

ARB's Carbon Capture and Sequestration (CCS) Program

CCS Technical Discussion Series: Well Mechanical Integrity

Background on ARB's CCS Technical Discussions

ARB is currently developing a program to allow for the use of carbon capture and sequestration (CCS) in its climate change programs, and to advance the use of CCS as a greenhouse gas (GHG) reduction strategy generally. As part of this effort, ARB's CCS program staff seeks to better understand the ability of CCS to contribute to California's climate goals, the limitations or advantages of the technology, and the innovation and incentives necessary for adoption. To support this work, ARB is developing a quantification methodology (QM) for CCS projects. As with other QMs, the CCS QM may be adopted for use in the Cap-and-Trade and Low Carbon Fuel Standard programs as determined appropriate in rulemaking(s) specific to these programs. For more information on ARB's CCS program and development of the QM please visit our website at <http://www.arb.ca.gov/cc/ccs/ccs.htm>.

In order to ensure staff is using the best available information and understands stakeholder concerns, we will be hosting a series of technical discussions. The CCS technical discussions will be topic focused stakeholder-led discussions. The intent is to allow interested parties to provide input that will inform development of the CCS QM, as well as the CCS program generally. ARB will identify subject areas and specific questions, with the expectation that stakeholders will provide presentations, or other materials, and participate in an open discussion.

The CCS technical discussions will be accessible via webinar, conference call, and in-person at ARB headquarters in Sacramento, California. At the discussion, ARB will provide a short overview of the identified subject area, as well as other information pertinent to the discussion if applicable, but the primary focus will be on stakeholder presentations and discussion. ARB generally will not provide a presentation or formal meeting notes, but will post all stakeholder presentations or other submitted materials to ARB's CCS website at <http://www.arb.ca.gov/cc/ccs/meetings/meetings.htm>.

Well Mechanical Integrity Technical Discussion:

Well mechanical integrity is an important aspect of prospective CCS projects. A leak from the intended storage reservoir, either to the atmosphere or into unintended compartments in the subsurface, can pose a safety risk to human health, cause contamination of aquifers or other mineral resources in the subsurface, cause damage to plants and wildlife, and result in atmospheric GHG emissions. ARB's QM for CCS must ensure that emission reductions for CO₂ sequestration projects are permanent, quantifiable, and verifiable. Wells are one of the most likely sources of potential leaks.

The main goal of this technical discussion is to determine what considerations need to be taken into account to ensure well mechanical integrity (for both newly drilled injection wells and legacy wells within the CCS project area) is maintained throughout the lifetime of CCS projects. For the purposes of this discussion, legacy wells include any existing wells that may be impacted by the project. These wells may be older, inactive, or more

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recent, active wells that may serve as potential leak points from the storage reservoir to the surface or subsurface if they are not properly sealed. They may also be wells previously utilized for other projects (e.g., oil and gas extraction) that an operator may want to modify for use as a CCS injection well.

Participating in the Well Mechanical Integrity Technical Discussion

DATE: Thursday May 12, 2016

TIME: 9:30 a.m. to 3:00 p.m.

To attend in person:

LOCATION: Coastal Hearing Room

ADDRESS: Cal/EPA Headquarters Building
1001 "I" Street
Sacramento, California 95814

To participate by webinar:

<https://attendee.gotowebinar.com/register/1489308664053159939>

To participate by teleconference:

United States: +1 (631) 992-3221

Access Code: 490-131-889

Please note that this is a toll call.

Presenting at the Well Mechanical Integrity Technical Discussion

If you would like to present at the Well Mechanical Integrity Technical Discussion, please contact Ms. Sara King at (916) 323-1009 or Sara.King@arb.ca.gov by April 20, 2016. ARB is requesting that presentations be limited to 20 minutes. Depending on interest, ARB may adjust presentation length and will communicate this to presenters ahead of time.

If you require special accommodation for the scheduled meeting or need this document in an alternate format (e.g., Braille, large print) or another language, please contact Ms. Regina Cornish at (916) 327-1493, as soon as possible. TTY/TDD/Speech to Speech users may dial 711 for the California Relay Service.

If you have questions about the Well Mechanical Integrity Technical Discussion, please contact Ms. Sara King, Air Pollution Specialist, at (916) 323-1009 or Sara.King@arb.ca.gov.

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Questions to Guide the Well Mechanical Integrity Technical Discussion

The following section provides a list of questions that is intended to guide stakeholder presentations and the discussion generally. Please note that this list is not exhaustive either in topics or questions.

Area of review (i.e., the boundary of the project area to be reviewed)

1. Current U.S. EPA Class VI permitting of CCS injection wells requires computational modeling that accounts for the physical and chemical properties of all phases of the injected CO₂ stream and that is based on specific site and reservoir parameters to determine the area of review (AOR). Are there any additional considerations beyond this requirement that should be considered to determine the AOR?
2. Class II well permitting allows the use of a ¼ mile fixed radius from the injection well. Is this permitting option sufficient to ensure containment in the case of enhanced oil recovery operations? Why or why not?

Material use

1. Are there recommendations on what materials or material requirement specifications should be used in well and well platform construction to prevent breaches in well mechanical integrity?
2. Are there recommendations on what specialty materials should be required for CCS injection (e.g., corrosion resistant materials)?
3. In what portions of the well would specialty materials be most crucial?

Well mechanical integrity testing prior to injection

1. Current U.S. EPA permitting requires the following tests for both Class II and Class VI wells: resistivity, spontaneous potential logs, caliper logs, and a cement bond and temperature log after the casing is set. Wells with intermediate and long string casings also require electric porosity and gamma ray logs before the casing is set, and fracture finder logs and a cement bond, temperature, or density log after the casing is set. Are there recommendations on additional tests that should be performed during construction and/or immediately after well construction to demonstrate that mechanical integrity is sufficient prior to CO₂ injection?
2. What useful information does each suggested test provide?
3. What tools/devices are available to perform such tests?
4. What are the benefits and drawbacks of each tool type?

Monitoring and testing while injecting

1. Are there recommendations on what monitoring and/or tests be performed while injecting to establish continued well mechanical integrity?
2. What useful information does each suggested test or monitoring method provide?

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3. Are there recommendations on how frequently this monitoring and testing be performed?
4. What tools are available to perform such an analysis?
5. What are the benefits and drawbacks of each tool type?

Plugging

1. Are there recommendations on the methods used to plug the injection well(s) in order to prevent leaks that would be specific to CO₂ injection (e.g., to account for high pressure from higher volume injection or the corrosive nature of CO₂)?
2. What should the plugging requirements be and why?

Post-injection monitoring and testing of the injection well or other wells in the area of review

1. Are there recommendations on what monitoring and/or testing be performed after injection has ceased and the well is plugged?
2. What useful information does each suggested test or monitoring method provide?
3. Are there recommendations on how frequent this monitoring and testing be performed and for how long after injection ceases?
4. What tools are available to perform such an analysis?
5. What are the benefits and drawbacks of each tool type?

Potential factors for well mechanical integrity failure

1. The two factors we anticipate will most influence well mechanical integrity failure in a CCS project are aging well infrastructure that can lead to breaches in the materials, and the corrosive nature of CO₂ when combined with water. Are there any other potential factors that may lead to well mechanical integrity failure in injection wells?
2. Which factors are most important or have the highest risk?
3. What sorts of mitigation measures should be required when risks are identified?
4. Where and when is failure likely to happen?
5. Why would a failure happen?

Leak response

1. If a leak is discovered in an injection or legacy well, what are the possible solutions? What methods can and should be used to quantify the leak?
2. What are the pros and cons associated with each solution?
3. With respect to well mechanical integrity, what kind of information should a leak response plan include? Emergency response plans will be discussed more broadly at a later date.

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4. Current U.S. EPA Class VI well permitting requires alarms and automatic shut off-systems. Are there recommendations on other automatic leak response features that should be considered? Why are the suggested features useful?
5. Can existing wells be retrofitted with alarms and automatic shut off-systems?

Legacy wells as potential leakage pathways

1. Can legacy wells be categorized in terms of risk and associated response in terms of certain characteristics (e.g., age, depth, materials)?
2. How can and should unknown or unmapped wells be located?
3. Are there recommendations on what tests and analysis could and should be performed on located legacy wells in the project area to ensure they have mechanical integrity and will not serve as leak points?
4. Are there recommendations on what criteria ARB should use to define a legacy well as a leakage risk?
5. If a legacy well is considered a risk, what possible methods could be used to mitigate the concern? Would special methods be needed for buried wells?
6. Are there recommendations on how a plug on a legacy well be defined to be considered sufficient to minimize leakage concern?
7. Are there recommendations on specific methods to plug an unplugged legacy well? Are there any re-plugging techniques that could be used on legacy wells with insufficient plugs? What are they?

Legacy wells as potential injection wells

1. Can legacy wells be brought up to UIC Class VI or similar well standards for use as CO₂ injection wells?
2. Can physical modifications be made to a legacy well to allow for this?
3. What kind of modifications would be necessary and how could these modifications be accomplished?
4. If legacy well conversion is allowed for use as a CO₂ injection well, are there recommendations for other requirements that should be required, such as additional monitoring?

Alternative solutions

1. Are there any other possible solutions to help ensure well mechanical integrity that are not covered by the questions above?
2. Do you have any other suggestions about topics or concerns that are related to well mechanical integrity that you think we should consider?