

US Regulatory Programs & the International Standard for Quantifying Geologic Storage through CO₂-EOR

A Side-by-Side Comparison

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US REGULATORY PROGRAMS & THE INTERNATIONAL STANDARD FOR QUANTIFYING GEOLOGIC STORAGE THROUGH CO₂-EOR: A SIDE-BY-SIDE COMPARISON

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ABOUT THIS SIDE-BY-SIDE

This document provides a side-by-side comparison of frameworks to quantify the carbon dioxide (CO₂) storage that occurs incidentally through CO₂-enhanced oil recovery (EOR). The frameworks compared are:

- US Environmental Protection Administration (EPA) Greenhouse Gas Reporting Program (GHGRP) Subpart RR, with additional references provided for context on the EPA's Underground Injection Control (UIC) program Class II permit requirements.
- International Organization for Standardization (ISO), "*Carbon dioxide capture, transportation and geological storage—Carbon dioxide storage using enhanced oil recovery (CO₂-EOR)*" (ISO 27916).

Excerpts and summaries of key components from each framework are placed side-by-side and organized by category for comparative purposes to facilitate discussion among experts in the regulation of incidental CO₂ storage through CO₂-EOR. This document should not be used as a guide to either EPA requirements or the ISO 27916 standard. This is not intended to be informative about either requirement on its own. EPA and ISO programs are only described in the context of CO₂-EOR and incidental storage.

Note: This document is for discussion purposes only and should not be read as providing legal advice or as a regulatory reference for the rules or requirements under EPA's Greenhouse Gas Reporting Program, EPA's Underground Injection Control Program, the federal §45Q credit for carbon oxide sequestration, or for ISO 27916.

REFERENCES TO THE EPA UIC PROGRAM & THE RELATIONSHIP TO SUBPART RR

While this document compares the GHGRP Subpart RR and the ISO 27916 standard, it is important to note that the US EPA UIC program regulates the construction, operation, permitting, and closure of CO₂ injection wells. The US EPA UIC program sets requirements and other safeguards to protect underground sources of drinking water (USDWs) as authorized by the Safe Drinking Water Act. UIC program Class II is the well class permit required for CO₂-EOR projects. The preamble of Subpart RR provides a discussion on the "Relationship to Underground Injection Control Regulations under the Safe Drinking Water Act," including the following:

- The UIC program "is designed to prevent the movement of such fluid [e.g., CO₂ injected for EOR] into USDWs by addressing the potential pathways through which injected fluids can migrate and potentially endanger USDWs."
- "While requirements under the UIC program are focused on demonstrating that USDWs are not endangered as a result of CO₂ injection into the subsurface, requirements under the GHG Reporting Program through 40 CFR part 98, subpart RR will

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enable EPA to verify the quantity of CO₂ that is geologically sequestered and to assess the efficacy of GS [geologic sequestration] as a mitigation strategy.”

- “EPA designed the reporting requirements under 40 CFR part 98, subpart RR with careful consideration of UIC requirements...to minimize overlap between the two programs.” For example, EPA states that “facilities reporting under 40 CFR part 98, subpart RR may use flow meters used to comply with the flow monitoring and reporting provisions in their UIC permit.”

Class II program implementation has been delegated by EPA to many states and is retained by EPA for all remaining states. States can be approved for this delegation of “primacy” when their regulations meet or exceed the federal UIC requirements.

Where it provides useful context in this side-by-side, the UIC program has been referenced.

For more information on US programs related to quantifying geologic storage through CO₂-EOR, see the Carbon Capture Coalition’s [“Overview: Accounting of Carbon Storage through Enhanced Oil Recovery—Navigating Aspects of EPA’s Underground Injection Control Program and Greenhouse Gas Reporting Program Related to the Section 45Q Tax Credit.”](#)

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| <p>All text in left column describes US EPA programs. Unless otherwise noted, the US EPA Greenhouse Gas Reporting Program Subpart RR is the regulation being cited or summarized in the left-hand column.</p> | <p>All text in right column describes the ISO 27916.</p> |
| <p align="center">Section A: Overview of purpose</p> | |
| <p>US EPA Greenhouse Gas Reporting Program (GHGRP) is a federal reporting framework to quantify and verify greenhouse gas emissions, including for geologic storage of CO₂.</p> <p>As described by EPA in the Subpart RR preamble, the Subpart RR reporting requirements were designed with “careful consideration of UIC requirements...to minimize overlap between the two programs.”</p> | <p>Documentation and demonstration of safe, long-term containment of CO₂ stored in association with CO₂-EOR and quantification of associated storage in CO₂-EOR operations.</p> <p>The standard assumes and acknowledges that there are existing regulatory programs and standards apply to CO₂-EOR projects, from permitting to corrective action, and that this standard does not address those topics.</p> |
| <p align="center">Section B: Authority for administration</p> | |
| <p>The US EPA administers the GHGRP Subpart RR under the EPA’s Clean Air Act authority.</p> | <p>The standard requires providing the required documentation to an “authority,” which is defined as a “competent governmental entity or entities with legal power to regulate or permit CO₂-EOR to regulate storage of CO₂ in associate CO₂-EOR operation, or to regulate quantification of the storage of CO₂ in association with a CO₂-EOR operation.”</p> |

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Section C: Detailed purpose & scope

Greenhouse Gas Reporting Program. The GHGRP is a federal reporting framework under the EPA’s Clean Air Act authority for greenhouse gas emissions (GHGs) from large sources of GHGs, fuel and industrial gas suppliers, and CO₂ injection sites. The program includes 41 different GHG source categories, listed as subparts, and the data collected by the EPA through the program can be used for tracking and comparing net emissions and other purposes.

EPA states that “requirements under the GHG Reporting Program through 40 CFR part 98, subpart RR will enable EPA to verify the quantity of CO₂ that is geologically sequestered and to assess the efficacy of GS [geologic sequestration] as a mitigation strategy. Subpart RR achieves this by requiring facilities conducting GS to develop and implement a MRV [monitoring, reporting, and verification] plan to detect and quantify leakage of injected CO₂ to the surface in the event leakage occurs and to report the amount of CO₂ geologically sequestered using a mass balance approach, regardless of the class of UIC permit that a facility holds.” (preamble to Subpart RR)

EPA stated in a [response](#) to public comments that “a facility subject to subpart RR must calculate the quantity of CO₂ geologically sequestered using a mass balance equation that takes into account CO₂ injected, CO₂ emitted from subsurface leakage (if any), CO₂ produced (if any), and fugitive or vented emissions from surface equipment (if any) located between the flow meter(s) and the wellhead(s). EPA has concluded that a full mass balance is required to calculate and verify the

“The absence of an accepted standard for demonstrating the safe, long-term containment of CO₂ in association with CO₂-EOR and documenting the quantity of associated stored CO₂ constitutes one of the barriers to the increased use of anthropogenic CO₂ in CO₂-EOR operations. The purpose of this document is to remove that barrier and thereby facilitate the exchange of goods and services related to the increased use and emissions reductions through associated storage by providing methods for demonstrating the safe, long-term containment of, and determining the quantity of CO₂ stored in association with CO₂-EOR.” (Introduction)

The standard provides “requirements for demonstrating that the site in question is adequate to provide safe, long-term containment of CO₂, for demonstrating that the CO₂ flood is operated in a way to assure containment of the CO₂ in the EOR complex, and for quantifying associated storage.” (Introduction)

“The results of quantifications under this document could be used as input for calculations conducted in accordance with a number of other standards, protocols or programs for the quantification or reporting of greenhouse gas emissions, mitigation, or reductions, including those complying with ISO 14064-1, ISO 14064-2 and ISO 14064-3.” (Introduction)

“Specifically, this document provides for:

- the identification and quantification of CO₂ losses (including fugitive emissions)

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quantity of CO₂ geologically sequestered. The quantity of CO₂ received is not adequate to calculate this number.”

Reported data are verified¹ by EPA and made public in the fall of each year.²

Enforcement. As Subpart RR is a reporting framework, there is no enforcement mechanism beyond the enforcement of compliance with the administrative requirements (e.g., no corrective action requirements for leakage under RR beyond accounting for any CO₂ emissions; any corrective action would be in the context of protecting USDWs under the EPA UIC program).

Note: A project injecting CO₂ will report under the relevant GHGRP subpart(s) while also meeting the requirements of their EPA UIC permit.

- quantification of the amount of CO₂ stored in association with CO₂-EOR projects using a mass-balance approach.

Such quantification could be used in a broader scheme for the quantification and verification of emissions and emission reductions over the entire carbon capture, transportation and storage chain.” (Introduction)

Enforcement. The ISO standard does not have an enforcement mechanism and to the extent that it facilitates “the exchange of goods and services,” there is an implication that contract law or some other commercial enforcement mechanism might be called into action if there is fraud or failure to meet terms.

¹ See details of the EPA’s process for ensuring GHGRP data is “accurate, complete, and consistent” on the EPA GHGRP website. Available at <https://www.epa.gov/ghgreporting/ghgrp-methodology-and-verification>.

² Data reported as part of the GHGRP is made available to the public unless it is qualified as confidential under the Clean Air Act. More information available at <https://www.epa.gov/ghgreporting/confidential-business-information-ghg-reporting>.

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| Section D: Application | |
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| <p>Subpart RR applies:</p> <ul style="list-style-type: none"> • To projects operating under a UIC Class VI permit, and • To UIC Class II permit holders that have opted-in to report under RR (reporting under RR is optional for facilities operating under a Class II permit). • The EPA recognizes that injecting CO₂ captured from industrial facilities (including power plants) for EOR can result in secure geologic storage of that CO₂, even when the primary purpose of the injection is to produce additional oil.³ <p>In the context of CO₂-EOR, RR applies only to CO₂-EOR projects for which the quantification of CO₂ storage is sought.</p> | <p>1.1 Applicability. “This document applies to carbon dioxide (CO₂) that is injected in enhanced recovery operations for oil and other hydrocarbons (CO₂-EOR) for which quantification of CO₂ that is safely stored long-term in association with the CO₂-EOR project is sought. Recognizing that some CO₂-EOR projects use nonanthropogenic CO₂ in combination with anthropogenic CO₂, the document also shows how allocation ratios could be utilized for optional calculations of the anthropogenic portion of the associated stored CO₂ (see Annex B).”</p> <p>The introduction (p.vi) refers to storage as an inherent and intrinsic part of CO₂-EOR operations.</p> <p>1.2 Non-applicability. Projects must use ISO 27914 for CO₂ injection in formations that are no longer producing paying or commercial quantities of hydrocarbons, and where the intent of such injection is not to enhance hydrocarbon recovery.</p> <p>It also does not apply to buffer storage and other above ground CO₂.</p> |

³ See memorandum from Peter C. Grevatt, director, Office of Ground Water and Drinking Water, US EPA, to EPA’s Regional Water Division Directors on “Key Principles in EPA’s Underground Injection Control Program Class VI Rule Related to Transition of Class II Enhanced Oil or Gas Recovery Wells to Class VI.

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Section E: Plan for monitoring, reporting, verification

Overview

EPA's GHGRP Subpart RR preamble states in the "Summary of the Final Rule" (II)(B)(5), "Facilities must develop a monitoring, reporting, and verification (MRV) plan, submit the MRV plan to EPA, receive an approved MRV plan from EPA, implement the EPA-approved plan, and submit annual reports.

The MRV plan must include five major components:

- Delineation of the maximum monitoring area (MMA) and the active monitoring area (AMA).
- Identification and evaluation of the potential surface leakage pathways and an assessment of the likelihood, magnitude, and timing, of surface leakage of CO₂ through these pathways in the MMA.
- A strategy for detecting and quantifying any surface leakage of CO₂ in the event leakage occurs.
- An approach for establishing the expected baselines for monitoring CO₂ surface leakage.
- A summary of considerations made to calculate site-specific variables for the mass balance equation."

The project operator must conduct the underlying risk assessments and modeling activities included in their MRV plan to support their documentation.

Note: EPA UIC Class II permits have detailed operating and monitoring requirements (e.g., monitoring injection pressure and monitoring the nature of injected fluids) and reporting requirements which are focused on the protection of USDWs.

Overview

This document provides "requirements for demonstrating that the site in question is adequate to provide safe, long-term containment of CO₂, for demonstrating that the CO₂ flood is operated in a way to assure containment of the CO₂ in the EOR complex, and for quantifying associated storage."

(Introduction)

To provide containment assurance and monitoring within the EOR complex, the following are required (all described in greater detail in sections below):

- An EOR operations management plan (6.1.1) that specifies procedures for field management and an operational containment assurance during the quantification period
- An initial containment assurance plan (6.1.2) to identify potential leakage pathways
- Monitoring of potential leakage pathways from the containment assurance plan (6.2.1)
- Monitoring methods for detecting and quantifying losses (6.2.2)
- Monitoring program implementation to address facility and project losses (6.2.3)

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| <p>Monitoring area</p> <p>§ 98.448(a)(1) “Delineation of the maximum monitoring area and the active monitoring areas. The first period for your active monitoring area will begin from the date determined in your MRV plan through the date at which the plan calls for the first expansion of the monitoring area. The length of each monitoring period can be any time interval chosen by you that is greater than 1 year.”</p> | <p>Monitoring area</p> <p>The EOR complex, within which monitoring would occur is defined as: “<i>project reservoir</i> (3.19), <i>trap</i> (3.23), and such additional surrounding volume in the subsurface as defined by the <i>operator</i> (3.16) within which injected CO₂ will remain in <i>safe, long-term</i> (3.21) <i>containment</i> (3.8).” (3.10)</p> |
| <p>Leakage</p> <p>§ 98.448(a)(2) “Identification of potential surface leakage pathways for CO₂ in the maximum monitoring area and the likelihood, magnitude, and timing, of surface leakage of CO₂ through these pathways.”</p> <p>§ 98.448(a)(3) “A strategy for detecting and quantifying any surface leakage of CO₂.”</p> <p>§ 98.448(a)(4) “A strategy for establishing the expected baselines for monitoring CO₂ surface leakage.”</p> <p>The operator has to conduct a modeling effort to assure that containment has occurred and quantify any leakage that occurs from operations. In order to discontinue reporting under Subpart RR, as described in Section P below, operators are required to demonstrate to the EPA administrator that the amount of CO₂ claimed as stored during the reporting period is not expected to migrate in a manner likely to result in surface leakage.</p> | <p>Leakage</p> <p>6.1.1 EOR operations plan requires</p> <p>“d) assessment of containment by geologic features and engineering systems in accordance with 6.1.3;</p> <p>e) an assessment and management of potential leakage pathway risks and monitoring technologies and procedures (see 6.1.3), including definition of detection thresholds, that are sufficient” to meet the de minimis loss requirements (8.6).</p> <p>“g) corrective measures for potential leakage or unexpected events.”</p> <p>Monitoring program, methods, and implementation. 6.2.1 Monitoring of potential leakage pathways. “The monitoring program shall address the identified inventory of potential leakage pathways from the containment assurance plan [see 6.1.1 e)] to determine, for each potential leakage pathway, whether it is:</p> <p>a) not active and thus excluded from the monitoring program;</p> |

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| | <p>b) not active, but might activate under operation of the CO₂-EOR project and is thus to be addressed by the monitoring program; or</p> <p>c) active.</p> <p>The operator shall conduct the potential leakage pathway assessment in accordance with the EOR operation management plan or as required by the authority. A final leakage pathway assessment shall be conducted prior to project termination.</p> <p>NOTE It is likely that the monitoring program could require collection of data prior to start of the quantification period and during the operational life of the project (see 5.5).”</p> <p>“6.1.2 Initial containment assurance</p> <p>The EOR operations management plan shall provide an initial containment assurance plan to identify and assess potential geologic, engineered, and engineering-affected leakage pathways that might lead to loss of CO₂ from the EOR complex.”</p> <p>“6.1.3 Operational containment assurance</p> <p>The EOR operations management plan shall provide operational containment assurance during the quantification period, based on engineering data encompassing such items as the results of reservoir management practices, including injection-withdrawal ratio monitoring, well integrity monitoring, pressure monitoring, monitoring of CO₂ movement within leakage pathways identified in the initial containment assurance and monitoring of pressure response within the</p> |
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| | <p>boundary of the EOR complex. The operational containment assurance may include results from other monitoring. These results shall be used in periodically providing evidence of containment, including the supporting rationale.”</p> |
| <p>Quantification of leakage/loss</p> <p>§ 98.448(a)(5) “A summary of the considerations you intend to use to calculate site-specific variables for the mass balance equation. This includes, but is not limited to, considerations for calculating CO₂ emissions from equipment leaks and vented emissions of CO₂ between the injection flow meter and injection well and/or the production flow meter and production well, and considerations for calculating CO₂ in produced fluids.”</p> | <p>Quantification of leakage/loss</p> <p>6.1.1 EOR operations management plan requires in part:</p> <p>“f) method of quantification of CO₂ below the detection threshold in accordance with 8.6;</p> <p>h) providing data for associated storage quantification”</p> <p>6.2.2 Monitoring methods</p> <p>“The monitoring program shall describe tools, methods, applicability, and frequency for detecting and quantifying losses (see 8.4). Details of the monitoring program and data assessed (including relevant data prior to the quantification period) shall be provided in the initial documentation (see 4.3), along with the threshold beneath which there would be no detection. The method of quantification for quantities of CO₂ below the detection threshold shall be specified in the EOR operations management plan (see 8.6).”</p> <p>“6.2.3 Monitoring program implementation. The monitoring program shall be implemented to address facility and project losses in accordance with the EOR operations management plan (see 6.1) as applied to the inventory of potential leakage pathways (see 6.2.1). The monitoring program shall be reviewed and revised as EOR operational practices are modified.”</p> |

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| <p>Monitoring requirements–Existing wells</p> <p>§ 98.448(a)(6) “If a well is permitted under the Underground Injection Control program, for each injection well, report the well identification number used for the Underground Injection Control permit and the Underground Injection Control permit class. If the well is not yet permitted, and you have applied for an Underground Injection Control permit, report the well identification numbers in the permit application. If an offshore well is not subject to the Safe Drinking Water Act, for each injection well, report any well identification number and any identification number used for the legal instrument authorizing geologic sequestration. If you are submitting your Underground Injection Control permit application as part of your proposed MRV plan, you must notify EPA when the permit has been approved. If you are an offshore facility not subject to the Safe Drinking Water Act, and are submitting your application for the legal instrument authorizing geologic sequestration as part of your proposed MRV plan, you must notify EPA when the legal instrument authorizing geologic sequestration has been approved.”</p> <p><i>Note: Existing wells must also be provided to the EPA for Class II permit.</i></p> | <p>Monitoring requirements–Existing wells</p> <p>5.4 Existing wells within the EOR complex</p> <p>“The description of wells shall identify each well penetrating the EOR complex and shall provide evidence it has been constructed and/or plugged & abandoned in such a manner as to provide safe, long-term containment of CO₂. Such wells include injection, production, monitoring, temporarily abandoned, shut-in, and plugged & abandoned wells. The following information shall be provided where available:</p> <ul style="list-style-type: none"> a) well name; b) unique well identifier; c) spud and completion dates; d) well status (e.g. injection, production, monitoring, temporarily abandoned, shut-in, plugged & abandoned); e) surface or seabed location; f) total and measured depth; g) plugging & abandonment information; h) well construction, completion, and well integrity technical details; i) significant equipment remaining in the well; and j) well intervention details and history. <p>In some cases, remote sensing methods or field or aerial surveys to locate old wells may be necessary.”</p> |
| <p>Timing and approval process</p> <p>§ 98.448 describes requirements for the contents of the MRV plan that include, in part:</p> | <p>Timing and approval process</p> <p>Requires preparing the “initial documentation” at the beginning of the quantification period, which is defined in 3.20 as the “period of time during which associated storage (3.2) is being</p> |

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(a)(7) “Proposed date to begin collecting data for calculating total amount sequestered according to equation RR-11 or RR-12 of this subpart. This date must be after expected baselines as required by paragraph (a)(4) of this section are established and the leakage detection and quantification strategy as required by paragraph (a)(3) of this section is implemented in the initial AMA.”

(b) “Timing. You must submit a proposed MRV plan to EPA according to the following schedule:

(1) You must submit a proposed MRV plan to EPA by June 30, 2011 if you were issued a final Underground Injection Control permit authorizing the injection of CO₂ into the subsurface on or before December 31, 2010. You will be allowed to request one extension of up to an additional 180 days in which to submit your proposed MRV plan.

(2) You must submit a proposed MRV plan to EPA within 180 days of receiving a final Underground Injection Control permit authorizing the injection of CO₂ into the subsurface. If your facility is an offshore facility not subject to the Safe Drinking Water Act, you must submit a proposed MRV plan to EPA within 180 days of receiving authorization to begin geologic sequestration of CO₂. You will be allowed to request one extension of the submittal date of up to an additional 180 days.

(3) If you are injecting a CO₂ stream in subsurface geologic formations to enhance the recovery of oil or natural gas and you are not permitted as Class VI under the Underground Injection Control program, you may opt to submit an MRV plan at any time.

(4) If EPA determines that your proposed MRV plan is incomplete, you must submit an updated MRV plan within

quantified.” It does not specify the timing of when this documentation should be offered to the authority.

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| <p>45 days of EPA notification, unless otherwise specified by EPA.</p> <p>(c) Final MRV plan. The Administrator will issue a final MRV plan within a reasonable period of time. The Administrator's final MRV plan is subject to the provisions of part 78 of this chapter. Once the MRV plan is final and no longer subject to administrative appeal under part 78 of this chapter, you must implement the plan starting on the day after the day on which the plan becomes final and is no longer subject to such appeal.”</p> <p>“EPA has designed MRV plan requirements under 40 CFR part 98, subpart RR so that facilities will not need to disrupt or delay normal operations. However, EPA clarifies that facilities will report the amounts of CO₂ geologically sequestered under 40 CFR part 98, subpart RR after they implement an EPA-approved MRV plan iterative process, EPA will issue a final MRV plan as submitted, or with revisions.” (EPA response to public comment in the Final Rule, 75 FR 75072)</p> | |
| <p>Section F: GHGs to report & data reporting requirements</p> | |
| <p>Subpart RR requires reporting to the EPA on an annual basis of the following (under 40 CFR § 98.442 GHGs to report):</p> <p>“(a) Mass of CO₂ received.</p> <p>(b) Mass of CO₂ injected into the subsurface.</p> <p>(c) Mass of CO₂ produced (i.e., mixed with produced oil, gas, or other fluids)</p> <p>(d) Mass of CO₂ emitted by surface leakage.</p> | <p>4.3 Initial documentation</p> <p>“At the beginning of the quantification period, initial documentation shall be prepared and shall include:</p> <ul style="list-style-type: none"> a) a description of the EOR complex and engineered systems (see Clause 5); b) the initial containment assurance (see 6.1.2); c) the monitoring program (see 6.2); |

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| <p>(e) Mass of CO₂ equipment leakage and vented CO₂ emissions from surface equipment located between the injection flow meter and the injection wellhead.</p> <p>(f) Mass of CO₂ equipment leakage and vented CO₂ emissions from surface equipment located between the production flow meter and the production wellhead.</p> <p>(g) Mass of CO₂ sequestered in subsurface geologic formations.</p> <p>(h) Cumulative mass of CO₂ reported as sequestered in subsurface geologic formations in all years since the facility became subject to reporting requirements under this subpart.”</p> <p>Missing data. Subpart RR also has procedures for estimating missing data in §98.445 that require “a complete record of all measured parameters used in the GHG quantities calculations is required. Whenever the monitoring procedures cannot be followed” there is a set of missing data procedures required.</p> <p>Data reporting requirements. EPA has requirements for data reporting, timing, schedule, and contents of reporting that apply to the entire GHGRP.</p> <p>In addition, Subpart RR has detailed information required in § 98.446 data reporting requirements including:</p> <ul style="list-style-type: none"> • Detailed information from each receiving flow meter if receiving the CO₂ via pipeline. • Detailed information for reporting CO₂ received in containers • Reporting the total net mass of CO₂ received (metric tons), if you use more than one receiving flow meter. | <p>d) the quantification method to be used (see Clause 8 and Annex B); and</p> <p>e) the total mass of previously injected CO₂ within the EOR complex at the start of quantification period (see 8.5 and Annex B).</p> <p>The initial documentation shall be offered to the authority.”</p> <p>4.4 Periodic documentation. “Periodic documentation should be prepared at least annually with the following information:</p> <p>a) the quantity of associated storage in specified units of CO₂ mass, or volumetric units convertible to mass, (see 8.2 m_{stored}) during the period covered by the documentation;</p> <p>b) the cumulative quantity of associated storage in specified units of CO₂ mass, or volumetric units convertible to mass, (see 8.2 m_{stored}) since the beginning of the quantification period;</p> <p>c) the formula and data used to quantify the mass of associated storage, including the mass of CO₂ delivered to the CO₂-EOR project and losses during the period covered by the documentation (see Clause 8 and Annex B);</p> <p>d) the methods used to estimate missing data and the amounts estimated as described in 9.2;</p> <p>e) the approach and method for quantification utilized by the operator, including accuracy, precision and uncertainties (see Clause 8 and Annex B);</p> <p>f) a statement describing the nature of validation or verification of the statement including the date of review, process, findings, and responsible person or entity; and</p> |
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- The source of CO₂ received according to the listed source categories (e.g., ethanol).
- Whether you began data collection according to your approved MRV plan in a reporting year prior to this annual report submission, and requirements if the answer is “yes.”
- An annual monitoring report in narrative form (filed as an attachment to E-GGRT)

§ 98.444 (f) “*Format.* Each proposed MRV plan or revision and each annual report must be submitted electronically in a format specified by the Administrator.”

§ 98.444 (g) “*Certificate of representation.* You must submit a certificate of representation according to the provisions in § 98.4 at least 60 days before submission of your MRV plan, your research and development exemption request, your MRV plan submission extension request, or your initial annual report under this part, whichever is earlier.

[75 FR 75078, Dec. 1, 2010, as amended at 76 FR 73907, Nov. 29, 2011]”

Public transparency and confidential business information (CBI). As part of the GHGRP, Subpart RR data is available to the public unless the data is deemed [confidential business information](#) (CBI). The public can access the summarized annual data, the monitoring report narrative, and the approved MRV plans on the EPA website.

g) source of each CO₂ stream quantified as associated storage (see 8.3).

The periodic documentation shall be offered to the authority.

NOTE The operator can determine that more frequent recordkeeping and documentation are required to meet the goals or requirements of the CO₂-EOR project.”

The initial and periodic documentation shall be offered to the authority.

“9.1 Record retention. Records supporting documentation as described in Clauses 4 to 10 of this document shall be retained for the duration of the operator’s involvement in the CO₂-EOR project. Such supporting documentation shall be offered to the authority after termination of the lease/permit pertaining to the CO₂-EOR project.

9.2 Missing data procedures. The operator shall specify the procedures used to estimate monitoring, sampling and testing data for periods during which actual data are unavailable, such as periods of maintenance, equipment failure, or power outages. These procedures should avoid overestimations of the amounts of CO₂ stored.”

Public transparency and confidential business information (CBI). There is no provision or call for any kind of transparency on reported data.

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Section G: Assessments, changes, etc. during reporting/quantification period

Revisions to monitoring, reporting, and verification plan

§ 98.444 (d) “*MRV plan revisions.* You must revise and submit the MRV plan within 180 days to the Administrator for approval if any of the following in paragraphs (d)(1) through (d)(4) of this section applies. You must include the reason(s) for the revisions in your submittal.

- (1) A material change was made to monitoring and/or operational parameters that was not anticipated in the original MRV plan. Examples of material changes include but are not limited to: Large changes in the volume of CO₂ injected; the construction of new injection wells not identified in the MRV plan; failures of the monitoring system including monitoring system sensitivity, performance, location, or baseline; changes to surface land use that affects baseline or operational conditions; observed plume location that differs significantly from the predicted plume area used for developing the MRV plan; a change in the maximum monitoring area or active monitoring area; or a change in monitoring technology that would result in coverage or detection capability different from the MRV plan.
- (2) A change in the permit class of your Underground Injection Control permit.
- (3) If you are notified by EPA of substantive errors in your MRV plan or monitoring report.
- (4) You choose to revise your MRV plan for any other reason in any reporting year.

Periodic assessment, review, and revisions

The initial documentation (4.3(a)) requires a plan (5.1 and 6.1.1(c)) to describe periodic assessment of reservoir performance as compared with expected behaviour in accordance with 6.1.3 but does not require changes in behavior to be reported as part of the periodic documentation submitted to the authority, as described in 4.4.

6.1.3 Operational containment assurance

“Containment assurance and reservoir management shall be reviewed, and the EOR operation management plan shall be revised as necessary if changes occur that have the potential to adversely affect containment, which may include:

- a) unexpected changes in project performance that have potential to influence associated storage of CO₂;
- b) addition or abandonment of injection zones;
- c) change to the areal extent of the project reservoir;
- d) addition or abandonment of wells;
- e) anomalous change of injection-withdrawal ratio;
- f) development of reservoirs which are located above or below the project reservoir; or
- g) discovery of CO₂ beyond the boundary of the CO₂-EOR complex.”

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(e) Revised MRV plan. The requirements of paragraph (c) of this section apply to any submission of a revised MRV plan. You must continue reporting under your currently approved plan while awaiting approval of a revised MRV plan.”

Note: All three of the currently approved MRV plans for CO₂-EOR projects carved out routine operational changes that will take place under regulated conditions and will not constitute a material change that triggers a new MRV plan.

Section H: Quantification

Uses a mass-balance approach to storage quantification.

Subpart RR requires calculation of CO₂ geologic sequestration using specific equations which are unique to each input detailed in the regulation.

§ 98.443 Calculating CO₂ geologic sequestration. “You must calculate the mass of CO₂ received using CO₂ received equations (Equations RR-1 to RR-3 of this section), unless you follow the procedures in § 98.444(a)(4).

You must calculate CO₂ sequestered using injection equations (Equations RR-4 to RR-6 of this section), production/recycling equations (Equations RR-7 to RR-9 of this section), surface leakage equations (Equation RR-10 of this section), and sequestration equations (Equations RR-11 and RR-12 of this section). For your first year of reporting, you must calculate CO₂ sequestered starting from the date set forth in your approved MRV plan.” See 98.433 for the specific equations and inputs used.

Uses a mass-balance approach to storage quantification.

8.2 Quantification principles. Provides quantification principles for “any method of quantification used by the operator”:

- a) The mass of CO₂ stored in association with CO₂-EOR [m_{stored}] shall be determined by subtracting loss from input [see Formula (1)].
- b) The manner by which associated storage is quantified shall assure completeness and preclude double counting. The CO₂ that is recycled and reinjected into the EOR complex shall not be quantified as associated storage. Loss from the CO₂ recycling facilities shall be quantified.
- c) Native CO₂ produced and captured in the CO₂-EOR project [m_{native}] should be quantified and documented and may be included in m_{input} if approved by the authority (see Note 2).

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Subpart RR details specific procedures in **§ 98.444 for monitoring and quality assessment and control**, including how to measure, track CO₂ across each stage of a project, and when and how to use an estimation or measurement in what is reported, including for missing data. RR provides specific equations, data measurement specifications, and procedures (e.g., depending on what time of meter is used) for calculation of the following:

- Calculate and report the annual mass of CO₂ received by pipeline, if applicable.
- Calculate and report the annual mass of CO₂ received in containers.
- Report the annual mass of CO₂ injected in accordance with the procedures specified
- Calculate the annual mass of CO₂ produced from oil or gas production wells or from other fluid wells for each separator that sends a stream of gas into a recycle or end use system in accordance with the procedures specified in paragraphs (d)(1) through (d)(3) of this section. You must account for any CO₂ that is produced and not processed through a separator. You must account only for wells that produce the CO₂ that was injected into the well or wells covered by this source category.

Subpart RR contains 13 detailed equations for calculating geologic sequestration and specifies which equations apply (based on type of flow meter) and how and where to obtain the data for the equations.

d) The operator shall quantify any CO₂ that is subsequently produced from the EOR complex and transferred offsite (see 8.4.5).

e) Quantification results shall be expressed either in units of mass or in volumetric units convertible to mass.”

Provides a single formula, Formula 1. It states “that the method defined by Formula (1) should be used to document the associated storage of the mass of CO₂ [*m*_{stored}] within a defined period. *m*_{stored} should be calculated by quantifying the following variables:

$$m_{\text{stored}} = m_{\text{input}} - m_{\text{loss operations}} - m_{\text{loss EOR complex}}$$

- *m*_{input}: the total mass of CO₂ *m*_{received} by the EOR project, approved *m*_{native}, (see 8.3);
- *m*_{loss operations}: the total mass of CO₂ loss from project operations (see 8.4.1 to 8.4.5); and
- *m*_{loss EOR complex}: the total mass of CO₂ loss from the EOR complex (see 8.4.6).

NOTE 1 In some jurisdictions *m*_{loss operations} could be considered as fugitive emissions. ”

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Section I: Monitoring and quality assurance (QA)/quality control (QC)—CO₂ received

§ 98.444. (a) CO₂ received.

“(1) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly flow rate of CO₂ received by pipeline by following the most appropriate of the following procedures:

- (i) You may measure flow rate at the receiving custody transfer meter prior to any subsequent processing operations at the facility and collect the flow rate quarterly.
- (ii) If you took ownership of the CO₂ in a commercial transaction, you may use the quarterly flow rate data from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.
- (iii) If you inject CO₂ received from a production process unit that is part of your facility, you may use the quarterly CO₂ flow rate that was measured at the equivalent of a custody transfer meter following procedures provided in subpart PP of this part. To be the equivalent of a custody transfer meter, a meter must measure the flow of CO₂ being transported to an injection well to the same degree of accuracy as a meter used for commercial transactions.

(2) Except as provided in paragraph (a)(4) of this section, you must determine the quarterly mass or volume of contents in all containers if you receive CO₂ in containers by following the most appropriate of the following procedures:

8.3 Quantification of input [m_{input}]

“The total CO₂ received at the custody transfer meter by the EOR project [$m_{received}$] shall be documented. The CO₂ stream received (including CO₂ transferred from another CO₂-EOR project) shall be metered. The native CO₂ recovered and included as m_{native} shall be documented.

CO₂ delivered to multiple CO₂-EOR projects shall be allocated among those CO₂-EOR projects. This allocation may be accomplished by contract. The sum of the quantities of allocated CO₂ shall not exceed the total quantities of CO₂ received.

NOTE Some operators could also quantify the anthropogenic portion of m_{input} (see 8.5).”

“8.4.1 Quantification of loss. The operator shall quantify the total mass of CO loss from project operations within a defined period.

The m_{loss} operations is composed of the following variables:

- a) Loss of CO₂ due to leakage from production, handling and recycling CO₂-EOR facilities (infrastructure including wellheads) [m_{loss} leakage facilities];
- b) Loss of CO₂ from venting/flaring from production operations [m_{loss} vent/flare];
- c) Loss of CO₂ due to entrainment within produced gas/oil/water when this CO₂ is not separated and reinjected

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| <p>(i) You may measure the mass of contents of containers summed quarterly using weigh bills, scales, or load cells.</p> <p>(ii) You may determine the volume of the contents of containers summed quarterly.</p> <p>(iii) If you took ownership of the CO₂ in a commercial transaction, you may use the quarterly mass or volume of contents from the sales contract if it is a one-time transaction or from invoices or manifests if it is an ongoing commercial transaction with discrete shipments.</p> <p>(3) Except as provided in paragraph (a)(4) of this section, you must determine a quarterly concentration of the CO₂ received that is representative of all CO₂ received in that quarter by following the most appropriate of the following procedures:</p> <p>(i) You may sample the CO₂ stream at least once per quarter at the point of receipt and measure its CO₂ concentration.</p> <p>(ii) If you took ownership of the CO₂ in a commercial transaction for which the sales contract was contingent on CO₂ concentration, and if the supplier of the CO₂ sampled the CO₂ stream in a quarter and measured its concentration per the sales contract terms, you may use the CO₂ concentration data from the sales contract for that quarter.</p> <p>(iii) If you inject CO₂ from a production process unit that is part of your facility, you may report the quarterly CO₂ concentration of the CO₂ stream supplied that was measured following the procedures provided in subpart PP of this part.</p> | <p>[<i>m</i>_{loss entrained}]; and</p> <p>d) Loss of CO₂ due to any transfer of CO₂ outside the CO₂-EOR project [<i>m</i>_{loss transfer}]. <i>m</i>_{loss operations} may be calculated using Formula (2):</p> $m_{\text{loss operations}} = m_{\text{loss leakage facilities}} + m_{\text{loss vent/flare}} + m_{\text{loss entrained}} + m_{\text{loss transfer}}$ <p>NOTE Formula (2) is evaluated over a period of time in accordance with the documenting periods (see 4.4).”</p> |
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| <p>(4) If the CO₂ you receive is wholly injected and is not mixed with any other supply of CO₂, you may report the annual mass of CO₂ injected that you determined following the requirements under paragraph (b) of this section as the total annual mass of CO₂ received instead of using Equation RR-1 or RR-2 of this subpart to calculate CO₂ received.</p> <p>(5) You must assume that the CO₂ you receive meets the definition of a CO₂ stream unless you can trace it through written records to a source other than a CO₂ stream.”</p> | |
| <p>Section J: Monitoring and QA/QC—CO₂ injected</p> | |
| <p>§ 98.444. (b) CO₂ injected.</p> <p>“1) You must select a point or points of measurement at which the CO₂ stream(s) is representative of the CO₂ stream(s) being injected. You may use as the point or points of measurement the location(s) of the flow meter(s) used to comply with the flow monitoring and reporting provisions in your Underground Injection Control permit.</p> <p>(2) You must measure flow rate of CO₂ injected with a flow meter and collect the flow rate quarterly.</p> <p>(3) You must sample the injected CO₂ stream at least once per quarter immediately upstream or downstream of the flow meter used to measure flow rate of that CO₂ stream and measure the CO₂ concentration of the sample.”</p> <p><i>Note: In two of the approved MRV plans for CO₂-EOR projects, the argument that treating the amount received as amount injected was accepted as a better estimate than</i></p> | <p>As referred to in the principles (8.2 (b)) and stated again under the section precluding double counting (8.6):</p> <p>8.2 (b) “The manner by which associated storage is quantified shall assure completeness and preclude double counting. The CO₂ that is recycled and reinjected into the EOR complex shall not be quantified as associated storage. Loss from the CO₂ recycling facilities shall be quantified.”</p> <p>8.7 “The operator shall detail how CO₂ that is produced, captured, recycled and injected in the CO₂-EOR project is quantified and how that quantification assures completeness and precludes double-counting of CO₂.”</p> <p>Transfer of CO₂ from one CO₂-EOR project to another CO₂-EOR project should not be double counted for purposes of quantification in associated storage.</p> |

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| <p><i>measurement totaled over each injection point in the calculation for geologic sequestration.</i></p> | |
| <p>Section K: Monitoring and QA/QC—CO₂ produced</p> | |
| <p>§ 98.444. (c) CO₂ produced.</p> <p>“(1) The point of measurement for the quantity of CO₂ produced from oil or other fluid production wells is a flow meter directly downstream of each separator that sends a stream of gas into a recycle or end use system.</p> <p>(2) You must sample the produced gas stream at least once per quarter immediately upstream or downstream of the flow meter used to measure flow rate of that gas stream and measure the CO₂ concentration of the sample.</p> <p>(3) You must measure flow rate of gas produced with a flow meter and collect the flow rate quarterly.”</p> <p><i>Note: In two of the approved CO₂-EOR MRV plans, alternative measurement locations for CO₂ produced were approved based on facility layout details.</i></p> | <p>8.4.4 Entrained CO₂ in products. “CO₂ is the mass not completely separated from the produced streams and that exists in solution after the separation of gas and liquid at the surface facilities. The entrained CO₂ is considered a loss when the oil is sold or when the produced water is not reinjected into the reservoir.</p> <p>The operator shall quantify and document the CO₂ loss by entrainment [$m_{\text{loss entrained}}$].”</p> |
| <p>Section L: Monitoring and QA/QC—equipment & facility leaks and vented emissions</p> | |
| <p>§ 98.444 (d) “CO₂ emissions from equipment leaks and vented emissions of CO₂. If you have equipment located on the surface between the flow meter used to measure injection quantity and the injection wellhead or between the flow meter used to measure production quantity and the production wellhead, you must follow the monitoring and QA/QC requirements specified in subpart W of this part for the equipment.”</p> | <p>“8.4.2 Leakage from facilities. The CO₂ loss from facilities (including wellheads) shall be quantified and documented. The total CO₂ leakage should be measured when possible. Leakage shall be estimated when not measured. The operator shall describe in the initial documentation how the loss is quantified and whether leakage is measured or estimated [$m_{\text{loss leakage facilities}}$].”</p> |

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| <p>GHGRP Subpart W—Petroleum and natural gas systems. Operators of petroleum and natural gas systems with GHG emissions of 25,000 metric tons of CO₂ equivalent or higher must report under Subpart W. This subpart details requirements for how to estimate emissions from venting, flaring, fugitive leaks, and other emissions from petroleum and natural gas systems, including EOR operations.</p> <ul style="list-style-type: none"> • To calculate the emissions under Subpart W, data are collected on the basis of a basin-level facility⁴ for onshore production. • Subpart W requires reporting and accounting of equipment leakage and vented CO₂ emissions leaks from surface equipment. Data for onshore production is reported at a basin level. | |
| Section M: Measurement devices & general standards | |
| <p>Subpart RR includes detailed requirements in § 98.444 (e) and (f) for operation and maintenance of measurement devices, including what recognized standards may be followed for the methods used.</p> | <p>Does not contain comparable language.</p> |

⁴ For onshore petroleum and natural gas production, a facility under Subpart W is defined at the geologic basin level and all equipment and wells owned by a person or entity within such a basin are considered one facility in terms of how the rule is applied. See 40 CFR 98.6, for the definition of facility under Subparts RR and UU. When the EPA uses the term “basin” it refers to geologic provinces as published by the American Association of Petroleum Geologists (AAPG). See EPA’s Frequently Asked Questions description of facilities under the GHGRP. Available at <https://ccdsupport.com/confluence/pages/viewpage.action?pageId=189038689>.

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Section N: Data reporting requirements

EPA has requirements for data reporting, timing, schedule, and contents of reporting that apply to the entire GHGRP.

In addition, Subpart RR has detailed information required in **§ 98.446 “Data reporting requirements”** including:

- Detailed information from each receiving flow meter if receiving the CO₂ via pipeline.
- Detailed information for reporting CO₂ received in containers
- Reporting the total net mass of CO₂ received (metric tons), if you use more than one receiving flow meter.
- The source of CO₂ received according to the listed source categories (e.g., ethanol).
- Whether you began data collection according to your approved MRV plan in a reporting year prior to this annual report submission, and requirements if the answer is “yes.”

As is also described above in Section F:

4.4 “Periodic documentation should be prepared at least annually and shall provide the following information:

- a) the quantity of associated storage in specified units of CO₂ mass, or volumetric units convertible to mass, (see 8.2 m_{stored}) during the period covered by the documentation;
- b) the cumulative quantity of associated storage in specified units of CO₂ mass, or volumetric units convertible to mass, (see 8.2 m_{stored}) since the beginning of the quantification period;
- c) the formula and data used to quantify the mass of associated storage, including the mass of CO₂ delivered to the CO₂-EOR project and losses during the period covered by the documentation (see Clause 8 and Annex B);
- d) the methods used to estimate missing data and the amounts estimated as described in 9.2;
- e) the approach and method for quantification utilized by the operator, including accuracy, precision and uncertainties (see Clause 8 and Annex B);
- f) a statement describing the nature of validation or verification of the statement including the date of review, process, findings, and responsible person or entity; and
- g) source of each CO₂ stream quantified as associated storage (see 8.3).

The periodic documentation shall be offered to the authority.

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| | <p>NOTE The operator can determine that more frequent recordkeeping and documentation are required to meet the goals or requirements of the CO₂-EOR project.”</p> <p>The initial and periodic documentation shall be offered to the authority.</p> |
| <p>Section O: Records that must be retained</p> | |
| <p>Specific records requirements are detailed for the GHGRP and additional requirements for Subpart RR in § 98.447. There are quarterly and annual requirements depending on the type of data being retained. All records must be retained for at least three years.</p> | <p>“9.1 Record retention. Records supporting documentation as described in Clauses 4 to 10 of this document shall be retained for the duration of the operator’s involvement in the CO₂-EOR project. Such supporting documentation shall be offered to the authority after termination of the lease/permit pertaining to the CO₂-EOR project.”</p> |
| <p>Section P: Well construction, geologic assessment, EOR operations, and site management</p> | |
| <p>Injection well requirements for well construction, operations, management, and site closure for CO₂-EOR projects are under the EPA UIC Program Class II and are focused on the protection of USDWs and do not address CO₂ emissions. See 40 CFR §146.1 for general criteria and standards for the UIC program and § 146.22 for requirements specific to Class II.</p> <p>Most states with active oil and gas operations have primacy to implement UIC Class II and in many cases impose additional requirements for the injection of fluids into productive oil fields (e.g., CO₂-EOR).</p> | <p>The introduction states that “this document does not provide requirements for the selection, characterization or permitting of sites for CO₂-EOR projects because those sites are selected, characterized, and permitted pursuant to requirements and standards applicable to oil and gas exploration and production. Likewise, this document does not specify environment, health and safety protections or corrective action and mitigation requirements that are provided by the regulations and standards applicable to all hydrocarbon production operations.”</p> <p>The standard does provide requirements for an EOR operations management plan, initial containment assurance, new well construction, and well intervention, as detailed below.</p> |

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| | <p>“6.1.1 EOR operations management plan</p> <p>The EOR operations management plan (see 5.1) shall specify the procedures for field management, including:</p> <ul style="list-style-type: none">a) project data as described in Clause 5, to be used for monitoring and quantification;b) engineering controls for injection and production;c) periodic assessment of reservoir performance as compared with expected behaviour in accordance with 6.1.3;d) assessment of containment by geologic features and engineering systems in accordance with 6.1.3;” <p>6.1.3 Operational containment assurance</p> <p>The EOR operations management plan shall provide operational containment assurance during the quantification period, based on engineering data encompassing such items as the results of reservoir management practices, including injection-withdrawal ratio monitoring, well integrity monitoring, pressure monitoring, monitoring of CO₂ movement within leakage pathways identified in the initial containment assurance and monitoring of pressure response within the boundary of the EOR complex.</p> <p>The operational containment assurance may include results from other monitoring. These results shall be used in periodically providing evidence of containment, including the supporting rationale.</p> <p>Containment assurance and reservoir management shall be reviewed, and the EOR operation management plan shall be</p> |
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revised as necessary if changes occur that have the potential to adversely affect containment, which may include:

- a) unexpected changes in project performance that have potential to influence associated storage of CO₂;
- b) addition or abandonment of injection zones;
- c) change to the areal extent of the project reservoir;
- d) addition or abandonment of wells;
- e) anomalous change of injection-withdrawal ratio;
- f) development of reservoirs which are located above or below the project reservoir; or
- g) discovery of CO₂ beyond the boundary of the CO₂-EOR complex.”

7.1 New well construction

“A description of the new wells shall provide evidence that they are designed, constructed, and tested to provide safe, long-term containment of CO₂. Well materials, including metals, cements, and elastomers, shall be selected based on their ability to withstand the expected operational environment including the thermomechanical stress of operation and the geochemistry (including CO₂ where present) of the subsurface. At a minimum, wells that penetrate the EOR complex shall be cemented through each cap rock using cement that is suitable for the thermomechanical and geochemical environment for the safe, long-term containment of CO₂. To the extent not provided by other evidence of suitable construction (for example: reference to information that has been provided to the authority

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during permitting of CO₂-EOR operations), the following information shall be provided:

- a) well name;
- b) unique well identifier;
- c) spud date, completion date;
- d) status (e.g. injection, production, monitoring, temporarily abandoned, shut-in, plugged & abandoned);
- e) surface or seabed location;
- f) total and measured depth;
- g) well construction, completion, and well integrity technical details; and
- h) significant equipment remaining in the well.

7.2 Well intervention

A description of the well modifications shall provide evidence that they are designed, constructed, and tested to provide safe, long-term containment of CO₂. Well materials, including metals, cements, and elastomers, shall be selected based on their ability to withstand the expected operational environment including the thermomechanical stress of operation and the geochemistry (including CO₂ where present) of the subsurface. To the extent not provided by other evidence that the well modifications performed are suitable (for example: reference to information that has been provided to the authority during permitting of well intervention), the following information shall be provided:

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| | <ul style="list-style-type: none"> a) well name; b) unique well identifier; c) intervention type and date; d) status after intervention (e.g. injection, production, monitoring, temporarily abandoned, shut-in, plugged & abandoned); e) surface or seabed location; f) total and measured depth; g) plugging and abandonment information (if applicable); h) well intervention details; and i) significant equipment remaining in the well.” |
| Section Q: Discontinue reporting and/or project termination | |
| <p>Discontinue reporting</p> <p>Facilities operating under Class II permits that opt in to Subpart RR may elect to submit a request to discontinue reporting under Subpart RR at any time, including before wells are plugged and closed, if they make a demonstration that the amount of CO₂ claimed as stored during the reporting period is not expected to migrate in a manner likely to result in surface leakage.⁵ Facilities that are approved by the EPA to discontinue reporting under RR while still operating, revert</p> | <p>Discontinue reporting</p> <p>There is no comparable language. The standard provides criteria and processes in the context of project termination but does not provide language for projects that continue to operate a CO₂-EOR project beyond the period during which quantification of CO₂ storage is sought.</p> <p>There is a provision for projects that continue to operate without injecting anthropogenic CO₂ in “10.2 periodic</p> |

⁵ For additional information on how EPA has applied 40 CFR sec 98.441(b) to the defined period of reporting, see page 3-4 of EPA’s decision on the MRV Plan for Denver Unit, December 22, 2015. Available at https://www.epa.gov/sites/production/files/2015-12/documents/denver_unit_final_decision.pdf.

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| <p>back to reporting under GHGRP Subpart UU. Details on the request to discontinue reporting are in § 98.441.</p> <p>As Subpart RR is a reporting framework, there are no operational requirements under Subpart RR for discontinuing a project once reporting has ended. Requirements for reporting CO₂ injection under GHGRP Subpart UU and for meeting permit requirements under Class II would continue to apply.</p> | <p>assurance of containment,” which states that “if injection of the anthropogenic CO₂ ceases and the CO₂-EOR project continues to operate for hydrocarbon extraction purposes, periodic documentation (see 4.4) shall be provided as defined by the operations management plan or authority until CO₂-EOR project termination is completed.</p> <p>NOTE CO₂ injection cessation is discussed further in Annex A.</p> |
| <p>Cease operations</p> <p>The GHGRP Subpart RR is a reporting framework, and, once the requirements are met to discontinue reporting, they do not continue to have an obligation under RR (they go back to reporting CO₂ injection under Subpart UU). The project may continue or discontinue operations.</p> <p><i>Note: A CO₂-EOR project that planned to cease operations would follow the requirements of their Class II permit as set by the US EPA or the state program.</i></p> <p><i>The US EPA UIC program has detailed requirements for well closure, plugging and abandonment, reporting, and corrective action in order to protect USDWs.</i></p> | <p>Project termination</p> <p>The EOR operations management plan (6.1) specifies procedures for “developing a termination plan for the CO₂-EOR project that specifies criteria for termination and outlines the termination qualification process sufficient to meet the requirements of Clause 10. (6.1 (i))</p> <p>10 Project termination</p> <p>“10.1 General</p> <p>This clause provides requirements for the termination and documentation of a CO₂-EOR project that are in addition to the existing permitting, regulatory, and contractual framework that generally define the rules for safe and secure termination of hydrocarbon recovery projects. Compliance shall be demonstrated as part of the termination process through documentation provided to the authority or in the final periodic documentation under 4.4.</p> <p>10.2 Periodic assurance of containment</p> <p>If injection of the anthropogenic CO₂ ceases and the CO₂-EOR project continues to operate for hydrocarbon extraction purposes, periodic documentation (see 4.4) shall be provided</p> |

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| | <p>as defined by the operations management plan or authority until CO₂-EOR project termination is completed.</p> <p>NOTE CO₂ injection cessation is discussed further in Annex A.</p> <p>10.3 Termination plan</p> <p>The operator shall develop a termination plan for the CO₂-EOR project that specifies criteria for termination and documents the termination qualification process. This plan shall be developed to coincide with the initial documentation statement; shall be reviewed regularly; and shall be updated as appropriate during the project operation. The plan should specify:</p> <ul style="list-style-type: none">a) criteria that confirm compliance with the containment assurance and EOR operations management plan requirements of Clause 6;b) the termination process and anticipated timing;c) monitoring consistent with requirements of 6.1 and 6.2;d) corrective measures to address potential leakage pursuant to 6.1.1 e) and g); ande) provisional plans for site decommissioning, including plans for plugging & abandonment of wells and decommissioning of facilities as referenced in 5.2 and 7.2 g). <p>10.4 Requisites for termination</p> <p>Relying on CO₂ quantification, monitoring and operational information collected within the project, the operator shall satisfy the following requisites to demonstrate proper</p> |
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| | <p>termination and compile them in the termination documentation:</p> <ul style="list-style-type: none">a) the absence of detectable leakage (see 6.2) or open conduits to the surface out of the EOR complex, and that the injected CO₂ is, at the time of project termination, safely contained;b) compliance with all well decommissioning and plugging requirements for all CO₂-EOR project wells [see 7.2 g)], that wells do not allow fluid movement out of the EOR complex, and that the CO₂-EOR project wells do not pose a leakage risk;c) the injected CO₂ is safely contained with sufficient documentation of the characteristics of the EOR complex and operational history of the CO₂-EOR project to demonstrate long-term stability and predictability of the associated storage;d) risks and uncertainties relating to the associated storage of CO₂ were managed throughout the EOR project life; ande) facilities and ancillary equipment associated with the CO₂-EOR project have been removed, except those required to be retained by lease or contractual obligations, integral to other operations, or intended for different uses which may be left in place with approval of the authority. <p>The termination documentation shall describe the location of the injected CO₂. The termination documentation shall be offered to the authorities after termination of the CO₂-EOR project.</p> |
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| | <p>10.5 CO₂-EOR project termination</p> <p>CO₂-EOR project termination is completed when all of the following occur: cessation of CO₂ injection, cessation of hydrocarbon production from the project reservoir, and wells are plugged & abandoned unless otherwise required by the authority.”</p> |
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