](#)) to estimate injectivity and storage capacity;
- c) evaluation of storage containment, including legacy wells ([5.4.6](#));
- d) geochemical characterization of the confining unit(s), storage unit(s) rocks and fluids ([5.4.4](#));
- e) geomechanical characterization of the confining unit(s) and storage unit(s) ([5.4.5](#));
- f) modeling ([5.5](#)) to test injection scenarios and evaluate outcomes; and
- g) further assessment of risks ([6.4](#)).

Additional activities during the site characterization phase may include:

- h) collection and analysis of additional storage site data ([5.4](#));
- i) preliminary designs of storage facilities and project operations ([Clause 8](#));
- j) assessment of possible environmental impacts;
- k) initial design of the monitoring plan ([9.4](#));
- l) determination of economic feasibility; and
- m) preparation of regulatory submissions.

NOTE While this clause describes the site characterization phase, site characterization activities may also be performed in other phases of the storage project.

4.2.5 Design and development phase

The design and development phase of the storage project lifecycle commences after a storage site is selected and ends when injection operations begin.

Design and development activities include:

- a) site design;
- b) installation of surface facilities;
- c) well design and well construction ([7.3](#));
- d) finalization of the initial monitoring plan, installation of monitoring hardware, and acquisition of baseline data ([Clause 9](#)); and
- e) repair of legacy wells when deemed necessary ([7.4](#)).

4.2.6 Operations phase

The operations phase of the storage project lifecycle commences when the storage project receives the first CO₂ stream and ends immediately after injection of the last CO₂ stream.

Storage facility operation activities include:

- a) receipt and delivery of the CO₂ stream to injection wells;
- b) injection operations ([Clause 8](#));
- c) monitoring of the storage site ([Clause 9](#));
- d) quantification of CO₂ streams ([Clause 10](#));
- e) monitoring and maintenance of equipment and infrastructure ([8.5](#)); and
- f) planning and preparations for project termination ([Clause 11](#)).

4.2.7 Post-injection phase

The post-injection phase of the storage project life cycle starts when CO₂ injection finishes and ends when the project operator has demonstrated compliance with criteria for project termination ([11.2](#)).

Termination activities include:

- a) finalizing criteria for termination ([11.2](#)) and finalizing the termination plan ([11.3](#));
- b) decommissioning of the storage facility as specified in the termination plan, and consistent with the requirements of [7.5](#);
- c) implementing the monitoring program for the post injection phase ([9.2.4](#));
- d) executing the qualification process for project termination ([11.4](#)); and
- e) archiving of reports, results, and other data that form the basis for the termination qualification process.

4.3 Project management plan

4.3.1 General

The project management plan is a living document that provides an integrated project management reference through the life cycle of the geological storage project from site screening through to project termination. The project operator shall develop and maintain a project management plan from the onset of the project.

The project management plan should be reviewed as additional knowledge is gained regarding project performance and containment assurance. The plan should be updated when significant changes occur to the storage project that are likely to impact project outcomes, and the updated plan should be included in the project register ([4.4.2](#)).

4.3.2 Project management plan specifications

The project management plan should include, but is not limited to:

- a) statements of project objectives;
- b) project description ([4.3.3](#));
- c) criteria for project termination ([11.2](#));
- d) risk management plan ([6.3](#));
- e) operations maintenance plan ([Clause 8](#));