BS ISO 27914:2017

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Carbon dioxide capture, transportation and geological storage — Geological storage

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National foreword

This British Standard is the UK implementation of ISO 27914:2017.

The UK participation in its preparation was entrusted to Technical Committee PSE/265, Carbon Capture Transportation and Storage.

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INTERNATIONAL STANDARD

ISO 27914

First edition
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Carbon dioxide capture, transportation and geological storage — Geological storage

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

Reference number
ISO 27914:2017(E)

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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
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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 voluntary nature of standards, 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 Technical Committee ISO/TC 265, *Carbon dioxide capture, transportation, and geological storage*.

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Introduction

Geological storage of carbon dioxide (CO_2) is recognized as a key technology for abatement of CO_2 emissions to the atmosphere or ocean and is an essential component in the process of carbon dioxide capture and storage (CCS)[1]. The objective of this document is to provide recommendations for the safe and effective storage of CO_2 in subsurface geologic formations through all phases of a storage project life cycle (see Figure 1). While CCS is a nascent industry, this document is supported by a wide range of operational experiences in pilot to commercial scale carbon dioxide storage projects that have used methods and technologies mostly developed and widely deployed by the oil and gas industry including CO_2-enhanced oil recovery (EOR). This document applies to injection of CO_2 into geologic units for the sole purpose of storage and does not apply to CO_2 injection for hydrocarbon recovery, or storage of CO_2 that occurs in association with carbon dioxide enhanced hydrocarbon recovery. [ISO 29716 is in development to address carbon dioxide storage using enhanced oil recovery (CO_2-EOR)]. This document is supplemented by recommended practice manuals for CO_2 storage and numerous standards and technical recommendations developed for the oil and gas industry. [See Bibliography for selected references (References [1] to [12])].

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INTERNATIONAL STANDARD ISO 27914:2017(E)

Carbon dioxide capture, transportation and geological storage — Geological storage

1 Scope

This document

a) establishes requirements and recommendations for the geological storage of CO_2 streams, the purpose of which is to promote commercial, safe, long-term containment of carbon dioxide in a way that minimizes risk to the environment, natural resources, and human health,

b) is applicable for both onshore and offshore geological storage within permeable and porous geological strata including hydrocarbon reservoirs where a CO_2 stream is not being injected for the purpose of hydrocarbon production or for storage in association with CO_2-EOR,

c) includes activities associated with site screening and selection, characterization, design and development, operation of storage sites, and preparation for site closure,

d) recognizes that site selection and management are unique for each project and that intrinsic technical risk and uncertainty will be dealt with on a site-specific basis,

e) acknowledges that permitting and approval by regulatory authorities will be required throughout the project life cycle, including the closure period, although the permitting process is not included in this document,

f) provides requirements and recommendations for the development of management systems, community and other stakeholder engagement, risk assessment, risk management and risk communication,

g) does not apply to, modify, interpret, or supersede any national or international regulations, treaties, protocols or instruments otherwise applicable to the activities addressed in this document, and

h) does not apply to or modify any property rights or interests in the surface or the subsurface (including mineral rights), or any pre-existing commercial contract or arrangement relating to such property.

The life cycle of a CO_2 geological storage project covers all aspects, periods, and stages of the project, from those that lead to the start of the project (including site screening, selection, 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 period, which includes a closure period. Figure 1 illustrates the limits of this document.

NOTE 1 This document does not address any post-closure period or specify post-closure period requirements.

This document does not apply to

— the post-closure period,

— injection of CO_2 for enhancing production of hydrocarbons or for storage associated with CO_2-EOR,

— disposal of other acid gases except as considered part of the CO_2 stream,

— disposal of waste and other matter added for purpose of disposal,

— CO_2 injection and storage in coal, basalt, shale and salt caverns, or

— underground storage using any form of buried container.

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NOTE 2 This document may not be suitable for research projects, for example, those with a primary objective to test technologies or methods of monitoring.

NOTE 3 The closure period in this document does overlap with the post-closure phase of the EU regulatory definition. This document, however, is not concerned with transfer of liability.

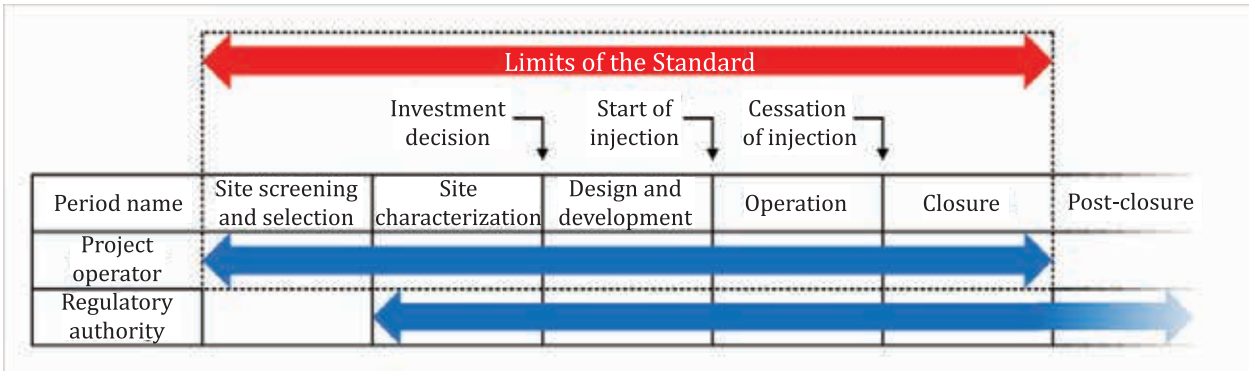

Figure 1 — Entities involved in the storage project life cycle

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 terminological databases for use in standardization at the following addresses:

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

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

3.1
abandonment
process and procedures used to permanently end the operation of a well

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 migration of contamination, 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
acceptable risk
risk (3.39) borne by the *project operator* (3.33) and others, having regard to legal obligations and management policies

3.3
area of review
geographical area(s) of a *storage project* (3.56), or part of it, designated for assessment of the extent to which a storage project, or part of it, 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.

3.4
baseline
reference basis for comparison against which project performance is monitored or measured

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3.5
biosphere
realm of living organisms including the atmosphere, on the ground surface and in soils, in oceans and seas, in surface waters such as rivers and lakes, and in the subsurface above the *storage complex* (3.54)

3.6
carbon dioxide (CO_2) plume
region within geologic strata where CO_2 is present in free phase

3.7
carbon dioxide (CO_2) stream
stream consisting overwhelmingly of carbon dioxide

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 and/or trace substances added to assist in CO_2 migration detection.

3.8
casing
pipe material placed inside a drilled hole to prevent the surrounding strata from collapsing into the hole

Note 1 to entry: There are many acceptable variations on casing design but typical types of casing in most injection wells are:

a) surface casing, i.e. the outermost casing that extends from the surface to the base of the lowermost *protected groundwater* (3.37);

b) intermediate casing is one or more strings of casing installed between the surface and long-string casing for various design reasons;

c) long-string casing, which extends from the surface to or through protected groundwater to the bottom of the well.

3.9
casing shoe
reinforcing steel collar that is screwed onto the bottom joint of the *casing* (3.8) to prevent abrasion or distortion of the casing when it is forced past obstructions on the wall of the borehole

3.10
closure period
period between the cessation of injection and the demonstration of compliance with the criteria for *site closure* (3.52)

3.11
containment
retention of CO_2 and formation fluids within a *storage complex* (3.54)

3.12
corrective action
action taken to correct material irregularities or to contain breaches in order to prevent or minimize damage to, or release of CO_2 from, a *storage complex* (3.54)

Note 1 to entry: Corrective actions are implemented after an irregularity has occurred to help prevent or minimize damage.

3.13
decommission
take an engineered system or component out of service, render it inoperative, dismantle and decontaminate it

3.14
element of concern
valued element or objective for which *risk* (3.39) is evaluated and managed

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3.15
elevated pressure zone
zone within a *storage complex* (3.54) where there is sufficient pressure to cause flow of formation fluids through a pathway from the *storage unit(s)* (3.59) to outside the storage complex into economic resources, *protected groundwater* (3.37), or the *biosphere* (3.5)

3.16
event
material occurrence or change in a particular set of circumstances

3.17
geological storage
long-term *containment* (3.11) of *CO2 streams* (3.7) in subsurface geological formations

Note 1 to entry: Long-term means the minimum period necessary for CO_2 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.

Note 3 to entry: Within the context of this document, geological storage

a) is applicable to permeable and porous strata that do not contain *protected groundwater* (3.37),

b) is applicable to nonproducing hydrocarbon reservoirs, and

c) does not apply to

    1) CO_2 injection and storage in unmineable coal beds, basalt formations, shales, and salt caverns,

    2) CO_2 injection and storage in any formations containing producible hydrocarbons, and

    3) underground storage in materials involving the use of any form of man-made containers.

3.18
geosphere
solid earth below the ground surface and bottom of rivers and other bodies of water on land, and below the sea bottom offshore

3.19
injectivity
rate and pressure at which fluids can be pumped into the *storage unit* (3.59) without fracturing the storage unit

3.20
leakage
unintended release of fluid out of a pre-defined *containment* (3.11)

Note 1 to entry: In this document, the pre-defined containment is the *storage complex* (3.54).

3.21
legacy well
pre-existing well within the *area of review* (3.3) of a CO_2 *storage project* (3.56) that was drilled for a different purpose than CO_2 injection or *monitoring* (3.27) of the respective CO_2 storage project

3.22
likelihood
chance of something happening, expressed qualitatively or quantitatively and described using general terms or mathematically, e.g. by specifying a probability or frequency of occurrence over a given period

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3.23
liner
casing (3.8) string that does not extend to the surface

3.24
management of change
procedure used when making a change to the process equipment or operating procedures to detail changes made and to document steps taken to inform and train operating personnel and relevant stakeholders on process changes

3.25
mechanical integrity
mechanical condition of a well, such that engineered components maintain their original dimensions and functions, solid geological materials are kept out of the wellbore, and fluids including CO_2 are prevented from uncontrolled flow into, out of, along, or across the wellbore, cement sheath, annulus, *casing* (3.8), *tubing* (3.62), and/or *packers* (3.30)

3.26
mechanical integrity test
MIT
test performed on a well to confirm that it maintains internal or external *mechanical integrity* (3.25)

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.

3.27
monitoring
continuous or repeated checking, supervising, critically observing, measuring or determining the status of a system to identify change from *baseline* (3.4) or variance from an expected performance level

Note 1 to entry: In case of *geological storage* (3.17), monitoring is not restricted to the technical infrastructure of an operator. It also includes the wider surroundings of the surface and/or subsurface *storage site* (3.58).

3.28
operational period
period enduring from CO_2 stream first entering the wellhead for storage until injection ceases

3.29
overburden
geological material overlying an area or geological formation of interest in the subsurface

3.30
packer
mechanical device that seals the outside of *tubing* (3.62) to the inside of *casing* (3.8), isolating an annular space

3.31
post-closure period
period that begins after the demonstration of compliance with the criteria for *site closure* (3.52)

Note 1 to entry: In some countries, demonstration of compliance may need approval from a third party.

3.32
primary seal
continuous geological unit (known in reservoir engineering as caprock and in hydrogeology as aquitard or aquiclude) above a *storage unit* (3.59) that is part of a *storage complex* (3.54) and effectively restricts migration of fluids out of the storage unit and *leakage* (3.20) out of the storage complex

3.33
project operator
entity that is legally responsible for the CO_2 *storage project* (3.56)

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3.34
project organization
project operator (3.33) and any subcontractor or other person or organization acting under the project operator's control or on behalf of the project operator

3.35
project personnel
person or persons employed by any member of the *project organization* (3.34)

3.36
project stakeholder
individual, group of individuals, or organization whose interests are or could be affected by a *storage project* (3.56)

Note 1 to entry: Stakeholders can include decision makers, employees, shareholders, academia, insurance companies, banks, community residents, suppliers, customers, non-governmental organizations, governments, regulators, labour unions, and other individuals or groups.

3.37
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

3.38
regulatory authority
entity that has legal authority to permit, approve, or otherwise authorize the siting, construction, testing, operation, *monitoring* (3.27), modification, plugging, or closure of a *geological storage* (3.17) site, well, unit, complex, or project and monitors compliance with the terms of the permit, approval, or authorization

3.39
risk
effect of uncertainty on project objectives [e.g. on performance metrics for an *element of concern* (3.14)], expressed in terms of the severity of consequences (negative impacts) of an *event* (3.16) and the associated *likelihood* (3.22) of their occurrence

Note 1 to entry: An effect is a deviation from the expected and can be either positive or negative.

Note 2 to entry: Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).

3.40
risk analysis
process for understanding the nature and level of *risk* (3.39)

3.41
risk assessment
overall process of *risk identification* (3.45), *risk analysis* (3.40), and *risk evaluation* (3.43)

3.42
risk control
measure whose purpose is to reduce a specific *risk* (3.39) or avoid escalation of risk

3.43
risk evaluation
process of comparing the results of a *risk analysis* (3.40) with *risk evaluation criteria* (3.44) to determine whether the *risk* (3.39), its magnitude, or both are acceptable or treatment is required to reduce the risk

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3.44
risk evaluation criteria
terms of reference against which the significance of *risk* (3.39) is evaluated

3.45
risk identification
process of finding, recognizing, and describing *risk* (3.39)

3.46
risk management plan
scheme specifying the approach, management components, and resources to be applied to the management of *risk scenarios* (3.48)

3.47
risk owner
person or entity with the accountability and authority to manage *risk* (3.39)

3.48
risk scenario
combination or a chain of circumstances through which a *threat* (3.60) can cause an *event* (3.16) to occur and through which the consequences of an event can have a negative impact on *elements of concern* (3.14)

3.49
risk treatment
process to reduce a specified *risk* (3.39) through implementation of *risk controls* (3.42)

3.50
secondary seal
geological unit that effectively restricts migration of fluids in the sedimentary succession between the *primary seal(s)* (3.32) and *protected groundwater* (3.37), protected resources, or the seabed

3.51
site characterization
detailed evaluation of one or more candidate sites for CO_2 storage identified in the screening and selection stage of a CO_2 *storage project* (3.56) to confirm and refine *storage complex* (3.54) integrity, storage capacity, and *injectivity* (3.19) estimates and provide basic data for initial predictive modelling of fluid flow, geochemical reactions, geomechanical effects, *risk assessment* (3.41), and *monitoring* (3.27) and *validation* (3.65) program design

3.52
site closure
end of the *closure period* (3.10), which occurs when the *project operator* (3.33) has demonstrated compliance with criteria for site closure

3.53
site screening and selection
initial evaluation of the suitability of geologically storing CO_2 at the regional or sub-regional scale by identifying, assessing, and possibly comparing candidate storage formations or sites

3.54
storage complex
subsurface geological system extending vertically to comprise *storage unit(s)* (3.59) and identified seal(s), and extending laterally to the defined limits of the CO_2 *storage project* (3.56)

Note 1 to entry: Limits can be defined by natural geologic boundaries, regulation, or legal rights.

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3.55
storage facility
area on the ground surface or, in offshore cases, in the sea or on the sea bed, defined by the operator and/or regulatory agency, where CO_2 injection facilities are developed and operational activities [including *monitoring* (3.27)] take place

Note 1 to entry: In many instances, the storage facility and the *area of review* (3.3) may be coextensive. Because the areas have different derivations — the area of review being based on potential impacts and the storage facility being based on operational activities — there is a potential for the areas to be different for a specific project. Therefore, each term is used in this document to reflect its specific derivation and application.

3.56
storage project
physical and temporal extent of activities associated with a project for the *geological storage* (3.17) of CO_2 that includes site selection and characterization, *baseline* (3.4) data collection, permitting, design and construction of site facilities (site pipelines, compressors, etc.), well drilling, receipt of CO_2 at the *storage site* (3.58) and CO_2 injection during the active injection phase, and *site closure* (3.52) (including well and facilities abandonment)

Note 1 to entry: It also includes testing and *monitoring* (3.27) during all project phases.

3.57
storage project life cycle
stages of a *storage project* (3.56), beginning with those necessary to initiate the project (including site screening, assessment, engineering, and permitting) and leading up to the start of injection, followed by operations until the cessation of injection, and culminating in the *closure period* (3.10)

Note 1 to entry: This document does not include a *post-closure period* (3.31) in the storage project life cycle.

3.58
storage site
site that comprises the *storage facility* (3.55), *storage project* (3.56) wells, and the *storage complex* (3.54)

3.59
storage unit
geological stratum (or strata) into which CO_2 is injected for the purpose of storage

3.60
threat
element that alone or in combination with other elements has the potential to cause damage or produce a negative impact

3.61
tolerable risk
risk (3.39) considered as temporarily or conditionally acceptable

Note 1 to entry: It is tolerated in order to facilitate a gradual response [i.e. *monitoring* (3.27) and *risk treatment* (3.49)] until the risk has been reduced.

3.62
tubing
tubular string normally run inside the injection or production *casing* (3.8) that acts as the primary conduit for fluids

3.63
transfer of responsibility
transfer of all rights, responsibilities, and liabilities associated with a *storage site* (3.58) to a post-closure steward

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3.64
unacceptable risk
risk (3.39) of a nature and level that is regarded as unacceptable by the *project operator* (3.33) or by an authority whose approval is required for the project to proceed

3.65
validation
confirmation that the system under consideration meets, in all respects, the specification of that system

3.66
verification
confirmation by examination and provision of objective evidence that specified criteria are met

Note 1 to entry: In the context of the Clean Development Mechanism (CDM), verification is the independent review by a designated operational entity of monitored reductions in anthropogenic emissions.

4 Management systems

4.1 Scope of activities

4.1.1 General

Management systems are essential for the implementation and public credibility of geological storage processes. Successful management systems are flexible so that operators can make changes during the project and are robust enough to ensure that they meet site-specific project and regulatory needs. Management systems for a storage project interconnect through all project activities and phases and provide an auditable trail of the decision-making processes.

The intent of management systems is to ensure that existing recommended practices are followed, and to allow and promote improvement in the management of the CO_2 storage site in accordance with 4.3. Management systems also help to ensure that quality assurance and quality control, regulatory compliance, process improvements, and efficiency improvements are integrated into regular management processes and decision-making, as well as ensuring project transparency so that project stakeholders, regulatory authorities, and the public develop confidence in the management and implementation of storage projects. Another important function of management systems is embedding a risk management process into the culture and practices of a storage project to help ensure that the events that can affect project objectives are identified and managed.

4.1.2 Storage project operator's roles and responsibilities

The project operator shall design and develop the injection operations of the CO_2 storage site (see 7.3 and 8.2) and be responsible for operations that fall within the project boundaries as defined within 4.2. In particular, the project operator shall be responsible for

a) all activities related to the storage project and for the coordination and integration of those activities, especially activities that involve the handling and fate of CO_2,

b) formulating a statement of the storage project's principles, values, and quantitative project objectives with reference to the storage permit, and communicating this statement throughout the project organization, to project stakeholders, and to regulatory authorities,

c) coordinating, integrating, and communicating the activities and responsibilities of the project organization to project stakeholders and regulatory authorities,

d) coordinating the activities of the members of the project organization,

e) monitoring compliance with this document by the project organization,

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f) defining clear boundaries with the capture and transport operators and establishing the activities and responsibilities necessary to properly address interfaces among these systems,

g) project risk management during the life cycle of the storage project, and

h) determining and ensuring the availability and effectiveness of the energy, physical, financial, and human resources required to meet the objectives and principles (see 4.3) of the storage project.

The project operator can change over the project life cycle prior to site closure. In such cases, the former project operator shall be responsible for ensuring that all necessary documentation, materials, and processes are transferred to the subsequent project operator. The subsequent project operator shall be responsible for the effective transition of management systems and processes. Transferred records shall be retained by the subsequent project operator, and copies of the transferred records should be retained by the former project operators until the end of the closure period.

4.1.3 Stakeholder identification and engagement

The project operator shall identify project stakeholders early in the storage project life cycle and engage them during all phases of the project.

NOTE Examples of project stakeholders are included in the definitions.

4.1.4 Storage project delineation

The project operator shall describe the scope of the key project stages. This can be in accordance with Figure 1. The description of scope should maintain and communicate the clear alignment of project activities with the storage project's objectives and principles (see 4.3).

The project operator should organize, allocate human resources, and direct the activities of a storage project in accordance with the storage project periods specified in this subclause. A project operator may employ project stages different from that specified in this subclause, but should describe and document support for the alternative periods with reference to those specified in this subclause.

As detailed in the other clauses in this document, particular responsibilities apply to the project operator during specific project periods, including:

a) site screening and selection period: identifying and eliminating prospective sites that are unsuitable for storage in a manner consistent with 5.2;

b) site characterization period:

   1) completing a geological and hydrogeological characterization of the storage unit in accordance with 5.4.2 to provide a reasonable estimate of capacity and injectivity and to assess risk;

   2) evaluating and qualifying the sealing capacity of the primary seal in accordance with 5.4.3.1;

   3) characterizing the chemical composition of the CO_2 stream in accordance with 5.4.4 and conducting a geomechanical characterization of the storage unit and seal in accordance with 5.4.5;

c) design, development, and operation period:

   1) developing and implementing a risk management process in accordance with Clause 6;

   2) developing and disseminating protocols that promote the effective integrated functioning of the project organization;

   3) selecting appropriate materials and methods for site development in accordance with Clause 7;

   4) applying industry recommended practices for site design, development, and operations, including design of wellsites, operational procedures for drilling, facility construction,

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monitoring hardware installation, and site-security and emergency procedures in accordance with Clauses 7 and 8;

5) developing operations and maintenance procedures for monitoring and improving the performance of the complete integrated storage project over the project life cycle in accordance with 7.6, 8.3 and 9.4;

6) establishing a provisional site closure plan as described in 10.3 and developing the quantitative key performance indicators expected to be used to demonstrate compliance with the criteria for site closure described in 10.2;

d) closure period:

1) finalizing the criteria for site closure as established in 10.2 and closure plan described in 10.3;

2) continuing to implement the risk management plan and risk treatment plans as described in 6.6 and 6.8;

3) plugging and abandoning injection, observation and monitoring wells as specified in the closure plan, and consistent with the requirements of 7.8;

4) implementing the monitoring program for the closure period described in 9.2.4; executing the site-closure qualification process as described in 10.4; and archiving of reports, results, and other data that form the basis for the site-closure qualification process.

NOTE Post-closure period: this document does not cover the post-closure period. See Figure 1.

4.2 Project boundaries

4.2.1 Responsibility

The project operator bears responsibilities attached to multiple overlapping work areas in which project boundaries may be defined in terms of legal descriptions (surveys), contracts, permit conditions, surface, seabed, and/or subsurface operational activities, and the physical effects (current or anticipated) of the project.

4.2.2 Organizational boundaries

The project operator for the storage project shall be identified and specific responsibilities and reporting relationships shall be delineated between the project operator and other members of the project organization. If control of the storage project is shared among organizations, the project's internal boundaries among organizations and areas of responsibility shall be delineated.

4.2.3 Operational boundaries

The operational boundary of a storage project encompasses the storage facility and the storage complex. The project operator shall plan for potential impacts on storage project operational activities from activities associated with the area of review or with other CCS components outside the operational boundaries, such as CO_2 capture, processing, and transportation, including planned and potential variations in these components.

4.3 Management commitment to principles

4.3.1 General

Persons or groups of people who are responsible for a storage project at the highest level shall demonstrate their commitment to industry recommended practices for the long-term safe geological storage of CO_2 by incorporating the principles specified in 4.3.2 to 4.3.4 into their actions and decisions.

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4.3.2 Internal principles

The project operator shall:

a) operate on the basis of sound, state-of-the-art science and engineering;

b) seek cost-effective means, but allow a prudent margin for safety and environmental protection;

c) ensure safe CO_2 stream handling;

d) implement an appropriate risk management system;

e) establish systems that ensure the site is monitored throughout the project life cycle so that unplanned occurrences can be addressed promptly (see 9.4.3).

4.3.3 External principles

The project operator shall:

a) operate in an open and transparent fashion with project stakeholders and regulatory authorities to build public understanding, trust, and credibility;

b) establish a local stakeholder interaction strategy and regularly (before start-up of each project phase and then at least yearly or when significant changes occur) engage with and seek input from local stakeholders;

c) provide reports to the public when major milestones are reached or significant unplanned events occur;

d) seek independent assessments of significant project activities to ensure compliance with applicable standards and industry recommended practices.

4.3.4 Health, safety, and environmental principles

The project operator shall:

a) establish health, safety, and environmental protection for project personnel and local communities including ecosystems as the project's highest priorities;

b) develop and put in place an emergency response plan and required equipment or identify providers of equipment and services. Response plans should be coordinated with local emergency services and responsible regulatory authorities;

c) ensure that environmental and human health impacts of the storage project are minimized to an acceptable risk throughout the project life cycle;

d) provide the appropriate resources for continuous improvement of health, safety, and environmental protection;

e) on the basis of the project risk profile, document potential environmental impacts and present them to the project's stakeholders.

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