Appendix F

Purpose and Rationale for Proposed Amendments to the Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard

This Page Intentionally Left Blank

Contents

III. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal for the Geologic Carbon Storage Protocol 5

Global Changes throughout the Proposed Amendments 5

Section A. Definitions and APPLICABILITY 8

Section A.2(a) Definitions. 9

Section A.2(b). Acronyms. 28

SECTION B. ACCOUNTING REQUIREMENTS FOR CCS PROJECTS UNDER THE LCFS 29

Section B.1 SYSTEM BOUNDARY [deleted] 29

Section B.2 Analysis of the CO_2 Stream for Well Integrity [relocated] 30

Section B.3 INVALIDATION AND BUFFER ACCOUNT [deleted] 31

Section C. Permanence requirements for geologic STORAGE. 32

Section C.1.2 Terms and Conditions 36

Section C.2.1 Minimum Site Selection Criteria 36

Section C.2.2 Risk Assessment 36

Section C.2.3 Geologic and Hydrogeologic Evaluation Requirements 37

Section C.2.4 Storage Complex Delineation [new] 41

Section C.2.5 Corrective Action Requirements [new] 44

Section C.2.6 Baseline Testing and Monitoring [new] 45

Section C.3.1 Well Construction 46

Section C.3.2 Pre-Injection Testing [deleted] 46

Section C.3.2 Injection Well Operating Requirements [new] 46

Section C.4.1. Testing and Monitoring 47

Section C.4.2 Mechanical Integrity Testing 48

Section C.4.2.1 Reporting of Mechanical Integrity Tests 48

Section C.4.3 GCS Site Monitoring [renamed] 48

Section C.4.3.2.4 Verification [relocated & deleted] 54

Section C.5.1 Well Plugging and Abandonment 54

Section C.5.2 Post-Injection Site Care and Site Closure 55

Section C.6 Emergency and Remedial Response 55

Section C.6.1 Emergency and Remedial Response Requirements [removed] 56

Section C.7 Financial Responsibility 56

Section C.8 Modification or Revocation and Reissuance of Permanence Certification 56

Section C.8.2 Minor Modification of Permanence Certifications 57
Section C.9 Legal Understanding, Contracts, and Post-Closure Care 57
Section D Verification [new] 57
Appendices A through F [deleted] 58
Appendix A [renamed from Appendix G] 58
IV. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal for the Greenhouse Gas Quantification Methodology for Carbon Capture and Sequestration under the Low Carbon Fuel Standard 60

The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal for the Geologic Carbon Storage Protocol

Global Changes throughout the Proposed Amendments

The proposed global changes in this section are minor updates that do not alter current requirements under the GCS Protocol.

Section Renumbering

Purpose

Many subsections of the Proposed Amendments are renumbered to reflect the addition or deletion of other subsections. These subsection numbering changes are denoted in subsection headings throughout this document. A subsection heading denoted as "new" reflects how it is numbered under the Proposed Amendments.

Rationale

Section numbering changes are non-substantive and are needed to maintain consistent organization of regulatory requirements under the Proposed Amendments and increase readability and understanding by applicants.

Rename Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard to Geologic Carbon Storage Protocol

Purpose

The proposed amendments change the name of the "Carbon Capture and Sequestration (CCS) Protocol Under the Low Carbon Fuel Standard" to "Geologic Carbon Storage (GCS) Protocol."

Rationale

Geologic carbon storage is a separate process and component of projects and is independent from how carbon is captured. Many forms of carbon capture can produce the carbon that gets storage in a geologic carbon storage site. This change will allow the geologic carbon storage site to obtain permanence on its own. This will allow a storage site to receive carbon dioxide for injection from many different capture facilities. The removal of "Under the Low Carbon Fuel Standard" from the name of the GCS Protocol, combined with removal of LCFS-specific references from other parts of the GCS Protocol, as described further below, allows for the use of the GCS Protocol in multiple CARB programs.

Replace CCS Project with GCS Site

Purpose

The proposed amendments change "CCS Project" to "GCS site" in all instances.

Rationale

This change is necessary to more precisely specify that requirements in the CCS Protocol are applicable to a "GCS site" and not a "CCS Project," which includes carbon capture and transport operations in addition to carbon sequestration operations at the GCS site. This change also ensures alignment with the definition of "CCS Project" in Section 95481 of the proposed updates to the LCFS regulation. The proposed updates to LCFS regulation defines "CCS Project" as "a project that captures CO_2 by an eligible entity specified in section 95490(a), transports the captured CO_2 to an injection site, and injects and permanently sequesters the captured CO_2 pursuant to the Geologic Carbon Storage Protocol (GCS Protocol) and the Greenhouse Gas Quantification Methodology for Carbon Capture and Sequestration under the Low Carbon Fuel Standard (LCFS CCS QM), as specified in section 95490."

Replacing LCFS-specific references

Purpose

The CCS Protocol is currently only applicable to the Low Carbon Fuel Standard (LCFS) Program and includes multiple references which explicitly cite the LCFS Program by name. The proposed amendments remove these LCFS-specific references.

Rationale

The proposed amendments are necessary to allow multiple CARB programs to utilize the GCS Protocol.

Change "Reevaluation" to "Re-evaluation"

Purpose

This amendment inserts a hyphen in "reevaluation" to read "re-evaluation".

Rationale

Hyphenating "re-evaluation" is non-substantive and is needed lest "reevaluation" be mistaken for "revaluation".

Correcting Cross-references

Purpose

Cross-references need to be amended to either rectify incorrect cross-references or update cross-references due to renumbering of provisions as a result of the proposed amendments.

Rationale

Cross-reference changes are non-substantive and are needed to maintain consistent organization of regulatory requirements under the Proposed Amendments.

Correcting Grammatical and Typographical Errors

Purpose

Grammatical and typographical errors need to be corrected to improve readability of the CCS Protocol requirements.

Rationale

Correcting grammatical and typographical errors is non-substantive and is needed to improve readability of CCS Protocol requirements.

Reorganization

Purpose

Various sections and provisions of the CCS Protocol have been reorganized without changing the language of the requirements.

Rationale

Reorganizing the GCS Protocol provisions is non-substantive and is needed to assist GCS operators with organizing their information.

Rename "Formation Testing and Well Logging" to "Formation and Well Testing"

Purpose

The proposed amendments change the name to better reflect the terms used in industry.

Rationale

"Formation Testing and Well Logging" is not a term widely used in industry for these activities. "Formation and Well Testing" is more accurate and will be more familiar to GCS operators who are developing these projects.

Rename "Sequestration Site Certification" to "Preliminary GCS Site Certification" and rename "CCS Project Certification" to "Final GCS Site Certification"

Purpose

The proposed amendments change the names of the two phases of Permanence Certification, Sequestration Site Certification and CCS Project Certification, to Preliminary GCS Site Certification and Final GCS Site Certification, respectively.

Rationale

Other amendments discuss the move away from usage of "project" in favor of "site" and the change of "CCS" to "GCS". The previous names of the two phases of Permanence Certification did not necessarily reflect the fact that both certifications relate to the GCS

site, not the overall CCS project (including capture and transport), nor the fact that the certifications were sequential. Using one term (GCS Site Certification) and using "Preliminary" and "Final" establishes that these two phases are specifically related to certification of the GCS site and that the Final GCS Site Certification comes after the Preliminary GCS Site Certification.

Change "Sequestration" to "Storage"

Purpose

The proposed amendments change "sequestration" to "storage", as well as other related terms (e.g., "sequester" to "store").

Rationale

SB 905 requires CARB to create a Carbon Capture, Removal, Utilization, and Storage Program. To align with the use of "storage" in the overall program, "sequester" and its related usages have been changed to "storage".

Change "Monitoring, Measurement, and Verification Plan" to "Containment Monitoring Plan"

Purpose

The proposed amendments revise the title of this plan to more accurately describe the purpose of the type of monitoring this section describes.

Rationale

References to measurement and verification data related to the Low Carbon Fuel Standard regulation and the regulation, itself, were removed from the Monitoring, Measurement, and Verification Plan to ensure that the GCS Protocol can be incorporated into other CARB programs (which include their own monitoring, measurement, and verification requirements). The main purpose of the monitoring in this plan is to ensure containment of the injected CO_2, therefore "Containment Monitoring" was selected as the new name of this plan.

Section A. DEFINITIONS AND APPLICABILITY.

Section A.1. Applicability

Purpose

This section establishes the types of projects that are eligible to apply for permanence certification under this Regulation. The amendments remove eligibility for projects that "capture carbon dioxide (CO_2) and" and add "store captured carbon" to establish that only projects that store captured carbon are eligible to apply for permanence certification.

Rationale

This change is necessary to establish that the scope of the GCS Protocol applies only to projects that geologically store captured CO_2.

Section A.2. Minor changes throughout the Definitions subsection

Purpose

Throughout section A.2, various definitions are added, removed, or amended as described in the following statements of purpose and rationale. Some renumbering and reordering occur in this section to accommodate these additions and removals.

Rationale

This change is necessary to maintain a continuous list in alphabetical order and with sequential numbering.

Section A.2(a) Applicability of definitions

Purpose

In the current Regulation, this section specifies that the following definitions apply to the Low Carbon Fuel Standard Regulation. The proposed amendments remove this language to specify that the following definitions apply to the proposed SB 905 regulatory language.

Rationale

This change is necessary to align with the global change to remove the GCS Protocol from the LCFS regulation and update and move the GCS Protocol to the Carbon Capture, Removal, Utilization, and Storage Program.

Section A.2(a) Definitions.

<u>“Abandoned Well” Definition [new]</u>

Purpose

A new definition for “abandoned well” is added for the purpose of establishing the conditions that define an abandoned well.

Rationale

This term was used previously in the GCS Protocol but was not defined. Defining “abandoned well” clarifies the expectations for the GCS operator with regards to actions that must be taken for abandoned wells.

<u>“Active life” Definition</u>

Purpose

The definition of “active life” is amended to remove “operational life” as this term is not used in the GCS Protocol.

Rationale

The term “operational life” is not used in the GCS Protocol. Thus, it should be removed from the definition. This change is non-substantive.

“Aqueous diffusion coefficient” Definition

Purpose

The definition of “aqueous diffusion coefficient” is amended to define the typical units used.

Rationale

It is good practice to spell out units before abbreviations are used. This change is non-substantive.

“Atmospheric CO2 leakage” Definition

Purpose

The proposed amendments move “atmospheric leakage” from within the “CO_2 leakage” definition to its own definition and add CO_2 to the definition.

Rationale

A proper list of definitions has each definition clearly defined rather than lumped together. The addition of the CO_2 to the definition align the definition with the other leakage definitions in this section.

“Biogenic CO2” Definition [deleted]

Purpose

The proposed amendments remove the definition of “Biogenic CO_2”.

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Borehole” Definition

Purpose

The proposed amendment removes the second sentence of the definition of “borehole”.

Rationale

The GCS Protocol defines “borehole” as “a cylindrical hole cut into rock or soil by drilling. Also refers to the inside diameter of the wellbore wall (i.e., the rock face that bounds the drilled hole.” However, the second part of the definition does not apply to any of the uses of the term “borehole” in the GCS Protocol. The second part of the

definition of the term “borehole” is unnecessary and is therefore removed.

“Brine” Definition

Purpose

The definition of “brine” is amended to define brine as water containing dissolved solids in excess of 10 grams per liter.

Rationale

Freshwater is defined as water containing fewer than 10 grams per liter total dissolved solids, per the U.S. EPA Safe Drinking Water Act. The previous definition of brine was defined as water containing dissolved solids in excess of 100 grams per liter. With that definition, water with a total dissolved solids level between 10 grams and 100 grams per liter was undefined. Amending the definition of brine to start at 10 grams per liter removes that undefined range.

“Brittleness” Definition [deleted]

Purpose

The proposed amendments remove the definition of “brittleness”.

Rationale

The requirements for calculating rock strength in the GCS Protocol were amended to use ductility instead of brittleness, as this is a practice more common in industry. Therefore, the term “brittleness” is no longer used in the GCS Protocol and can be removed from the definitions.

“Capillary pressure” Definition [moved]

Purpose

The proposed amendments moved the definition of “capillary pressure” from before “capillary entry-pressure” to after for correct alphabetization.

Rationale

“Capillary pressure” was incorrectly placed before “capillary entry-pressure” and needs to be moved for correct alphabetization.

“Capture Facility Operator” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Capture Facility Operator”.

Rationale

This change is necessary to ensure that the scope of the GCS Protocol applies only to projects that geologically store captured CO_2.

“Carbon capture and sequestration” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Carbon capture and sequestration”.

Rationale

Carbon capture and sequestration refers to the entire process of capturing, transporting, and storing CO_2. The scope of the GCS Protocol applies only to projects that geologically store captured CO_2, thus this broad definition is not applicable. All references to CCS have been changed to GCS, so this definition should be removed.

“Carbon dioxide equivalent” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Carbon dioxide equivalent” or “CO_2 equivalent” or “CO_2e”.

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Carbon intensity” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Carbon intensity".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Casing” or “casing string” Definition

Purpose

The definition of “casing” or “casing string” was amended for grammar and clarity. Unnecessary wording was removed and the definition of “surface casing” was amended to clarify that the surface casing length typically varies but may not always vary.

Rationale

Clarifying the definition improves readability and understanding for the GCS operator.

“Casing inspection log” Definition

Purpose

The definition of “Casing inspection log” was amended to clarify that these logs can be used for any casing, not just the long string casing. The amendments also establish the data measured and how that measurement is acquired.

Rationale

The details of what a casing inspection log is are added to differentiate the casing bond log from the cement bond log, which is a new definition that has been added as part of these amendments.

“CCS capture facility” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “CCS capture facility."

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“CCS project” Definition [deleted]

Purpose

The proposed amendments remove the definition and replace references to CCS project with GCS site.

Rationale

This change is necessary to maintain alignment with other CARB regulatory text, as the term “project” is associated with definitions specific to other CARB regulations. Additionally, the purpose of the GCS Protocol is to certify particular sites for storage, not the projects as a whole. For these reasons, it is necessary to remove the definition.

“CCS Project Operator” Definition [deleted]

Purpose

The proposed amendments remove the definition and replace references to CCS Project Operator with GCS operator.

Rationale

This change is necessary to maintain alignment with other CARB regulatory text, as the term “project” is associated with definitions specific to other CARB regulations. Additionally, the purpose of the GCS Protocol is to certify particular sites for storage, not

the projects as a whole. For these reasons, it is necessary to remove the definition.

“CCUS Program” Definition [new]

Purpose

The proposed amendments add a new definition for the Carbon Capture Removal Utilization and Storage Program.

Rationale

This change is necessary to maintain alignment with other CARB regulatory text.

“Cement bond log” Definition [new]

Purpose

A new definition for “cement bond log” is added to clarify what a cement bond log is and what it is used for.

Rationale

Previously, casing inspection logs were incorrectly identified as the method the GCS operator had to implement to evaluate the quality of the cement bond of the well. The correct log is the cement bond log. This has been corrected as part of these amendments, and therefore a definition for cement bond log has to be included.

“CO2-EOR” Definition

Purpose

The proposed amendments remove CO_2-enhanced oil recovery from the definition of CO_2-EOR as this acronym is specified in A.1. Applicability.

Rationale

This change is necessary to align with the revised GCS Protocol which does not reference CO_2-enhanced oil recovery and to reduce redundancy throughout.

“CO2 injected” Definition [new]

Purpose

This proposed amendment adds a definition for “CO_2 injected” and associated requirements in Section B to establish this term as the basis how injected CO_2 must be identified and measured for all GCS projects seeking permanence certification.

Rationale

This change is necessary to provide a uniform and technically consistent foundation for quantifying injected CO_2 injected. This definition improves clarity and supports consistent accounting without tying the GCS Protocol to any specific program.

“CO2 leakage” Definition

Purpose

The definition of “CO_2 leakage” is amended to establish that any movement of stored CO_2 out of the storage complex, as defined under a site’s approved permanence certification and consistent with GCS protocol is considered as a CO_2 leakage. “Atmospheric leakage” and “Subsurface leakage” is deleted from the definition.

Rationale

Movement of stored CO_2 that exits the intended storage zone but remains within the certified storage complex is not considered leakage. The definition is amended to clarify this distinction. The revised definition and deletion of the two related leakage terms is necessary to conform with the rest of the Protocol.

“CO2 plume” Definition

Purpose

The definition of “CO_2 plume” is amended to establish that the plume encompasses all phases of the injected CO_2 stream, not just the free-phase and dissolved phases.

Rationale

The amended language is broader and accounts for other phases other than the free-phase and dissolved phases that CO_2 may be in. The CO_2 plume must account for all of the CO_2 underground, regardless of phase.

“CO2 separation” Definition [moved]

Purpose

The definition of “CO_2 separation” is moved from after “CO_2 stream” to before for proper alphabetization.

Rationale

“CO_2 separation” was incorrectly placed – this amendment rectifies the incorrect alphabetization.

“CO2 stream” Definition

Purpose

The definition of “CO_2 stream” is amended to include CO_2 that has been captured from ambient air and to place a condition on incidental associated substances that may be in the stream.

Rationale

CO_2 may come from point sources (e.g., power plants) or may come directly from ambient air through direct air capture. To not exclude CO_2 captured through direct air

capture, “or ambient air” is included in the definition. Additionally, while it is likely that incidental associated substances derived from the source materials and the capture process would be included in the CO_2 stream, that may not always be the case. As such, the definition is amended to establish that such incidental substances may be included, but do not have to be a part of the CO_2 stream.

“Computational model” Definition

Purpose

The definition of “computational model” is amended to align with other amendments in the computational modeling section of the GCS Protocol.

Rationale

It is more precise to say that the computational model predicts the migration of the CO_2 plume and area of elevated pressure, rather than CO_2 plume and elevated pressure migration. The previous phrasing could be interpreted as saying that the computational model can only predict the plume and pressure together, when in reality they are separate.

“Confining layer” Definition [new]

Purpose

The proposed amendments add a new definition for confining layer and move the definitions for primary and secondary confining layers to beneath this definition.

Rationale

While “confining layer” was used throughout the GCS Protocol, it was not defined by itself. Originally, the GCS Protocol placed the definitions for primary and secondary confining layers beneath the definition of confining system, which caused confusion with respect to the definitions of the confining layers and confining system, as well as the definition of the storage complex, below. This is because operators may define their storage complex with or without secondary confining layers. The proposed amendments address these issues by adding the definition, which clarifies the different geologic layers for the operator and improves understanding of Protocol requirements.

“Confining system” Definition

Purpose

The definition of “confining system” is amended to clarify the that the confining system lies above the storage zone and is composed of at least one confining layer to impede vertical CO_2 migration and at least one permeable layer to dissipate excess pressure. The definition is also amended to delete the definitions of primary and secondary confining layers.

Rationale

The proposed amendments to the definition of confining system are needed to align this

definition with those of both confining layer and storage complex. This change both clarifies the definitions of all five terms (confining layer, primary confining layer, secondary confining layer, confining system, and storage complex).

“Depleted oil and gas reservoir” Definition

Purpose

The definition of “depleted oil and gas reservoirs” is amended to use the singular rather than plural. “With” is changed to “using” for precision.

Rationale

Since this term is used in the singular in the GCS Protocol, the singular form should be defined. “Using” is a more specific term than “with” and improves the clarity of the definition.

“Deviated well” Definition [deleted]

Purpose

The proposed amendments remove the definition of “deviated well.”

Rationale

The requirement for deviation checks for deviated wells was removed to streamline the GCS Protocol and remove provisions that are not needed to assess the suitability of the GCS site to store CO_2. Therefore, the term “deviated well” is no longer used in the GCS Protocol and can be removed from the definitions.

"Embodied GHG” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Embodied GHG".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Entrained CO2” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Entrained CO_2".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is

necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

"Features, Events, and Processes" or "FEPs" Definition [new]

Purpose

The proposed definition clarifies Risk Assessment methodology and ensures consistent interpretation of the methodology provisions by GCS operators.

Rationale

Risk Assessment is a common scientific practice. Adding this definition aligns the GCS Protocol with established risk assessment methodologies and ensures GCS operators use a consistent framework when creating and evaluating risk scenarios. The defined methodology is necessary to ensure the enforceability of the Risk Assessment provisions of the GCS Protocol.

"Formation fluid" Definition [new]

Purpose

The proposed amendments create a new definition for formation fluid to mean any fluid that occupies pore space within a rock formation. Formation fluids occur as various saturations of oil, gas, and water, and are encountered in the process of drilling oil or gas and injection wells.

Rationale

Formation fluid movement/leakage is mentioned in many provisions of the GCS Protocol and must be defined so that GCS operators know when formation fluid movement/leakage has occurred.

"Fracture parting pressure" Definition

Purpose

The definition of "fracture parting pressure" is amended to remove "or 'parting pressure'" and include "parting" in "fracture parting pressure".

Rationale

There are several different pressures that can be considered "fracture pressure". Adding "parting" clarifies this definition and reduces confusion about which pressure is being discussed.

"Fracture pressure gradient" Definition

Purpose

The definition of "fracture pressure gradient" is amended to add "pressure" to "fracture pressure gradient".

Rationale

The definition includes pressure already, so renaming the term aligns with its definition and improves clarity.

“Fugitive emissions” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Fugitive emissions".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

“GCS operator” Definition [new]

Purpose

The proposed amendments define the “GCS operator” or “operator” to mean the entity(ies) including an owner who is responsible for operating and managing all activities at the GCS site.

Rationale

The definition was changed from “CCS Project Operator” to reflect the change of CCS to GCS and remove “project” as that term is typically used to refer to the entire carbon capture, transport, and storage process. This definition establishes that the GCS operator is only responsible for the GCS operations at the GCS site, not operations relating to capture or transport.

“GCS site”, “storage site”, or “site” Definition [new]

Purpose

A new definition for “GCS site”, “storage site”, or “site” is added to replace the deleted definition of “CCS project”. The definition establishes that the site is referencing the subsurface geologic storage complex, all injection, production, monitoring, and observation wells and plugged and abandoned wells that penetrate the storage complex, any facilities or infrastructure inclusive of and downstream of the injection meter or wellhead of the injection well (whichever is further upstream from injection), and other locations where in-situ monitoring is required to ensure permanent storage of injected CO_2.

Rationale

Since the GCS Protocol is focused on geologic carbon storage only, use of the term “project” is confusing as there are other components of a GCS project, such as capture and transport, that are not included in the scope of this GCS Protocol. Therefore, the

definition of a GCS site is established to clarify that the GCS Protocol requirements are applicable to the subsurface storage complex, all wells associated with storage operations that penetrate the storage complex, plugged and abandoned wells that penetrate the storage complex, facilities and infrastructure inclusive of and downstream of the injection meter or wellhead of the injection well (whichever is further upstream), and other locations where in-situ monitoring is required to ensure permanent storage of injected CO_2.

<u>"Geologic carbon storage" Definition</u>

Purpose

The definition of "geologic carbon storage" is amended to remove the reference to capture and transport of CO_2. Other wording is rearranged without substantively changing the definition.

Rationale

Since it is established elsewhere that the GCS Protocol is only focused on the storage of captured CO_2, the sentence about capture or transport of CO_2 is not necessary and can be removed.

<u>"GHG emissions reductions" Definition [deleted]</u>

Purpose

The proposed amendments remove the definition and any references to "GHG emissions reductions".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol is generic and can be used by prospective GCS operators regardless of their respective crediting pathways.

<u>"Injection well" Definition [new]</u>

Purpose

A new definition for "injection well" is added for the purpose of establishing the conditions that define an injection well.

Rationale

This term was used previously in the GCS Protocol but was not defined. Defining "injection well" clarifies the expectations for the GCS operator with regards to actions that must be taken for injection wells.

<u>"Monitoring well" Definition [new]</u>

Purpose

A new definition for "monitoring well" is added for the purpose of establishing the

conditions that define a monitoring well. Different types of monitoring wells are also defined.

Rationale

This term was used previously in the GCS Protocol but was not defined. Defining "monitoring well" clarifies the expectations for the GCS operator with regards to actions that must be taken for monitoring wells.

"Near surface monitoring" Definition [new]

Purpose

The proposed definition for "near surface monitoring" clarifies the distinct types of monitoring techniques for this monitoring method. The definition describes the general depth ranges for monitoring and measurement characteristics.

Rationale

The original Protocol uses "near surface monitoring" without defining the phrase. This could lead to inconsistent interpretation of monitoring and reporting requirements affecting the enforceability of the GCS Protocol. Adding this definition clarifies the differences between near surface monitoring, which involves shallow subsurface measurements, and surface monitoring, which relies on observational or measurement based techniques without subsurface penetration. Providing representative examples improves consistency and supports accurate implementation of monitoring requirements across all sites.

"Net worth" Definition [moved]

Purpose

The definition of "net worth" was moved from before "net working capital" to after for proper alphabetization.

Rationale

"Net worth" was incorrectly placed – this amendment rectifies the incorrect alphabetization.

"Observation well" Definition [new]

Purpose

A new definition for "observation well" is added for the purpose of establishing the conditions that define an observation well.

Rationale

This term was used previously in the GCS Protocol but was not defined. Defining "observation well" clarifies the expectations for the GCS operator with regards to actions that must be taken for observation wells.

“Permanent storage” or “permanence” Definition

Purpose

The definition of “permanent storage” or “permanence” is amended to clarify that the CO_2 must remain within the storage complex for at least 100 years post-injection completion.

Rationale

It is established in other provision of the GCS Protocol that the GCS operator has to monitor the site for at least 100 years post-injection completion. Without including the term “post-injection completion” after “100 years”, GCS operators could be confused as to whether the injection period counts towards the 100 years of permanence. This amendment clarifies that the injection period does not count towards the 100 years of permanence.

“Plugged and Abandoned Well” Definition [new]

Purpose

A new definition for “plugged and abandoned well” is added for the purpose of establishing the conditions that define a plugged and abandoned well.

Rationale

This term was used previously in the GCS protocol but was not defined. Defining “plugged and abandoned well” clarifies the expectations for the GCS operator with regards to actions that must be taken for observation wells.

“Post-injection site care and monitoring period” Definition

Purpose

The definition of “post-injection site care and monitoring period” is amended to clarify that the period begins only after “final” injection completion and ends 100 years after “final” injection completion.

Rationale

It is established in other provision of the GCS Protocol that the GCS operator has to monitor the site for at least 100 years post-injection completion. Without including the term “final” before injection completion, GCS site operators could be confused as to whether the any injection completion counts towards the 100 years of permanence and starts the post-injection site carte and monitoring period. This amendment clarifies that only after “final” injection completion does the post-injection site care and monitoring period begin.

“Pressure transient well test” Definition [new]

Purpose

A new definition for “pressure transient well test” is added since the requirement for

pressure fall-off tests has been amended to allow any pressure transient well test.

Rationale

The requirement for GCS operators to perform pressure fall-off tests has been amended to allow for any pressure transient well test to be used. As such, a definition for pressure transient well tests is needed to support this amendment.

“Pressure fall-off test” Definition [deleted]

Purpose

The definition for “pressure fall-off test” has been removed because it is no longer used in the GCS Protocol.

Rationale

The requirement for GCS operators to perform pressure fall-off tests has been amended to allow for any pressure transient well test to be used. As such, the definition of pressure fall-off tests is no longer needed and can be removed.

“Primacy state agency” Definition [new]

Purpose

A new definition for “primacy state agency” is added for the purpose of identifying state agencies responsible for implementing the U.S. EPA Class VI Underground Injection Control program in a state that has received primacy for such program from the U.S. EPA.

Rationale

The GCS Protocol applies to sites that may have received Class VI authorization from either the U.S. EPA or from a state that has primacy over the Class VI Underground Injection Control program. In order to make the requirements of the Protocol applicable to both situations, a term to identify those state agencies that have responsibility for implementing the Class VI program in a primacy state has to be defined.

“Production well” Definition [new]

Purpose

A new definition for “production well” is added for the purpose of establishing the conditions that define a production well.

Rationale

This term was used previously in the GCS Protocol but was not defined. Defining “production well” clarifies the expectations for the GCS operator with regards to actions that must be taken for production wells.

“Project GHG emissions” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Project GHG emissions".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol remains as generic as possible and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Pump test” Definition [deleted]

Purpose

The proposed amendments remove the definition of “pump test.”

Rationale

The requirement for pump tests was removed from the Geologic Evaluation section to streamline the GCS Protocol and remove provisions that are not needed to assess the suitability of the GCS site to store CO_2. Therefore, the term “pump test” is no longer used in the GCS Protocol and can be removed from the definitions.

“Risk Analysis” Definition [new]

Purpose

The proposed definition clarifies Risk Assessment methodology and ensures consistent interpretation of the methodology provisions by Operators.

Rationale

Risk Assessment is a common scientific practice. Adding this definition aligns the GCS Protocol with established risk-assessment methodologies and ensures Operators use a consistent framework when creating and evaluating risk scenarios. The defined methodology is necessary to ensure the enforceability of the Risk Assessment provisions of the GCS Protocol.

"Risk Scenario" Definition [new]

Purpose

The proposed definition clarifies Risk Assessment methodology and ensures consistent interpretation of the methodology provisions by Operators.

Rationale

Risk Assessment is a common scientific practice. Adding this definition aligns the GCS Protocol with established risk assessment methodologies and ensures Operators use a consistent framework when creating and evaluating risk scenarios. The defined

methodology is necessary to ensure the enforceability of the Risk Assessment provisions of the GCS Protocol.

“Rock compressibility” Definition [deleted]

Purpose

The proposed amendments remove the definition of “rock compressibility” as this term is no longer used in the GCS Protocol.

Rationale

The term “rock compressibility” is no longer used in the Geologic Evaluation or Formation and Well Testing sections and can therefore be removed from the GCS Protocol to streamline the requirements.

“Sequestration and storage site” Definition [deleted]

Purpose

The proposed amendments remove the definition of “sequestration and storage site” as this has been changed to “GCS site”.

Rationale

The term “sequestration and storage site” is no longer used and can therefore be removed from the GCS Protocol to streamline the requirements.

“Sequestration zone” Definition [deleted]

Purpose

The proposed amendments remove the definition of “sequestration zone” as it has been replaced by “storage zone”.

Rationale

The use of “sequestration” has been replaced with “storage”. The definition of “storage zone” appears elsewhere due to alphabetization and therefore this definition can be removed.

“Storage complex” Definition

Purpose

The proposed amendments revise the definition of “storage complex” to clarify which distinct layers which make up the storage complex and removes that characterization, monitoring and corrective action. The proposed amendments also remove sub-definitions (A through C).

Rationale

The original definition of storage complex did not actually identify which layers or formations make up the storage complex; therefore, the layers have been added to the

definition. The deleted portions of the definition were removed because those described requirements for the GCS operator to fulfill when applying for Permanence Certification rather than defining the storage complex. The requirements are not removed from the Protocol because they are located in the Site Characterization, Testing and Monitoring, and Corrective Action sections.

“Storage zone” Definition [new]

Purpose

A new definition of “storage zone” is added to reflect the change from “sequestration” to “storage”.

Rationale

“Sequestration” has been changed to “storage” throughout the GCS Protocol and this definition needed to be alphabetized accordingly. Otherwise, the definition is unchanged and this change is non-substantive.

"Stratigraphic test well” Definition [moved]

Purpose

The definition of “stratigraphic test well” was moved from before “storage coefficient” to after “storage zone” for proper alphabetization.

Rationale

“Stratigraphic test well” was incorrectly placed – this amendment rectifies the incorrect alphabetization.

“Surface monitoring” Definition [new]

Purpose

The proposed definition for “surface monitoring” clarifies the distinct types of monitoring techniques for this monitoring method. The definition clarifies that surface monitoring is at or above the ground surface and lists examples of surface monitoring techniques.

Rationale

The original Protocol uses “surface monitoring” without defining the phrase. This could lead to inconsistent interpretation of monitoring and reporting requirements affecting the enforceability of the GCS Protocol. Adding this definition clarifies the differences between near surface monitoring, which involves shallow subsurface measurements, and surface monitoring, which relies on observational or measurement based techniques without subsurface penetration. Providing representative examples improves consistency and supports accurate implementation of monitoring requirements across all sites.

“System boundary” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “System boundary".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol remains as generic as possible and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Validation” Definition [deleted]

Purpose

The proposed amendments remove the definition of “validation”.

Rationale

The third-party validation requirements have been removed as part of these proposed amendments and therefore there is no need to define “validation”.

“Vented emissions” Definition [deleted]

Purpose

The proposed amendments remove the definition and any references to “Vented emissions".

Rationale

The definition is specific to the Low Carbon Fuel Standard Regulation. This change is necessary to ensure that the GCS Protocol remains as generic as possible and can be used by prospective GCS operators regardless of their respective crediting pathways.

“Verification” Definition

Purpose

This definition specifies that verification occurs after a GCS operator submits either a quarterly or annual report. The proposed amendments modify the definition of “verification” by removing “quarterly or” and adds “or in the event of CO_2 leakage”, as GCS operators are only required to submit annual reports.

Rationale

This change is needed to align verification with the updated annual-only reporting deadlines, as well as specify that verification would also be required after a CO_2 leakage event, regardless of annual reporting.

Section A.2(b). Acronyms.

Removing and adding acronyms

Purpose

Staff proposes to remove the following acronyms:

- “APCD” means Air Pollution Control District.
- “AQMD” means Air Quality Management District.
- “CA-GREET” means the Greenhouse gases, Regulated Emissions, and Energy use in Transportation Model, as referred to in the LCFS regulation.
- “CCS” means Carbon Capture and Storage.
- “CO” means carbon monoxide.
- “COI” means conflict of interest.
- “CO_{2e}” means CO_2 equivalent.
- “$CO_{2(ag)}$” means carbon dioxide dissolved in an aqueous solution.
- “$CO_{2(g)}$” means carbon dioxide as a free gas phase.
- “DOGGR” means the California Division of Oil, Gas, and Geothermal Resources.
- “LCFS” means the Low Carbon Fuel Standard (title 17, California Code of Regulations, section 95480 et seq.)
- “N2O” means nitrous oxide.
- “NESHAPS” means the National Emission Standards for Hazardous Pollutants preconstruction approval under the Clean Air Act.
- “SIC” means Standard Industrial Classification codes for classifying industries by a four-digit code.
- “SSR” means sources, sinks, and reservoirs.
- “TOC” means total organic carbon.
- “VOC” means volatile organic compound.

Staff proposes to add the following acronyms:

- “CalGEM” means California Geologic Energy Management Division
- “CCUS” means carbon capture, utilization, and storage.
- “FEPs” means features, events and processes.
- “PTA” means pressure transient analysis.
- “PVT” means pressure-volume-temperature.
- “QA” means quality assurance.
- “QC” means quality control.
- “RCAL” means routine core analysis.
- “SCAL” means special core analysis.
- “USDW” means underground source of drinking water.
- “WAG” means water alternating gas.

Rationale

These amendments are necessary to remove acronyms that are no longer used or referenced within the GCS Protocol. Removing unused acronyms improves clarity and

reduces potential confusion. Additionally, adding acronyms is necessary to ensure that completeness as some acronyms are mentioned in this document but are not on the existing list of acronyms

Section B. Accounting Requirements for CCS Projects Under the LCFS

Section B. Heading [renamed]

Purpose

This amendment removes the existing section heading, “Accounting Requirements for CCS Projects Under The LCFS” and replaces it with “Quantification of Injected CO_2” to reflect the updated content of the section.

Rationale

Renaming the section ensures the heading accurately reflects its purpose within the GCS Protocol, which centers on geologic carbon storage rather than LCFS-specific accounting. Quantifying injected CO_2 is essential for determining the cumulative amount of CO_2 in the reservoir and for maintaining a complete record of geologic storage independent of any crediting program. Because the revised GCS Protocol is designed to function as a standalone technical framework, projects may obtain Permanence Certification without participating in LCFS or other CARB programs. Without a dedicated requirement to quantify injected CO_2, the State would lack the ability to track stored volumes. The updated heading and associated provisions clarify this core purpose and remove outdated LCFS-specific language to maintain program-neutral applicability.

Section B.1 System Boundary [deleted]

Purpose

The proposed amendment removes the LCFS-specific system boundary section from the GCS Protocol and Figure 1 and 2 associated with it.

Rationale

This existing system boundary requirements were developed for the LCFS Program and are not applicable to other programs. Because the revised GCS Protocol is intended to function as a program-independent technical framework, retaining the LCFS boundary condition would limit its applicability and could create conflicts with other boundary definitions and requirements in other programs. Removing this section along with the figures allows each program to define its own system boundaries in its respective regulation while the GCS Protocol focuses on core project-related requirements.

Section B.1 Injected CO2 Calculation [new]

Purpose

This amendment adds a new section establishing the quantification and data

requirements for injected CO_2.

Rationale

This change is necessary to provide a standardized method for quantifying the amount of CO_2 injected into the subsurface. Quantifying injected CO_2 is essential for determining the cumulative amount of CO_2 in the reservoir and for maintaining a complete record of geologic storage independent of any crediting program. Because the revised GCS Protocol is designed to function as a standalone technical framework, projects may obtain Permanence Certification without participating in LCFS or other CARB programs. Without a dedicated requirement to quantify injected CO_2, the State would lack the ability to track stored volumes.

Section B.2 Quantification of Geologic Sequestration CO2 Emission Reductions [deleted]

Purpose

This amendment removes LCFS-specific quantification equations (including anything related to greenhouse gas emissions reductions calculations), variables, and supporting language from Section B.2 of the CCS Protocol, retaining only the CO_2 injected term, its definition, and essential explanatory text.

Rationale

Section B.2 of the CCS Protocol was developed for the LCFS crediting framework and relies on program-specific quantification methodologies, assumptions, and equations that are not applicable across other regulatory programs. Because the revised GCS Protocol is intended to serve as a generalized technical standard, retaining LCFS-specific quantification requirements would limit its usability and create inconsistencies outside of the LCFS context.

The CO_2 injected term is retained because it is a program-neutral metric necessary for quantifying all GCS projects. Keeping this term, its definition, and the minimum supporting text ensure continuity in core technical requirements while removing elements that are tied to a specific program's lifecycle or crediting structure.

Section B.2 Analysis of the CO2 Stream for Well Integrity [relocated]

Purpose

This amendment moves the CO_2 stream analysis requirements from Section C.4.3.1.1 of the CCS Protocol to B.2 of the GCS Protocol. This new section addresses sampling and analysis requirements of injected CO_2.

Rationale

The CO_2 stream analysis requirements specify how operators must sample, characterize, and report the properties of the injected CO_2. These activities are essential for determining the composition and quantifying the amount of injected CO_2.

This section is not relevant for monitoring on-going project emissions. Relocating this requirement to Section B consolidates all requirements related to the quantification of injected CO_2 in one location to improve clarity and consistency without changing the underlying technical requirements. The injection amount is needed within the GCS Protocol itself, as opposed to just in the program-specific quantification methodologies and the Mandatory Reporting Regulation (MRR) because out of state operators are not required to report to the MRR and analysis of the CO_2 stream is related to ensuring well integrity. In-state projects would already be monitoring injected CO_2 through MRR and will already meet this requirement.

Section B.3 Invalidation and Buffer Account [deleted]

Purpose

This amendment removes the invalidation and buffer account provisions that are related to LCFS crediting.

Rationale

The buffer account mechanism within the CCS Protocol is tied to the LCFS crediting framework which quantifies fuel pathways and projects via lifecycle assessment. These changes are needed to align the revised GCS Protocol with its intended scope to quantify geologic carbon storage projects only.

Section B.3 Continuous Monitoring of Injection rate and Volume [relocated and revised]

Purpose

These amendments relocate the requirements previously in C.4.3.1.2 to Section B.3 to clearly consolidate all injected CO_2 data requirements. The definition of “continuous measurement” is revised to be performance-based, and unnecessary requirements such as monitoring energy inputs and references to “accounting purposes” are removed. Language is clarified by replacing “need to” with “shall.” The amendments also add a minimum calibration interval for injection flow meters and require reported injection rate and volume data to include statistical uncertainty metrics.

Rationale

The relocated provisions strictly support quantifying injected CO_2 and therefore belong in Section B. A performance-based definition of “continuous measurement” ensures high-resolution tracking and requires statistical metrics to confirm data quality. Because the Protocol focuses on injected CO_2 quantification rather than operational energy use, related monitoring requirements are removed. Clarifying language improves enforceability, while adding calibration interval requirements that are similar to LCFS standards ensures accurate measurement of injected CO_2. This is required to know the injected CO_2 within the reservoir in those cases where the storage site with permanence certification does not enter into a CARB program that would require reporting of this injected CO_2.

SECTION C. PERMANENCE REQUIREMENTS FOR GEOLOGIC STORAGE.

Section C.1.1 Application and Certification

Purpose

The amendments rename Figure 3 as Figure 1 for consistency following removal of earlier figures. They also eliminate references to third-party review and update cross-references to reflect the two Permanence Certification pathways based on permit type. In addition, the amendments define which comments will be considered and specify that the Executive Officer will forward those comments to the applicant, who is responsible for revising and/or responding to them.

Rationale

Renumbering is needed because figures in Section B were removed. References to third-party review must be deleted to maintain consistency with amendments that remove that requirement. Updating cross-references ensures alignment with structural changes throughout the Protocol. Finally, defining comment-handling criteria clarifies what constitutes a comment requiring response and appropriately assigns responsibility to the applicant, aligning the process with LCFS comment-response procedures.

Section C.1.1.1 Third-Party Review [deleted]

Purpose

The proposed amendments remove the third-party review requirements.

Rationale

The third-party review is duplicative of CARB's review of Permanence Certification applications and is not needed to ensure GCS sites are suitable to meet the permanence requirements for carbon storage. Removing this requirement also lessens the administrative burden on the GCS operator to find third-party reviewers that are acceptable to the Executive Officer.

Removal of the third-party review requirements does not preclude CARB from conducting an independent third-party review of the application materials as part of CARB's overall application review process.

Section C.1.1.1 Certification Application Materials [new]

Purpose

The proposed amendments establish two pathways for Permanence Certification: one for operators pursuing or holding a Class VI UIC permit and one for operators using any other injection permit. Class VI GCS operators must submit only those materials not already required under their Class VI permit, while non-Class VI operators must provide all information required by the GCS Protocol. Where requirements overlap, Class VI operators must attest to compliance with their Class VI permitting authority.

All GCS operators must also attest that they have obtained all necessary construction and operating permits and provide copies before Final GCS Site Certification. GCS operators must also submit schematics or drawings of various wells that penetrate the storage complex. Nonessential general information unrelated to evaluating the site's suitability for permanent CO_2 storage has been removed for all operators.

Rationale

Class VI permitting already requires extensive evaluation of a site's suitability for carbon storage, and many Class VI requirements closely mirror those in the GCS Protocol. To reduce duplication and administrative burden, the amendments rely on the Class VI review for overlapping provisions and require Class VI operators to submit only the additional information not addressed through their Class VI permit, along with attestations of continued compliance. Well schematics or drawings are needed to ensure correct well construction of wells that are not assessed by a Class VI review.

Non-Class VI operators, who may not be subject to equivalent regulatory requirements, must provide all information required under the GCS Protocol to enable CARB's full evaluation of site suitability.

Finally, requirements unrelated to assessing permanent CO_2 storage are removed to streamline submissions and focus all operators on information essential to determining permanence.

Section C.1.1.2.1 Electronic Reporting [new]

Purpose

The proposed amendments create a new provision establishing that failure to adhere to reporting requirements may result in the revocation of an issued Permanence Certification.

Rationale

This addition is necessary to establish an enforcement consequence for GCS operators who do not adhere to the GCS Protocol's reporting requirements.

Section C.1.1.2.2 Quarterly or Annual Quantification Reporting [new]

Purpose

The proposed amendments clarify that the option to report quarterly or annually is specifically tied to the reports related to quantification of the injected CO_2. The amendments also remove unnecessary language and specify dates by which the quarterly or annual reports must be submitted as well as how the reports are to be submitted.

Rationale

The amendments clarify the reporting requirements for quantification reporting, which

were previously tied to the LCFS regulation. Because the GCS Protocol is being amended to remove references to the LCFS regulation, including references LCFS reporting requirements,, the GCS Protocol has to specify the formatting and timing that is required for these reports.

Section C.1.1.2.3 Annual Permanence Reporting [new]

Purpose

The amendments refocus this section on the annual permanence information GCS operators must submit and establish two reporting pathways parallel to the application structure in section C.1.1.1. Class VI operators must report only information not already submitted to their permitting agencies and attest to continued compliance, financial responsibility, and adherence to approved plans. Non-Class VI operators must report all information required by the GCS Protocol and provide the same attestations. The amendments also clarify the timing and format of annual submissions.

Rationale

Because Class VI permitting requirements substantially overlap with the GCS Protocol, relying on Class VI reviews for shared elements streamlines reporting and reduces duplicative burden. Class VI operators therefore must report only information not already reviewed by permitting authorities and attest to compliance with all applicable permits. Non-Class VI operators, who may not be subject to equivalent regulatory obligations, must report in full compliance with the GCS Protocol to allow CARB to evaluate ongoing site suitability for permanent storage. With LCFS references removed throughout the Protocol, this section also specifies the required format and timing for annual reports.

Section C.1.1.2.4 Advanced Notice Reporting [new]

Purpose

The proposed amendments remove the requirement for the GCS operator to provide the Executive Officer advance written notice of any planned mechanical integrity test or workover. The amendments also remove “Planned Changes”.

Rationale

GCS operators are already required to give advanced notice to their permitting authority of planned mechanical integrity tests or workovers. Since Permanence Certification is not a permit to operate, CARB only requires reporting of the completed tests, and the requirement can be removed as it is not relevant to CARB’s authority over these sites.

“Planned Changes” is not needed any longer to differentiate between requirements since there will only be one provision in this section. Its removal is non-substantive.

Section C.1.1.3.5 Noncompliance and Event Reporting [deleted]

Purpose

The proposed amendments remove this section.

Rationale

These reporting requirements are related to emergency and remedial response reporting. As part of these proposed amendments, the Emergency and Remedial Response Plan has been amended to include reporting requirements in section C.6. There is therefore no longer a need to include reporting requirements in this location.

Section C.1.1.2.5 Additional Reporting [new]

Purpose

The proposed amendments revise the noncompliance reporting requirement to specify what the reports must contain. The amendments revise the well plugging and abandonment reporting requirement to establish such reporting is only required for non-Class VI GCS operators. The amendments also specify how and when the reports must be submitted.

Rationale

Because the prior noncompliance reporting provision referenced a section that has since been deleted, the requirements must be restated here to ensure operators have complete and clear guidance. Class VI operators already submit Notices of Intent to Plug, Well Plugging and Abandonment Plan amendments, and plugging reports to their permitting authority; CARB therefore only needs an attestation of compliance in the annual report, making this provision applicable solely to non-Class VI operators. Finally, with all LCFS references removed throughout the Protocol, the GCS Protocol must specify its own formatting and timing requirements for these reports.

Section C.1.1.3 Recordkeeping [new]

Purpose

The proposed amendments revise the record retention period from “at least 10 years after site closure” to “until the Executive Officer approves site closure”. The terms “pre-injection”, “active injection”, and “post-injection phases” are also revised to “before and during the active life of the GCS site, and the post-injection site care and monitoring period”.

Rationale

CARB does not have any mechanism to enforce requirements after the Executive Officer approves site closure, and therefore it is appropriate to have the record retention period end with Executive Officer approval of site closure. The language describing the phases of the site must be revised to be consistent with how those phases are described in the rest of the GCS Protocol for clarity.

Section C.1.2 Terms and Conditions

Purpose

The proposed amendments remove the stipulation that the Permanence Certification is non-transferable.

Rationale

This provision is deleted to be consistent with provisions for the transfer of Permanence Certifications under section C.8.2(a).

Section C.2.1 Minimum Site Selection Criteria

Purpose

The proposed amendments clarify that the minimum requirements of the confining system are a layered interval of low permeability rock formations and moderate permeability formations to dissipate excess pressure caused by CO_2 injection.

Rationale

Low permeability formations are needed to impede CO_2 migration and moderate permeability formations are needed to dissipate any excess pressure caused by CO_2 injection. Previously, the language was not clear that low permeability formation have one purpose and moderate permeability formations have another purpose, and that is why a layered interval of both types of formations is required. This amendment distinguishes the various purposes for the different formations to make clear to applicants why both types of formations are needed.

Section C.2.2 Risk Assessment

Purpose

The amendments require applicants to evaluate specific CO_2 leakage and seismicity risk scenarios using an industry-standard Features, Events, and Processes (FEP) methodology or an Executive Officer approved equivalent. Applicants must identify all reasonably anticipated scenarios, document the analysis, quantify cumulative leakage risk over 100 years post-injection, and describe how each risk will be managed or minimized. The risk classification table is expanded, with conservative assumptions required when qualitative methods are used. The amendments also explicitly link leakage quantification to demonstrating that the storage complex is very likely to retain over 99% of injected CO_2 for 100 years and incorporate the CCUS Program regulation's seismic risk assessment requirements. The Risk Management Plan is removed as it is no longer necessary.

Rationale

The previous requirements lacked a clear methodology and combined broad risk categories from the Emergency and Remedial Response Plan, making it difficult to quantify scenario-specific probabilities and consequences. The amendments resolve

this by specifying use of the FEP methodology and allowing alternative approaches only when they provide equivalent or better information. Refining the risk classification table to focus on CO_2 leakage and requiring conservative assumptions where data limit quantitative analysis ensures consistent, rigorous evaluations. Linking scenario analysis to the >90% likelihood of retaining >99% of CO_2 clarifies how operators must demonstrate permanence. Incorporating the CCUS Program regulation's seismic risk requirements aligns programs and reduces redundant reporting. The Risk Management Plan is removed because no enforceable provisions remained.

Section C.2.3 Geologic and Hydrogeologic Evaluation Requirements

Purpose

The proposed amendments reorganize section C.2.3 and add new requirements that streamline and clarify the section. The major changes to this section are related to reorganization of pre-existing provisions. Requirements specific to regional background information, site-specific characterization criteria, methodology and testing, and reporting are rearranged into separate sections with their own headings and subsection numbers. Changes were also made to incorporate more flexible testing method options, as well as to update the list of required geologic properties to match industry standard practices. Finally, new language and provisions were added related to the data, documentation, and analysis operators must submit in both Preliminary and Final GCS Site Certification applications in order for permanence to be evaluated.

Rationale

The Geologic and Hydrogeologic Evaluation previously contained repetitive and contradictory language that required operators to collect a broad swath of data and information for site characterization that was both vague and not standard industry practice. This placed an undue burden on the operator to collect data and information that was costly and unnecessary to site characterization. The proposed amendments clearly define the specific data and information that must be submitted with Permanence Certification applications in order for CARB to evaluate the following: whether the a specific site has the necessary geology to permanently store CO_2, the capability of the computational model to predict the plume boundary at 100 years post injection, the safety and efficacy of the planned operating procedures (i.e., injection pressures, volumes, and time period), whether well construction and corrective action properly account for the geology and proposed operating conditions of the site, and the ability of the proposed monitoring strategy to detect both subsurface and atmospheric leakage.

Section C.2.3.1 Formation Testing and Well Logging Program [deleted & relocated]

Purpose

The proposed amendments move the requirements in the Formation Testing and Well Logging Program and relocate them to new subsections within the revised section C.2.3.

Rationale

The requirements in these provisions are incorporated into new subsections that consolidate related requirements. The amendments are necessary to reduce redundancy and maintain consistency with other proposed amendments.

Section C.2.3.1 Regional Geologic Overview [new]

Purpose

The proposed amendments consolidate requirements specific to the regional geology. This includes regional geology and tectonics, structures, freshwater aquifers, seismic history, and natural resources.

Rationale

These amendments improve clarity and organization by relocating provisions for the regional geologic background that were previously intermixed with site-specific criteria and distributed across multiple subsections. This new section updates provisions related to regional geology to (1) remove superfluous site-specific criteria and (2) add language that clarifies provision for describing and depicting the basin's regional geology. Consolidating these elements and removing unnecessary requirements ensures that GCS operators can readily identify the minimum expectations for background information in support of the site characterization portion of their application.

Section C.2.3.2 Site Characterization Requirements [new]

Purpose

The proposed amendments consolidate all site-specific characterization criteria into a single section, organized by the storage complex, confining system, storage zone, and primary confining layer. The amendments update property requirements to align with current industry and scientific standards, remove overly prescriptive elements, and add flexibility for operators to collect data appropriate to their site. They also clarify how operators may submit existing or preliminary data to support their application and relocate interpretation-related topics to the Storage Complex Delineation section, where they more appropriately address site suitability for permanent CO_2 storage.

Rationale

These amendments provide operators with one consolidated set of criteria for site characterization. By decoupling required data and properties from specific methods, the revisions acknowledge that many properties can be derived through multiple approaches and allow operators to select methods appropriate for their site. Organizing criteria by formation ensures operators collect only relevant data, avoiding unnecessary or prescriptive requirements. The amendments further clarify when existing or preliminary data may be submitted, offering flexibility while maintaining data integrity. Relocating interpretation-related content to the Storage Complex Delineation section strengthens the logical structure of the Protocol and supports a clearer demonstration of

site suitability for CO_2 storage.

Section C.2.3.3 Formation and Well Testing Program [new]

Purpose

The proposed amendments consolidate all methodology-related requirements into a single section, streamline instructions for data collection and method selection, align terminology with industry standards, and increase flexibility by replacing overly specific well-testing requirements with broader transient well-testing provisions.

Rationale

These amendments simplify section C.2.3.3 by separating the requirements for sampling and data collection from the methods used to obtain them, recognizing that multiple techniques can determine the same geologic properties. Consolidating methodological provisions and updating terminology improves clarity and consistency, while broader transient well testing requirements give operators flexibility to choose the best methods appropriate for their site.

Section C.2.3.4 Formation and Well Testing Documentation Material [new]

Purpose

The proposed amendments reorganize and consolidate all requirements for documenting and describing the methods operators use to collect and process site-characterization data into a single section. The amendments also clarify what information belongs in the Plan and Final Report and add a new requirement for a Preliminary Report to be submitted with the Plan. Finally, the amendments introduce provisions that allow operators to reference material previously submitted with the Plan and Preliminary Report to reduce redundancy.

Rationale

The original Protocol did not clearly distinguish methodological and data-related information that should be included in the Plan versus the information that should be provided in the Final Report, resulting in confusion and repetitive submissions. The proposed amendments reorganize all method-documentation requirements into one location and provides clearly defined subsections for the Plan and the submission of preliminary findings, as well as a Final Report and supplementary materials. Finally, allowing operators to reference prior submissions streamlines the process and reduces duplication, improving clarity and efficiency for all applicants.

Section C.2.3.4(a) [new]

Purpose

The proposed amendments consolidate all requirements for documenting and describing methods used to collect and process site-characterization data into a single subsection. The amendments also add examples to illustrate the types of information,

documentation, and materials expected with each application, and add language that provides flexibility for operators to submit additional materials when demonstrating equivalency for alternative methods or results.

Rationale

The proposed amendments streamline requirements for operators to report their data collection and analysis methodologies and documentation by reorganizing the provisions in one location and ensuring they apply consistently to all methods. The addition of illustrative language helps to clarify the types of information and materials operators must provide, while new provisions for equivalency demonstrations allow operators to submit alternative supporting information not explicitly listed. Together, these changes improve clarity, consistency, and flexibility in how operators document and report methods used for site-characterization activities.

Section C.2.3.4.1 Formation and Well Testing Plan and Preliminary Report [new]

Purpose

The proposed amendments reorganize and consolidate requirements for the Formation and Well Testing Plan and Preliminary Report into a clear, structured section. The amendments streamline how operators document planned methods, describe testing approaches, and submit preliminary data and interpretations. The section also clarifies how operators may reference previously submitted information, identify challenges in planned data collection, and provide supporting documentation.

Rationale

In the original Protocol, data-collection provisions, method specifications, and reporting requirements were intermixed under the Formation and Well Testing Plan, with most reporting requirements placed in the requirements for a corresponding report. This structure created confusion, redundancy, and uncertainty about whether preliminary or existing data belonged in the regional evaluation, the Plan, or the Final Report.

Section C.2.3.4.1 resolves these issues by organizing Plan-related provisions into one coherent subsection, referencing the general requirements in C.2.3.4 to reduce duplication, and adding new provisions for describing anticipated data-collection challenges, submitting supporting documentation, summarizing prior site investigations, and providing preliminary results and interpretations. The section also clarifies how operators may reference information from the Plan within the Preliminary Report, improving efficiency and consistency.

Section C.2.3.4.2 Final Formation and Well Testing [new]

Purpose

The proposed amendments consolidate all requirements related to the final reporting of Formation and Well Testing activities into a single, coherent section. They clarify expectations for reporting completed methods, final data analyses, deviations from the

Plan, updated interpretations, and supporting documentation. The section also includes new language that allows operators to reference information previously submitted with the Plan and Preliminary Report.

Rationale

The original Protocol did not clearly distinguish what belonged in the Formation and Well Testing Plan versus the final report, resulting in confusion and repetitive submissions. Section C.2.3.4.2 reorganizes final-report requirements into a standalone structure aligned with the Plan, incorporates the general standards of section C.2.3.4, and adds new provisions requiring operators to identify deviations from the Plan, update results and interpretations with new data, and describe workarounds related to those deviations.

Allowing operators to reference previously submitted methodologies, documentation, and preliminary results reduces redundancy and improves clarity for both operators and reviewers. Overall, the section creates a more logical, efficient, and complete reporting framework that supports accurate and consistent site-characterization documentation.

Section C.2.3.4.3 Formation and Well Testing Supplementary Materials [new]

Purpose

The proposed amendments consolidate figure and supplemental-material requirements into one subsection, clarify expectations for supporting data and documentation, and streamline the volume of information submitted by limiting data to representative subsets where appropriate.

Rationale

The new subsection organizes all figure-related provisions so they apply broadly across data types and methodologies, recognizing that analyses may be derived from different data combinations. It also consolidates and updates requirements for supplemental materials and raw data needed to support an application. By limiting submissions to representative datasets and removing ambiguous or out-of-scope requirements, the amendments reduce review burden and increase clarity for operators.

Section C.2.4 Storage Complex Delineation [new]

Purpose

The proposed amendment removes “and Corrective Action” from the section title and other mentions within the section to clarify that the Storage Complex Delineation requirements are separate from the Corrective Action requirements. The Corrective Action requirements have been moved to a different section of the GCS Protocol (the new section C.2.5).

The amendments also establish the requirements that must be followed to delineate the storage complex, including a requirement for the storage complex to extend laterally

across the area in which CO_2 (free or dissolved phase) may migrate during injection and post-injection. The amendments also revise the record retention period to end with Executive Officer approval of site closure.

Rationale

Moving the Corrective Action requirements to their own section is not a substantive change. While Corrective Action is related to the Storage Complex Delineation, the two sections are distinct enough that separation is possible and useful for clarity.

Previously, it was not clear that the storage complex boundary must encompass the lateral area over which CO_2 may migrate during injection and post-injection, even though migration of CO_2 outside of the storage complex was always considered leakage. The amendments clarify this standard. The record retention period is also revised to maintain consistency with other requirements of the Protocol (see section C.1.1.3).

Section C.2.4.1 Computational Modeling Requirements

Purpose

The amendments clarify that computational modeling must demonstrate containment of the CO_2 plume throughout injection and the post-injection site care period. Models must incorporate geochemical inputs, distant parameters such as production or injection, and evaluate migration pathways through known faults, fractures, and artificial penetrations. Terminology is updated from “computer code” to “computational model”, third-party validation is removed, and the seismicity requirement is revised to require fracture-mechanics and fault-stability analysis rather than direct modeling of induced seismicity. Models must also be able to evaluate geochemical responses.

Rationale

The revisions clarify that plume containment must be assessed across the full area where CO_2 may migrate, reinforcing that movement outside the storage complex constitutes leakage. Incorporating geochemical information improves model fidelity by accounting for fluid–rock interactions and pressure-related behavior. Integrating distant parameters ensures boundary conditions reflect site-specific operating realities. Limiting required fault and fracture evaluation to known features acknowledges characterization limitations while ensuring identified pathways are analyzed. Updating terminology to “computational model” reflects the focus on the conceptual framework rather than code mechanics. Because induced seismicity cannot be directly modeled by current tools, replacing that requirement with fracture-mechanics and stability analysis provides a technically accurate method for assessing seismic risk.

Section C.2.4.2 Storage Complex Delineation using Computational Modeling Results

Purpose

The proposed amendments include a requirement that the modeling results that are submitted with the Preliminary GCS Site Certification application must include a prediction of the free-phase CO_2 plume extent and elevated pressure at five years after injection initiation and thereafter in time intervals over the lifetime of the site in intervals chosen by the GCS operator. The amendments also clarify that all parameter sensitivity analyses and model calibrations must be included when reporting the model results. The amendments also add “planned operation information” to the list of information that must be used to update the Storage Complex Delineation.

Rationale

Requiring predicted plume extent and elevated pressure at five years provides a clear early benchmark for comparing modeled and actual site behavior and gives operators time to adjust operations if deviations occur. Allowing operators to select subsequent time intervals offers flexibility to reflect site-specific conditions. Clarifying that all sensitivity analyses and model calibrations must be included ensures a complete basis for evaluating model performance.

Adding “planned operation information” ensures the Storage Complex Delineation reflects evolving operating conditions such as changes in injection rates, well counts, or completion intervals that are not captured by characterization or pre-injection testing data. Incorporating these parameters helps keep the delineation aligned with actual site development as closely as practicable.

Section C.2.4.3 Plume Extent Re-evaluation [new]

Purpose

The proposed amendments move the Plume Extent Re-evaluation section (previously C.2.4.4) to C.2.4.3 to be closer to the Storage Complex Delineation requirements. The amendments also clarify that the GCS operator is responsible for quantifying the amount of CO_2 leakage that occurred, but verification must occur pursuant to subsection D.1(c).

Rationale

These amendments group related sections together, since the Corrective Action requirements were moved to a different section.

Verification has a specific meaning in the GCS Protocol, namely that verification is done by a third-party that is accredited by CARB to verify reports for crediting purposes. The original language could be interpreted to mean that the GCS operator was the party responsible for verifying the amount of CO_2 leakage that occurred, which is incorrect. The amendments rectify this language to establish that the GCS operator is responsible

for quantifying the amount of CO_2 leakage, and the verification process is separate and will be done by the third-party verifiers.

Section C.2.4.3.1 Triggers for Plume Extent Re-evaluations Prior to the Next Scheduled Re-evaluation [new]

Purpose

The proposed amendments revise the criteria for unscheduled CO_2 plume extent re-evaluations related to earthquakes to refer to the yellow-light Traffic Light System (TLS) threshold or higher being triggered pursuant to subsection C.6.

Rationale

The proposed amendments are necessary to align the provision with the other edits related to the CCUS Program regulation.

Section C.2.5 Corrective Action Requirements [new]

Purpose

The amendments relocate the Corrective Action requirements into a standalone section organized in the order operators must follow. They clarify that all corrective action must be completed before Final GCS Site Certification and require both Class VI and non-Class VI operators to submit a Corrective Action Plan with their Preliminary GCS Site Certification application. The scope of wells subject to evaluation is narrowed to those that penetrate the storage complex within the surface projection of the storage complex. Operators must describe proposed corrective action methods and submit a Corrective Action Report that identifies all wells, includes a tabulation and map of their locations, provides supporting documentation, and attests that corrective action has been completed and approved by the appropriate authority. Associated requirements are revised to align with these changes.

Rationale

Reorganizing the section improves clarity without altering substantive requirements. Completing all corrective action before certification reduces leakage risk by ensuring all wells that intersect the storage complex are remediated prior to injection. Unlike shallow wells that do not penetrate the storage complex, deeper wells present meaningful leakage pathways; narrowing the identification requirement reduces unnecessary burden while preserving protective rigor. Requiring operators to describe corrective action methods enables CARB to assess their adequacy. Naming and clearly defining the Corrective Action Report improves transparency, and requiring maps of well locations supports evaluation of plume extent and monitoring design. Because other agencies regulate well abandonment, operators must attest to compliance with those authorities. Finally, actions triggered by re-evaluation are updated to reflect the revised structure of this section.

Section C.2.5.1 Casing Diagrams of Wells Penetrating the Confining System [deleted]

Purpose

The proposed amendments remove this section.

Rationale

Since CARB is relying on other relevant governmental authorities with jurisdiction over cementing/plugging and abandonment of wells, there is no need for CARB to receive the casing diagrams of wells that penetrate the confining system. Removing this requirement reduces the administrative burden on the GCS operator.

Section C.2.6 Baseline Testing and Monitoring [new]

Purpose

The proposed amendments incorporate the CCUS Program regulation's baseline seismicity monitoring and reporting requirements by reference. Certain terms are substituted to be consistent with the rest of the GCS Protocol requirements.

The proposed amendments also allow the Executive Officer to accept baseline testing and monitoring data that are collected for less than one year prior to the initiation of injection, provided the GCS operator can demonstrate to the satisfaction of the Executive Officer that the baseline data collection results from a shorter timeframe are equivalent to or more accurate than results from one year of data collection.

Rationale

SB 905 requires CARB to develop regulations for carbon capture and sequestration projects in California, including regulations regarding seismicity monitoring. CARB is establishing baseline seismicity monitoring requirements in alignment with the CCUS Program regardless of GCS site location to determine baseline seismicity at GCS sites. Establishing baseline seismicity for a GCS site prior to injection operations commencing is necessary to evaluate in the future whether detected seismic events are linked to CO_2 injection operations. Therefore, baseline seismicity requirements are necessary even for GCS sites with no or limited history of natural seismic activity.

Utilizing one year or more of data collection is appropriate for some monitoring methods, such as soil-gas monitoring, whose measured properties fluctuate depending on season, time of day, or other external factors. GCS operators also collect baseline data on subsurface properties, like reservoir fluid temperature and pressure, which are often static before initiation of injection operations. Collecting a year or more of data on these static properties is therefore not technically useful and places an unnecessary burden on GCS operators. The baseline data collection timeframe can reasonably be lowered for such data, as long as the GCS operator is able to demonstrate that the alternative timeline is appropriate to collect data that can be used to track the three-

dimensional extent of the CO_2 plume, history match the computational model, and compare to future readings during and after the operational phase of the site. This amendment streamlines the requirements of the GCS Protocol where appropriate while maintaining the purpose of the baseline testing and monitoring requirements.

Section C.3.1 Well Construction

Purpose

The amendments require operators to provide—rather than merely consider—the information listed in C.3.1(c)(1)(A)–(I) and C.3.1(d)(3)(A)–(G). They also allow operators to propose alternative long-string cementing methods when they can demonstrate that cementing to surface would compromise well or confining layer integrity. Any changes to casing, cement, tubing, or packer designs must be submitted in the Well Construction Report. Requirements for wellhead, valve, and piping design standards are removed. The amendments also add a requirement to run cement bond logs upon casing installation and include an interpretation of those results in the Well Construction Report.

Rationale

Requiring operators to submit the specified information resolves ambiguity around "considering" factors and allows CARB to evaluate well construction designs directly. Allowing alternative cementing methods increases flexibility while ensuring well and confining layer integrity remain protected. Clarifying that design changes must be submitted in the Well Construction Report ensures CARB receives complete and timely updates. Design standards for wellheads, valves, and piping are already regulated by other authorities, making duplicative requirements unnecessary. The cement bond log requirement is retained and relocated because it is essential for assessing cement integrity and was previously misplaced and misidentified. The correction ensures operators use the appropriate logging tool to evaluate the cement bond between the casing and borehole wall.

Section C.3.2 Pre-Injection Testing [deleted]

Purpose

This section is proposed to be deleted.

Rationale

The requirements of this section are either covered under the Formation and Well Testing section or moved to the Well Construction section. To remove duplicative requirements, this section needs to be deleted.

Section C.3.2 Injection Well Operating Requirements [new]

Purpose

The amendments replace "maximum anticipated surface injection pressure" with the standard term "maximum allowable surface pressure." They also require operators to

describe and quantify all fluids injected or produced at the GCS site, including the CO_2 stream. The numerical limit tied to fracture/parting pressure is removed, and operators must instead demonstrate that injection pressure will not initiate or propagate fractures, cause fluid movement outside the storage complex, or unacceptably increase induced-seismicity risk.

Rationale

Using “maximum allowable surface pressure” aligns with industry terminology and existing GCS Protocol usage. Relocating the requirement to describe injected and produced fluids reflects its operational nature rather than site characterization. Removing the fixed pressure limit provides flexibility where the previous 80-percent threshold may conflict with site-specific geologic conditions; operators must already demonstrate that injection pressures avoid fracturing, unintended fluid migration, and seismic risks, making a numerical cap unnecessary.

Section 3.3 Operating Restrictions and Incident Response [new]

Purpose

The proposed amendments removes a reference to crediting.

Rationale

To keep the GCS Protocol focused on the permanence of geologic storage, a reference to crediting was removed.

Section C.4.1. Testing and Monitoring

Purpose

The amendments relocate CO_2 stream sampling, analysis, and injection rate and volume monitoring requirements from C.4.1 to the new Section B, which governs injected CO_2 measurement. They reorder and streamline C.4.1(a) to align with the Protocol, ensure all subsections are represented, and simplify each testing and monitoring provision so it points directly to its corresponding subsection. Pressure fall-off tests are replaced with transient well testing to reflect a broader and more accurate set of applicable methods. The amendments also remove references to an obsolete quantification equation, eliminate requirements to quantify CO_2 emitted or sold to third parties, and remove the requirement to identify personnel performing monitoring activities.

Rationale

CO_2 composition and injectate measurement requirements relate to quantification, not emissions monitoring. Relocating them to Section B consolidates all injected CO_2 measurement provisions and improves clarity. Reordering C.4.1(a) and removing duplicative or outdated language streamlines the section without changing technical requirements. Allowing transient well testing makes the provision performance-based and better suited to varied site conditions. The deleted equation and third-party sales quantification requirements were specific to the LCFS and no longer fall within the GCS

Protocol's scope. Identifying individual personnel performing monitoring activities does not affect permanence or site suitability and removing that requirement reduces unnecessary administrative burden.

Section C.4.2 Mechanical Integrity Testing

Purpose

The amendments replace the broad term "any wells" with "injection, production, monitoring, and observation wells" to specify which wells must maintain mechanical integrity throughout operation, except during workovers. They also allow operators to propose alternative mechanical integrity testing methods or schedules when equivalency can be demonstrated. The requirement to notify the Executive Officer 30 days before testing is removed, as is the five-psi pressure gauge resolution requirement.

Rationale

Clarifying the well types aligns the provision with defined terminology and improves enforceability. Providing criteria for approving alternative test methods and schedules resolves ambiguity and supports performance-based flexibility. Because operators already notify their permitting authority of planned tests, a separate CARB notification is unnecessary and eliminates redundant burden. Finally, removing the pressure gauge resolution requirement reflects common industry equipment capabilities and avoids an impractical standard.

Section C.4.2.1 Reporting of Mechanical Integrity Tests

Purpose

The proposed amendments revise the reporting requirements of mechanical integrity tests to only be applicable for non-Class VI GCS operators.

Rationale

This amendment is in support of the creation of two separate pathways for application, one for Class VI GCS operators and one for non-Class VI GCS operators. Since non-Class VI GCS operators may not necessarily be required by their regulatory authority to submit the results of mechanical integrity tests annually, the GCS Protocol requires non-Class VI GCS operators to do this reporting to ensure that all GCS sites are held to the same standard as Class VI.

Section C.4.3 GCS Site Monitoring [renamed]

Purpose

The proposed amendments revise the requirements of the GCS site monitoring to reflect the changes made to move the quantification elements of the monitoring requirements from the Permanence portion of the GCS Protocol (section C) to the Quantification portion of the GCS Protocol (section B). The amendments also revise the recordkeeping requirements to align with other proposed amendments that establish the

recordkeeping period as up until the Executive Officer approves site closure.

Rationale

Consolidating the quantification elements of the monitoring requirements in one section (section B) improves the clarity of the GCS Protocol and helps GCS operators find relevant information more quickly. Revising the recordkeeping period improves the consistency of the GCS Protocol.

Section C.4.3.1 Injection Monitoring [renamed]

Purpose

The proposed amendments remove monitoring requirements related to Low Carbon Fuel Standard emissions accounting. The amendments also include a new minimum calibration schedule for metering equipment, such as fluid flow meters and fluid chemistry analyzers.

Rationale

Removing monitoring requirements related to Low Carbon Fuel Standard emissions accounting is necessary to ensure that the GCS Protocol can be used by prospective GCS operators regardless of their respective crediting pathways. Adding a minimum calibration schedule aligns with requirements in both the Low Carbon Fuel Standard and Mandatory Reporting Greenhouse Gas regulations, ensuring continuity across programs.

Section C.4.3.1.1 Analysis of the CO2 Stream [relocated & deleted]

Purpose

This amendment removes the CO_2 stream sampling and analysis requirements from under the CCS Project Emission Monitoring Section (C.4.3.1) to the new Section B, which covers the measurement and characterization of injected CO_2.

Rationale

The CO_2 stream analysis requirements specify how operators need to sample, characterize and report the properties of the injected CO_2. These activities are fundamental to establishing the composition and calculating the amount of injected CO_2. This section is not relevant for monitoring on-going project emissions. Relocating this requirement to Section B consolidates all the important information related to quantification of injected CO_2 in one place. The technical requirements are unchanged, but their placement is adjusted for clarity and consistency.

Section 4.3.1.2 Continuous Monitoring of Injection Rate and Volume [relocated & deleted]

Purpose

This amendment removes the continuous monitoring requirements for injection rate, volume, and composition from the CCS Project Emission Monitoring section and

relocates it as a new addition to Section B, addressing the measurement of injected CO_2.

Rationale

The requirements in Section C.4.3.1.2 describe how operators must measure and monitor flow rate, volume, and fluid composition to determine the cumulative amount of CO_2 injected. These activities support injectate quantification rather than broader project-level emission monitoring. Relocating these requirements to Section B consolidates all injected CO_2 measurement and accounting activities in one place, improves the internal organization of the GCS Protocol, and aligns with the shift toward a program-neutral structure. The technical requirements remain unchanged; only their placement is updated for clarity and consistency.

Section C.4.3.1.1 Continuous Monitoring of Injection Pressure [new]

Purpose

The proposed amendments create a new provision consolidating the requirements relating to continuous monitoring of injection pressure from the original subsection C.4.3(b)(1). The proposed amendments also clarify that continuous monitoring may be suspended during well workovers.

The amendments also create a distinction between Class VI GCS operators and non-Class VI GCS operators with regards to maximum injection pressure. Class VI GCS operators must ensure the injection pressure remains at or below their approved pressure as reviewed and approved by the appropriate governmental authority, while non-Class VI GCS operators must ensure that their injection pressure remains at or below the Executive Officer-approved injection pressure pursuant to subsection C.3.2(b).

Rationale

Consolidating requirements streamlines the GCS Protocol and improves readability for the audience. Continuous monitoring is not needed during well workovers because the well is not operating during workovers and there is no risk of the well exceeding its certified limits during that time.

Since Class VI operator’s injection pressure limits have been reviewed and approved by the EPA or primacy state agency in accordance with Class VI requirements, adherence to their limits is acceptable to meet the requirements of the GCS Protocol. Since non-Class VI operator’s injection pressure limits have not been approved against the Class VI standard, they must be subject to the requirements of the GCS Protocol.

Section C.4.3.1.2 Corrosion Monitoring and Casing Inspection [new]

Purpose

The proposed amendments consolidate requirements from the original subsection C.4.1(a)(3) relating to corrosion monitoring by moving them to this subsection. The

amendments also specify that the GCS operator may propose an alternative method for corrosion monitoring, provided that the GCS operator can demonstrate that the alternative method can provide results equivalent to or more accurate than the results from the methods listed in subsections C.4.3.1.2(b)(1) through (2).

Rationale

Consolidating requirements improves the clarity of the GCS Protocol for the reader. Without providing criteria upon which the Executive Officer can approve an alternative corrosion monitoring test, it is unclear to the GCS operator what makes an alternative test approvable.

Section C.4.3.1.3 Transient Well Testing [new]

Purpose

The proposed amendment changes the requirement for pressure fall-off testing to transient well testing. The amendments also allow the GCS operator to propose an alternative testing schedule, provided the operator can demonstrate to the satisfaction of the Executive Officer that the alternative schedule can provide results equivalent to or better than the results from testing at least once every five years. The amendments also remove requirements that are specific to using pressure fall-off tests, both in the requirements for the testing methodology and the reporting requirements.

Rationale

Changing pressure fall-off testing to transient well testing allows the GCS operator to choose the most appropriate well testing method for their site, rather than prescribe the use of only one type of testing method. A pressure fall-off test is classified as a pressure transient test, however, there is more than one type of transient test (e.g., drawdown, buildup, interference, pulse), any one of which may be the most appropriate for a site. All the transient well tests give equivalent results depending on well construction and purpose, as well as site geologic and hydrologic conditions. Without providing criteria upon which the Executive Officer an approve an alternative transient well test schedule, it is unclear to the GCS operator what makes an alternative schedule approvable.

Since a range of tests are allowed under the proposed amendments, the need for provisions relating to one specific test (i.e., pressure fall-off tests) are no longer necessary and can be removed.

Section C.4.3.1.4 Monitoring of Wellheads and Valves [new]

Purpose

The proposed amendments remove the specific requirement that the Inspection and Leak Detection Plan must be approved by the Executive Officer. The amendments also revise the bi-annual testing requirement to require testing at least once every six months. The amendments also remove the requirement that data collection from the Inspection and Leak Detection must be available for CARB review during the active life of the CCS project and replace it with a requirement to submit documentation of all

inspections, tests, and results collected pursuant to the Inspection and Leak Detection Plan to CARB annually. The amendments also clarify that testing for operational integrity must occur for subsurface equipment.

Rationale

Because Permanence Certification itself is approved by the Executive Officer, additional approval language is unnecessary and is removed. Clarifying “bi-annual” to “once every six months” eliminates ambiguity and provides operators with a precise testing interval. Annual submission of testing results aligns this section with the broader Testing and Monitoring reporting framework. Finally, because API Recommended Practice 14B governs subsurface safety-valve systems, the testing requirements must apply to subsurface—not surface—equipment, and the language is revised accordingly.

Section C.4.3.2 Containment Monitoring [renamed]

Purpose

The proposed amendments remove references to the Low Carbon Fuel Standard regulation and data related to emissions accounting under the regulation. The amendments also replace the term “Validate” with “Demonstrate”.

Rationale

References to measurement and verification data related to the Low Carbon Fuel Standard regulation and the regulation, itself, were removed to ensure that the GCS Protocol can be used by prospective GCS operators regardless of their respective crediting pathways. Replacing “validate” with “demonstrate” ensures that the requirement accurately reflects the intended obligation without implying the formal validation process described in the definition of “validation”.

Section C.4.3.2.1 Plume and Elevated Pressure-Tracking

Purpose

The amendments require operators to use one or more of the listed monitoring methods for tracking free-phase CO_2 or elevated pressure and allow the GCS operator to propose alternative approaches when equivalency is demonstrated. Reporting frequencies are standardized to annual submissions.

Rationale

Replacing “consider” with “use one or more of” ensures consistent application of scientifically supported monitoring methods, while establishing criteria for approving alternatives eliminates ambiguity. Annual reporting provides a uniform schedule that improves consistency, simplifies compliance, and aligns with broader monitoring and verification requirements.

Section C.4.3.2.2 Periodic Monitoring of Pressure and/or Composition Above the Storage Complex [new]

Purpose

The proposed amendments add a new section that expands upon the requirements for periodic monitoring of pressure and/or composition above the storage complex. The new section lists specific requirements for above-zone monitoring taken from original sections C.4.1(a)(4), C.4.1(a)(5) and C.4.1(a)(6), and includes reporting requirements consistent with those required by the other monitoring methods.

Rationale

Previously, the requirement for above-zone monitoring was mentioned in the GCS Protocol, but no specific requirements for methods or reporting were provided. GCS operators knew that it was required to monitor above the storage complex but were not given any information on how to monitor, how frequently to monitor, or how to report the results of such monitoring. This new section provides requirements for GCS operators to conduct monitoring and associated reporting related to above-zone monitoring.

Section C.4.3.2.3 Surface and Near Surface Monitoring [new]

Purpose

The amendments integrate the CCUS Program Regulation's surface and near-surface monitoring requirements into the GCS Protocol and remove provisions that conflict with or duplicate those standards. They also allow operators to propose alternative ecosystem stress monitoring methods when equivalent performance is demonstrated. In addition, operators must conduct soil and vadose-zone monitoring regardless of whether atmospheric CO_2 leakage indicators are present, and prescriptive lists of specific monitoring techniques are removed to streamline requirements.

Rationale

SB 905 directs CARB to adopt surface and near-surface monitoring requirements for carbon storage projects. CARB is establishing surface and near-surface CO_2 monitoring requirements in alignment with the CCUS Program regardless of project location to minimize risk of CO_2 leakage and loss of permanence. Aligning the GCS Protocol with the CCUS Program regulation's provisions ensures consistency across programs and reduces duplicative regulatory expectations. Allowing alternative ecosystem stress monitoring methods recognizes that vegetation surveys may be unsuitable at some sites and supports scientifically justified flexibility. Requiring soil and vadose-zone monitoring at all sites increases the likelihood of early leakage detection, whereas leaving this monitoring conditional could result in missed or delayed identification of leakage pathways. Removing prescriptive method lists streamlines the Protocol and maintains a performance-based approach while preserving necessary rigor.

Section C.4.3.2.4 Seismicity Monitoring [new]

Purpose

The proposed amendments revise the seismicity monitoring requirements to incorporate requirements that will be adopted under the CCUS Program regulation. Some regulations are incorporated by reference.

Rationale

SB 905 requires CARB to develop regulations for carbon capture and sequestration projects in California, including regulations regarding seismicity monitoring. To create consistency and alignment with similar programs, staff propose incorporating the CCUS Program regulation's seismicity monitoring requirements.

Section C.4.3.2.4 Verification [relocated & deleted]

Purpose

The proposed amendments remove this section as verification requirements have been moved to section D of the GCS Protocol.

Rationale

Moving requirements to other locations is non-substantive and is needed to improve clarity of the GCS Protocol.

Section C.5.1 Well Plugging and Abandonment

Purpose

The amendments revise the timeframe for updating the Well Plugging and Abandonment Plan so that updates are required only until all wells at the GCS site are plugged. They also require operators to explain rather than simply consider the information in subsections C.5.1(e)(1) through (4). In addition, operators must use the operational and monitoring history of the site when determining whether amendments to the original plan are warranted and must demonstrate this evaluation using the information detailed in subsections C.5.1(g)(1) through (4).

Rationale

The Well Plugging and Abandonment Plan is only needed until the last well is plugged. Therefore, "until all wells are plugged" is used as the defining timeframe.

The word "consider" is vague and does not accurately convey the need for the GCS operator to explain how the information in subsections C.5.1(e)(1) through (4) was taken into account when designing the Well Plugging and Abandonment Plan. Without this amendment, it is not clear to the GCS operator that CARB expects the GCS operator to explain how this information factors into their design of the Well Plugging and Abandonment Plan.

The original Well Plugging and Abandonment Plan is developed and approved before operations commence at the GCS site. While best efforts are made to account for operational expectations in the Well Plugging and Abandonment Plan, operational and monitoring history of the GCS site must be taken into account when considering whether to revise the Well Plugging and Abandonment Plan.

Section C.5.2 Post-Injection Site Care and Site Closure

Purpose

The amendments add post-injection seismicity monitoring requirements consistent with the CCUS Program regulation. They replace “CCS project wells” with “monitoring wells” and clarify that these wells must be abandoned after plume stabilization. The amendments also require operators seeking to use aerial leak-detection technologies to demonstrate that such methods perform at least as well as ground-based approaches. Provisions requiring verification of leak detection methods are removed, as are references to Executive Officer direction for site restoration and post-closure record retention requirements beyond CARB’s authority.

Rationale

Integrating the CCUS Program regulation’s seismicity monitoring requirements ensures consistency with SB 905 mandates. Because all other wells must already be plugged prior to plume stabilization, only monitoring wells remain; requiring their abandonment reduces the risk of upward CO_2 migration once subsurface conditions stabilize. Specifying Executive Officer approval criteria for aerial monitoring clarifies expectations for alternative technologies. Verification language is removed because containment monitoring methods are already verified through the third-party permanence verification process. References implying discretionary direction from the Executive Officer are unnecessary, as restoration is always required, and record retention obligations beyond site closure exceed CARB’s enforceable authority.

Section C.6 Emergency and Remedial Response

Purpose

The proposed amendments incorporate the CCUS Program regulation’s Emergency and Remedial Response requirements by reference into this section.

Rationale

SB 905 requires CARB to develop regulations for carbon capture and sequestration projects in California, including regulations regarding emergency and remedial response. CARB is establishing emergency and remedial response requirements in alignment with the CCUS Program regardless of GCS site location to minimize risks of CO_2 leakage and loss of permanence and to ensure protection of human health and the environment. Aligning the GCS Protocol requirements with the CCUS Program also ensures consistency between similar programs and avoids potential overlap or duplication of requirements.

Section C.6.1 Emergency and Remedial Response Requirements [removed]

Purpose

The proposed amendments remove this section.

Rationale

All of the Emergency and Remedial Response requirements (referenced from the CCUS Program regulation) are now in section C.6. This section (C.6.1) is no longer required and therefore is removed.

Section C.7 Financial Responsibility

Purpose

The proposed amendments incorporate the CCUS Program regulation's Financial Responsibility requirements by reference into this section for Class VI GCS operators.

Rationale

SB 905 requires CARB to develop regulations for carbon capture and sequestration projects in California, including regulations regarding financial responsibility. To create consistency and alignment between similar programs, staff propose adopting the CCUS Program regulation's financial responsibility requirements by reference for Class VI GCS operators. The CCUS Program's financial responsibility regulations rely on the GCS operator having obtained EPA-approved financial instruments under the Class VI program. Because non-Class VI GCS operators will not have EPA-approved financial instruments under the Class VI program, non-Class VI GCS operators must follow the existing financial responsibility requirements under subsections C.7(b) through (h) of the GCS Protocol. These requirements are aligned with the CCUS Program's financial responsibility regulations to ensure that all GCS operators are held to the same financial responsibility standard.

Section C.8 Modification or Revocation and Reissuance of Permanence Certification

Purpose

The proposed amendments revise the public comment process to be consistent with the procedures outlined in subsection C.1.1(b) for reviewing and addressing public comments.

Rationale

Aligning requirements in different sections of the GCS Protocol improves clarity and consistency.

Section C.8.2 Minor Modification of Permanence Certifications

Purpose

The proposed amendments add “well” as a modifier to the construction requirements.

Rationale

The proposed amendment states that it is specifically changes in well construction requirements that would be considered a minor modification of Permanence Certifications. Other types of construction could occur with the GCS project, therefore it is necessary to specify well construction requirements in this provision.

Section C.9 Legal Understanding, Contracts, and Post-Closure Care

Purpose

The proposed amendments require the GCS operator to provide an attestation that they are in compliance with the applicable laws or regulations governing pore space rights for storing injected CO_2 for their site. If no applicable laws exist, or if applicable laws or regulations do not cover the entirety of the pore space to be used for CO_2 storage, then the GCS operator must show proof of exclusive right to use the pore space in the storage zone within the storage complex for permanently storing CO_2.

Rationale

GCS operators must comply with the applicable laws or regulations that govern their GCS site in order to operate. Recognizing this, the amendments allow the GCS operator to attest that they are in compliance with the applicable laws or regulations regarding pore space rights for storing injected CO_2 in lieu of requiring demonstration of exclusive right to use the pore space in the storage zone within the storage complex. The proposed amendments require that applicable laws or regulations cover the entirety of the pore space to be used for CO_2 storage to ensure that all pore space owners are covered by an applicable law or regulation. Otherwise, the GCS operator must show proof of exclusive right to use the pore space in the storage zone within the storage complex for permanently storing CO_2.

SECTION D VERIFICATION [NEW]

Purpose

The proposed amendments create a new section specific to verification requirements, section D. The requirements that were in the original subsection C.4.3.2.4 were moved to this section and expanded upon, including specifying an annual verification date.

The proposed amendments require verifiers to review specific data, reports, and information and determine whether the GCS operator has complied with the respective GCS Protocol requirements, and whether there is an explanation for any deviations from the requirements. The amendments also require the verifier to assess whether the data indicates a need to revise any GCS Protocol Permanence Certification plan to ensure permanence and the continued protection of public health and the environment

and provide justification for any recommended changes.

Rationale

Moving requirements from one location to another is non-substantive. The addition of an annual verification date is needed to standardize the requirement for all GCS operators and align with requirements in other programs. The amendments give the operator clear instructions on what information must be submitted for the verifier's review. This change was made to improve clarity and usability of the GCS Protocol by explicitly outlining the operator's responsibilities, thereby supporting a more consistent and complete verification process.

As the GCS sites operate, additional data may become available over time and previously approved plans, modeling, risk assessments, conditions, or performance may need to be changed. Thus the verifier must evaluate any updates to ensure that permanence is maintained, which will continue to protect public health and the environment by identifying any risks or issues.

Appendices A through F [deleted]

Purpose

The proposed amendment removes the appendices related to quantification of GHG emissions in the life cycle assessment.

Rationale

Appendices A through F contain calculation methods for GHG emissions quantification, including CO_2 venting and fugitive emissions, unit conversions, data measurement/generation, reporting for energy and chemical inputs, emission factors, and component counts and risk rating and its contribution to buffer account. Since the main quantification section (Section B) is being proposed to be removed from the GCS Protocol and added to the LCFS regulation, the supporting information provided in Appendices A through F also needs to be deleted. This ensures the document remains internally consistent.

Appendix A [renamed from Appendix G]

Purpose

This amendment revises Appendix A by updating the appendix number and title, replacing LCFS-specific terminology with program-neutral language, and adjusting the risk rating values. The purpose is to ensure that Appendix A can be applied across different market-based programs and to establish a more conservative and protective risk-rating framework.

Rationale

The original Appendix G was developed specifically for the LCFS and relied on LCFS specific terminology, structures, and contribution levels that are not suitable for a

program-neutral GCS protocol. Updating the language to apply to any program broadens usability.

IV. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal for the Greenhouse Gas Quantification Methodology for Carbon Capture and Sequestration under the Low Carbon Fuel Standard

Global Changes throughout the Proposed Amendments

The proposed global changes in this section are minor updates that do not alter current requirements under the GCS Protocol.

Section Renumbering

Purpose

Many subsections of the Proposed Amendments are renumbered to reflect the addition or deletion of other subsections. These subsection numbering changes are denoted in subsection headings throughout this document. A subsection heading denoted as “new” reflects how it is numbered under the Proposed Amendments. Subdivisions of the LCFS CCS QM are termed “chapters” rather than “sections.”

Rationale

Section numbering changes are non-substantive and are needed to maintain consistent organization of regulatory requirements under the Proposed Amendments. Adoptiong the term “chapter” is to remain consistent with other market-based programs in California.

Rename Carbon Capture and Sequestration Protocol Under the Low Carbon Fuel Standard to Greenhouse Gas Quantification Methodology for Carbon Capture and Sequestration under the Low Carbon Fuel Standard (LCFS CCS QM) and GCS Protocol as appropriate

Purpose

The proposed amendments change the name of the “Carbon Capture and Sequestration (CCS) Protocol” to “Greenhouse Gas Quantification Methodology for Carbon Capture and Sequestration under the Low Carbon Fuel Standard.” These amendments also align with the transition of the CCS Protocol into the separate GCS Protocol and LCFS CCS QM.

Rationale

Renaming the CCS Protocol is non-substantive and is needed to maintain organization for future regulatory requirements. This change ensures that this terminology is applied consistently throughout the proposed amendments.

Replace applicable usage of “CCS Project” and all “Sequestration and storage site” with GCS Site

Purpose

The proposed amendments change all “Sequestration and storage site” and certain applicable uses of “CCS Project” to “GCS site.”

Rationale

This change is necessary to more precisely indicate that the activities occurring at the sequestration and storage site fall within the definition of a GCS site under the GCS Protocol. Eligible entities are required to follow the requirements outlined in the GCS Protocol for CO2 sequestration, injection, and storage. The LCFS CCS QM does not establish requirements for GCS site activities. As a result, all instances of “Sequestration and storage site” and certain applicable uses of “CCS Project,” which includes carbon capture and transport operations in addition to carbon sequestration operations at the GCS site, are replaced with “GCS site.”

Correcting Cross-references

Purpose

Cross-references need to be amended to either rectify incorrect cross-references or update cross-references due to renumbering of provisions as a result of the proposed amendments.

Rationale

Cross-reference changes are non-substantive and are needed to maintain consistent organization of regulatory requirements under the Proposed Amendments.

Correcting Grammatical and Typographical Errors

Purpose

Grammatical and typographical errors need to be corrected to improve readability of the CCS Protocol requirements.

Rationale

Correcting grammatical and typographical errors is non-substantive and is needed to improve readability of CCS Protocol requirements.

Reorganization

Purpose

Various sections and provisions of the CCS Protocol are reorganized without changing the language of the requirements.

Rationale

Reorganizing the LCFS CCS QM provisions is non-substantive and is needed to assist CCS project operators with organizing their information.

Chapter 1. Applicability and Definitions

Chapter 1.1 Applicability

Chapter 1.1(a)

Purpose

The proposed amendments specify that CCS projects must meet the permanence certification under the GCS Protocol and follow the requirements of the LCFS CCS QM and the LCFS regulation in order to be eligible to generate LCFS credits.

Rationale

This change is necessary because of the separation of the GSC Protocol and to establish that the CCS projects must follow the requirements in the LCFS CCS QM as well as the GCS Protocol and the LCFS regulations.

Chapter 1.1(b)

Purpose

The proposed amendments specify the actions that are required to be considered a CCS Project

Rationale

This change is necessary to specify the actions that are covered by the LCFS CCS QM.

Chapter 1.2 Definitions

Chapter 1.2(a)

Purpose

The proposed amendments specify the listed definitions apply

Rationale

This change is necessary to clarify which definitions apply to the LCFS CCS QM

Multiple-definitions [deleted]

"Active life"

"Aqueous diffusion coefficient"

"Artificial penetration"

"Assets"

“Biogenic CO_2”

“Borehole”

“Bottom hole pressure”

“Brittleness”

“Capillary pressure”

“Capillary entry pressure”

“Capture Facility Operator”

“Carbon intensity”

“Casing”

“Casing inspection logs (CIL)”

“Casing shoe”

“CCS capture facility”

“CO_2 plume”

“CO_2 separation”

“Completing interval”

“Computational model”

“Confining pressure”

“Confining system”

“Constitutive relationships”

“Corporate parent”

“Corporate action”

”Corrosion”

“Corrosion coupons”

“Corrosion loops”

“Current assets”

“Current liabilities”

“Darcy’s law”

“Depositional environment”

“Deviated well”

“Dissipation interval”

“Downhole measurement”

“Ductility”

“Elevated pressure”

“Embodied GHG”

“Equations of state”

“Fluid”

“Fluid pressure”

“Formation compressibility”

“Fracture pressure”

“Fracture gradient”

“Free phase CO2 plume”

“Freshwater aquifer”

“Geographic location”

“Geologic carbon sequestration (GCS)”

“Geologic formation”

“Geochemical analysis”

“Governing equation”

“Hydraulic conductivity”

“Hydraulic head”

“Injectivity”

“Isopach map”

“Leak off test”

“Liner”

“Lithofacies”

“Lithology”

“Lithostatic stress”

“Mechanical integrity”

“Mechanical integrity test”

“Microannuli”

“Model domain”

“Model parameter”

“Microphase flow”

“Net worth”

“New working capital”

“Permeability”

“Petrophysical analysis”

“Plume stabilization”

“Pore pressure”

“Pore space”

“Porosity”

“Post injection site care”

“Post injection site care and monitoring period”

“Precipitation kinetics”

“Pressure fall off test”

“Project GHG emissions”

“Pump test”

“Reactive transport model”

“Relative permeability”

“Rock compressibility”

“Sequestration and storage site”

“Site closure”

“Sequestration zone”

“Skin factor”

“Specific storage”

“Step rate test”

“Stratigraphic test well”

“Storage coefficient”

“Stratigraphy””

“Supercritical CO2”

“System boundary”

“Tangible net worth”

“Total dissolved solids (TDS)”

“Transmissibility”

“Transmissive fault or fracture”

“True stratigraphic thickness”

“True vertical depth”

“True vertical thickness”

“Tubing”

“Unconfined compressive stress”

“Vadose zone”

“Validation”

“Verification”

“Vertical stress”

“Viscosity”

“Well”

“Wireline”

“Workover”

Purpose

The proposed amendments removed definitions from the LCFS CCS QM

Rationale

These amendments are necessary because these definitions are no longer applicable to the LCFS CCS QM because that were either used for the permanence certification which is now the separate GCS Protocol or other changes made them no longer necessary for the LCFS CCS QM.

“Atmospheric CO2 leakage” definition

Purpose

The definition of “Atmospheric CO_2 leakage” is extracted from the original definition of "CO_2 leakage” and added as a standalone term.

Rationale

Separating this definition improves clarity and ensures the accuracy of the revised “CO_2 leakage” definition.

“Brine” definition

Purpose

The definition of “brine” is amended to define brine as water containing dissolved solids in excess of 10 grams per liter.

Rationale

Freshwater is defined as water containing fewer than 10 grams per liter total dissolved solids, per the U.S. EPA Safe Drinking Water Act. The previous definition of brine was defined as water containing dissolved solids in excess of 100 grams per liter. With that definition, water with a total dissolved solids level between 10 grams and 100 grams per liter was undefined. Amending the definition of brine to start at 10 grams per liter removes that undefined range.

“Carbon Capture and sequestration (CCS)” definition

Purpose

The definition of “Carbon Capture and Sequestration” is amended to align with the LCFS CCS QM requirements

Rationale

The amended definition is more closely aligned with what is applicable under the LCFS CCS QM.

“Carbon dioxide equivalent” definition

Purpose

The definition of “Carbon dioxide equivalent” is amended to align with the LCFS CCS QM requirements

Rationale

The amendments are necessary to refer to the current LCFS CCS QM instead of the previous LCFS CCS Protocol.

“CCS Project” definition

Purpose

The definition of “CCS Project” is amended to clearly identify all activities that define the CCS Project

Rationale

The amendments are necessary to specify that transportation is also included in the project and to use an acronym for geologic carbon sequestration site.

“CCS Project GHG emissions” definition

Purpose

The definition of “CCS Project GHG emissions” was amended to specify that identified GHG emission from the CCS Project make up the CCS Project GHG emissions.

Rationale

The addition of this definition is necessary to specify which emissions are included in the CCS Project GHG emissions.

“CCS Project Operator” definition

Purpose

The definition of “CCS Project Operator” was amended to specify which CCS Project activities the operator is responsible for.

Rationale

The amendments are necessary to specify that the CCS Project Operator is required for CCS Project operations and conformance with the LCFS regulation and GCS Protocol.

“CO2 leakage” definition

Purpose

The definition of “CO_2 leakage” is amended to establish that any movement of stored CO_2 out of the storage complex, as defined under a site’s approved permanence certification and consistent with GCS Protocol is considered as a CO_2 leakage. Definitions of “Atmospheric leakage” and “Subsurface leakage,” previously embedded within the original definition of “CO_2 leakage,” are extracted and added as separate definitions.

Rationale

Movement of stored CO_2 that exits the intended storage zone but remains within the certified storage complex is not considered leakage. The definition is amended to clarify this distinction.

“CO2 stream” Definition

Purpose

The definition of “CO_2 stream” is amended to include CO_2 that has been captured from ambient air and to place a condition on incidental associated substances that may be in the stream.

Rationale

CO_2 may come from point sources (e.g., power plants) or may come directly from ambient air through direct air capture. To not exclude CO_2 captured through direct air

capture, “or ambient air” is included in the definition. Additionally, while it is likely that incidental associated substances derived from the source materials and the capture process would be included in the CO_2 stream, that may not always be the case. As such, the definition is amended to establish that such incidental substances may be included, but do not have to be a part of the CO_2 stream

“CO2 supplier” definition

Purpose

The proposed amendments add the new definition “CO2 supplier.”

Rationale

The term “CO2 supplier” was used in the LCFS CCS QM without previously being defined. The proposed amendments address the issue by adding the definition.

“Depleted oil and gas reservoir” definition

Purpose

The definition of “depleted oil and gas reservoirs” is amended to use the singular rather than plural. “With” is changed to “using” for precision.

Rationale

Since this term is used in the singular in the LCFS CCS QM, the singular form should be defined. “Using” is a more specific term than “with” and improves the clarity of the definition.

“Fugitive emissions” definition

Purpose

The definition of “fugitive emissions” is amended to fix a typographical error.

Rationale

The phrase “from surface equipment such as” was inadvertently left out of the previous definition.

“GCS site” definition

Purpose

A new definition for “GCS site” is added to replace the deleted definition of “Sequestration and storage site.” The definition establishes that the site refers to the geologic carbon storage site in the subsurface and any surface facilities or infrastructure necessary to inject into the subsurface and monitor to ensure permanent storage of injected CO_2.

Rationale

The LCFS CCS QM is focused on the accounting methodology, while permanence

certification previously handled under the original CCS Protocol is now governed by the GCS Protocol. The GCS Protocol defines the “GCS site,” which receives the permanence certification, and establish this definition narrowly to clarify the applicable requirements to the subsurface storage complex and any necessary surface facilities or infrastructure related to injecting and monitoring CO_2. Therefore, LCFS CCS QM continues to use this term to refer to the sequestration and storage site for consistency with the GCS Protocol and to maintain the principle that regulations governing sequestration and storage sites are stipulated exclusively under the GCS Protocol.

“Greenhouse gas emissions reductions” definition

Purpose

The definition of “Greenhouse gas emissions reductions” is amended to make it more specific to the LCFS CCS QM

Rationale

The previous definition of greenhouse gas emissions reductions was a more broadly applicable definition it is modified to be more specific to the LCFS CCS QM.

“Low Carbon Fuel Standard Regulation” definition

Purpose

The proposed amendments add the new definition “Low Carbon Fuel Standard Regulation.”

Rationale

The definition is necessary to cite the legal version of the LCFS regulation.

“Permanent storage” or “Permanence” definition

Purpose

The term “Permanent sequestration” is revised to “Permanent storage,” and the definition is clarified to specify that the at least 100-year permanence period begins after completion of injection, as demonstrated through permanence certification under the GCS Protocol.

Rationale

The proposed amendment to maintain consistency with the GCS Protocol.

“Storage complex” Definition

Purpose

The proposed amendments revise the definition of “storage complex” to clarify which distinct layers which make up the storage complex and removes that characterization, monitoring and corrective action. The proposed amendments also remove sub-definitions (A through C).

Rationale

The original definition of storage complex did not actually identify which layers or formations make up the storage complex; therefore, the layers are added to the definition. The deleted portions of the definition were removed because those described requirements for the GCS operator to fulfill when applying for Permanence Certification rather than defining the storage complex.

“Subsurface CO2 leakage” definition

Purpose

The definition of “Subsurface CO_2 leakage” is extracted from the original definition of "CO_2 leakage” and added as a standalone term.

Rationale

Separating this definition improves clarity and ensures the accuracy of the revised “CO_2 leakage” definition.

Chapter 1.2(b) Acronyms

Multiple acronyms [deleted]

“API”

“APCD”

“AQMD”

“ASTM”

“CARB”

“CERCLA”

“CAA”

“CWA”

“CIL”

“CO_2(aq)”

“CO_2(g)”

“DOGGR”

“GPS”

“NESHAPS”

“NPDES”

“PSD”

“PSI”

“RCRA”

“SDWA”

“SIC”

“TDS”

“TOC”

“US EPA UIC”

Purpose

The proposed amendments removed acronyms from the LCFS CCS QM

Rationale

These amendments are necessary because these acronyms are no longer applicable to the LCFS CCS QM because that were either used for the permanence certification which is now the separate GCS Protocol or other changes made them no longer necessary for the LCFS CCS QM.

“CA-GREET” acronym

Purpose

The “CA-GREET” acronym is amended to include the correct reference.

Rationale

The amendment corrects a previous incorrect reference by specifying the California version.

“LCFS” acronym

Purpose

The LCFS” acronym is modified to add the acronym for California Code of Regulation

Rationale

The amendments make the reference consistent which how the LCFS regulation is typically cited.

Chapter 2 GHG Quantification Requirements for CCS Projects [new]

Purpose

The proposed amendments add a new chapter with additions and modifications to the text from the previous section B. Accounting Requirements for CCS Projects Under the LCFS.

Rationale

The new text clearly identifies that the Methodology established the requirements for all calculations.

Chapter 2.1 GHG Quantification Requirements

Chapter 2.1(a)

Purpose

The proposed amendments add requirements for all SRS to be identified and quantified. Metered data and equations in the QM must be used as required.

Rational

All methods for quantification of GHG emissions reductions as a result of CCS must be accurately quantified using standardized methodologies.

Chapter 2.1(b)

Purpose

The proposed amendments identify the values that must be reported for each reporting period.

Rationale

This standardizes the values that must be quantified and reported for all projects. The reporting can occur quarterly or annually as allowed by the LCFS regulation.

Chapter 2.1(c)

Purpose

The amendments specify that reporting must be consistent with the LCFS requirements and the version of CA-GREET referenced in the LCFS must be used.

Rationale

Ties LCFS CCS QM reporting to the project reporting under the LCFS, and identifies the source for all emissions factors and global warming potentials

Chapter 2.1(d)

Purpose

The amendment specifies the requirements for monitoring, verification, and auditing of parameters.

Rationale

Accounting conducted under the LCFS CCS QM is not exempt from compliance with LCFS regulations. All parameters used must be monitored, verified, and made available for audit.

Chapter 2.2 Project Boundary

Chapter 2.2(a)

Purpose

The amendments modify the language in section B.1. System Boundary of the original CCS Protocol to align with the new terminology used in the LCFS CCS QM.

Rationale

The revised LCFS CCS QM uses the term “project boundary” rather than the term “system boundary” and refers to calculations as quantification rather than accounting.

Chapter 2.2(b)

Purpose

The amendments identify the broad activities that are part of the system boundary.

Rationale

Emissions from all these activities are necessary to quantify the net GHG emissions reductions as a result of the CCS project.

Chapter 2.2(c)

Purpose

These amendments list out all the SSRs identified in Figures 1 and 2.

Rationale

To reinforce the minimum SSRs that must be included in the project boundary it is necessary to list in the text what is included in Figures 1 and 2.

Chapter 2.2(d)

Purpose

These amendments identify where the emissions factors for certain calculating can be found and what to do if one is not available.

Rationale

These amendments provide clarity and consistency for using the same emissions factors for all projects and calculations as much as possible. If in a rare instance one does not exist in the provided documentation, CARB may approve an emission factor.

Chapter 2.2(e)

Purpose

The amendments modify the existing language for ease of reading and clarity.

Rationale

The terminology is modified to be consistent with the new LCFS CCS QM and make is easier for stakeholders to read.

Chapter 2.2(f)

Purpose

The amendments modify the existing language for ease of reading and clarity.

Rationale

The terminology is modified to be consistent with the new LCFS CCS QM and make is easier for stakeholders to read.

Chapter 2.2(g)

Purpose

The amendments identify that in order to be considered sequestered CO2 must remain in the storage complex or it must be quantified as leakage

Rationale

Any CO2 that is no longer permanently sequestered must be quantified as leakage to accurately reflect net GHG emissions reductions under the LCFS CCS QM.

Chapter 2.2(h)

Purpose

These amendments specify that only SSRs included in the project boundary as defined by the LCFS CCS QM may be included

Rationale

These amendments provide clarity and consistency in the project boundary across all projects when quantifying net GHG emissions reductions. All projects should use the same project boundary.

Chapter 2 Figures 1 and 2

Purpose

Figures 1 and 2 are illustrative of the project boundary defined in Chapter 2.

Rationale

These figures are modified to be consistent with the SSRs identified in Chapter 2 and the calculation used in Chapter 3 and reflect the removal of the “Embodied GHG” definition that necessitating updating the project boundary illustration figures.

Chapter 3 Quantification of CCS Project Emissions Reductions

Purpose

The amendments to previous Section B.2. Quantification of Geologic Sequestration CO_2 Emissions Reductions identify this chapter is for quantifying net GHG emissions reductions from CCS in depleted oil and gas or saline reservoirs and by EOR.

Rationale

Changes from section to chapter are due to reformatting, and the addition of EOR, which was inadvertently left out, clearly identifies it as an approved activity as EOR is already included in other sections/chapters of the methodology.

Chapter 3.1 Covered Greenhouse Gas Emissions for GHG accounting

Purpose

The amendments identify the GHGs required to be considered in the emissions calculations.

Rationale

This is the text from previous section B.2.1 broken out into new chapter formatting with nonsubstantive changes.

Chapter 3.2 Greenhouse Gas Emissions Calculations

Purpose

The amendments change the title to more accurately reflect the topic of the chapter and then note adds clarification on the units used for reporting. This clarification results in removing the term “annual” from “annual GHG emissions reduction” and similar terminology throughout the rest of the LCFS CCS QM.

Rationale

The calculations in this chapter are both emissions reductions and emissions resulting in net emissions reduction, and it is important to identify that according to the LCFS regulation project reporting can occur on either a quarterly or annual basis and the LCFS CCS QM reporting must occur on the same timeframe as the LCFS project so the units are either per quarter or per year.

Chapter 3.2 (a) & (b)

No substantive changes from section 2.2(a) only removal of the term annual to account for the two potential reporting periods, reformatting of the equations for aesthetic purposes and the division into two subchapters (a) and (b).

Chapter 3.2(c)

No substantive changes from section 2.2(b) only relettering, cross-reference corrections and aesthetic changes.

Chapter 3.2 (d)

Purpose

The amendments explain when land use changes must be considered and relocate this text from the previous section B.2.2(f) of the CCS Protocol closer to chapter 3.2(d) of LCFS CCS QM.

Rationale

The existing equation included a land use change value with the explanation of the variable located in section B.2.2(f). The amended text moves previous section B.2.2(f) closer in proximity to the relevant variable and equation.

Chapter 3.2(e), (f), (g), (h), and (i)

This is previously part of section B.2.2(c). The unlettered paragraphs under equation 3 were lettered as chapter 3.2(e), 3.2(f), 3.2(g), 3.2(h) and 3.2(i). No substantive changes were made, only modification to clarify the language. The term embodied GHG emissions, had been changed to GHG emission, it does not change the meaning of the term. The equation is reformatted in a more ascetic manner.

Chapter 3.2(j). (k), and (l)

This is previously part of section B.2.2(d). The unlettered paragraphs below equation 4 were lettered as chapter 3.2(j), 3.2(k), and 3.2(i). No substantive changes were made, only modification to clarify the language. The term embodied GHG emissions, is changed to GHG emission, it does not change the meaning of the term. The equation is reformatted in a more ascetic manner.

Chapter 3.2(m)

No substantiative changes from first paragraph of section 2.2(e)

Chapter 3.2(n), (o), (p), (q), (r), (s), (t), and (u)

No substantive changes from section B.2.2(e). only relettering, removal of the term embodied, inclusion of the term “GHG pressure” in Equation 6 which is a previously identified variable but inadvertently left out of Equation 6, and correcting internal and external references.

Section B.2.2 (f) is relocated to Chapter 3.2(d)

Chapter 3.2(v)

No substantiative changes

Chapter 3.3 Invalidation and Buffer Account

Chapter 3.3(a)

No substantiative changes, only minor grammatical changes from section 3(a)

Chapter 3.3(b)

Purpose

The amendments identify how the number of invalidated LCFS credits will be calculated.

Rationale

Due to the separation of the permanence certification in the GSC Protocol from the LCFS credit calculations which are included in the LCFS CCS QM it is necessary to state that CO2 leakage must be calculated according to the separate GCS Protocol.

Chapter 3.3(c)

Purpose

The amendments specify the specific section by which CCS projects can apply for LCFS credits.

Rationale

The specific LCFS section references clarify the nexus between the LCFS CCS QM and the LCFS project which is actually receiving the LCFS credits.

Chapter 3.3(c)(1)

Purpose

The amendments specify that each CCS project must have received permanence certification under the GCS protocol to be issued LCFS credits.

Rationale

It is essential that permanence be demonstrated before issuance of LCFS credits. Unless permanence can be assured, any sequestered CO_2 cannot be considered when calculating credits under the LCFS regulation.

Chapter 3.3(c)(2)

Purpose

The amendments specify that each CCS project must contribute a number of LCFS credits to the Buffer Account and this subchapter is relettered due to the addition of subchapter 3.3(c)(1).

Rationale

The credits contributed to the Buffer Account help ensure accurate environmental accounting in case of loss of any sequestered CO_2.

Section B.3(c)(2)

The amendments remove section 3(c)(2) because permanence for the purpose of buffer accounts is addressed in the GSC Protocol.

Chapter 3.3(c)(3)

Purpose

The amendments provide the calculation for the Buffer Account contribution

Rationale

The equation uses the GSC Site Risk Rating from the GCS Protocol to calculate the contribution. Changes are due to separating into the GCS Protocol and the LCFS CCS QM. There was no explicit method for calculating the buffer contribution in the original protocol. This equation provides the method that was implied in the original protocol.

Chapter 3.3(d)

Purpose

The amendments require that the project maintain continuous permeance certification under the GCS Protocol and identifies the consequences if the certification is not maintained.

Rationale

If permeance certification is not maintained there is no mechanism to assure the CO2 is still being sequestered so the conservative approach is to consider all CO2 released immediately upon lapse of permanence certification and invalidate all credits associated with sequestration.

Chapter 4. Monitoring Reporting and Verification

Chapter 4.1(a)

Purpose

The amendments specify that the CCS Project Operator must maintain a monitoring plan consistent with the LCFS requirements.

Rationale

The monitoring plan is a requirement for all LCFS pathways and projects and aids the operator in collecting the required data and the verifier in verification of the required data.

Chapter 4.1(b)

Purpose

To identify the specific requirements for a CCS project in addition to the LCFS monitoring plan requires.

Rational

These items are items unique to the LCFS CCS QM that are necessary for the calculation of the net GHG emissions reductions for CCS that are not clearly identified in the LCFS monitoring plan requirements.

Chapter 4.2 Reporting for Verification

Chapter 4.2(a)

Purpose

Specify that quarterly or annual report that mee the requirements of the LCFS and the LCFS CCS QM must be submitted.

Rationale

This amendment specifies the reporting requirements that allow for verification of all reported data and calculation to ensure any credits issued under the LCFS program reflect true GHG emissions reductions and comply with both the LCFS regulations and the LCFS CCS QM.

Chapter 4.2(b)

Purpose

The amendments include more specific data that must be submitted as part of the quarterly or annual reports.

Rationale

The additional items identified are all required for the accurate quantification of the net GHG emissions reduction and are subject to verification.

Chapter 4.3 Verification

Chapter 4.3(a), (b)(1), (b)(2), (b)(3), and (c)(1)

No substantive changes form section 4.3.2.4. The addition of chapter 4.3(b)(4) is necessitated by the splitting of the original protocol into the GCS Protocol and the LCFS CCS QM

Chapter 4.3(b)(4)

Purpose

The amendment requires that the verification team responsible for LCFS accounting be the same team that conducts permanence compliance verification under the GCS Protocol.

Rational

It is necessary for the same verification team to conduct the permanence compliance verification under the GCS Protocol and the LCFS accounting verification under the

LCFS regulations and the LCFS CCS QM. This ensures that certain data used in LCFS accounting has already been verified by the same team for permanence compliance and can be consistently recognized during the LCFS accounting verification process.

Chapter 4.3(c)(2)

Purpose

The amendments clarify that the verifier must review the buffer account contribution.

Rational

It is importance to ensure the accuracy of all calculations resulting in crediting, including the buffer contributions.

Chapter 4.3(c)(3)

Nonsubstantive changes were necessitated by splitting the original protocol into the GCS Protocol and the LCFS CCS QM.

Chapter 4.3(c)(4)

Purpose

The amendments indicate that the verification statement for the LCFS project will include the verification of the CCS Project

Rationale

The LCFS project reflects the final quantification for credits and the materiality evaluation is on the final total project (CCS plus LCFS project) GHG emissions reductions value. The LCFS CCS QM verification is a subset of the overall verification.

All other sections from the original Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard that are not explicitly mentioned in this purpose and rationale were removed because they relate to the new GCS Protocol and are no longer required for the LCFS CCS QM.

Appendix A

No substantiative changes, only aesthetic and clarifying that reporting can be quarterly or annual.

Appendix B

No changes

Appendix C

No changes

Appendix D

No substantive changes, only changes affecting aesthetics and specifying that approval is from CARB and not specifically the Executive Officer are made.

Appendix D(d)

Purpose

The fuel-allocation formulas used to apportion fuel consumption between electricity and steam production are amended.

Rationale

The amendment specifies the standard efficiency-based allocation method for the applicable entities to follow.

Appendix E

Purpose

The amendments to Tables E4, E5, and E6 identify emissions factors, and equipment counts for common CCS equipment.

Rationale

The existing table had multiple values for the same component. To clarify which value should be used for the LCFS CCS QM, only a single conservative value for each component is included.

Appendix F

Only aesthetic changes were made to Appendix F

Appendix G

No longer required for the LCFS CCS QM and is part of the GCS Protocol.