

PREOPERATIONAL TESTING

CTV III

Preoperational Testing

Overview

Pre-operational formation testing for the project includes a suite of logging, coring, geohydrologic testing and reservoir testing during the drilling and completion of the injection and monitoring wells.

1. Open-hole logging will support reservoir rock and fluid properties characterization.
2. Coring of the reservoir and confining layer will provide data on porosity, permeability, mineralogy, and lithology.
3. Fluid sampling, pressure and temperature data gathering will define project baselines.
4. Reservoir testing will assess reservoir and confining layer geomechanics.

The results of the testing activities will be documented in a report and submitted to the EPA after the well drilling and testing activities have been completed, and before carbon dioxide injection commences.

For injection and monitoring wells see Attachment G for pre-injection testing of project wells.

Preoperational testing schedule will be discussed with the EPA during site review and testing will be completed prior to the injection of CO₂.

1. Reservoir

Reservoir property data will define the USDW, monitoring zone and storage reservoir baselines for monitoring. The stresses will constrain the operating parameters. One representative sample or test will be performed for each of the following:

- Pressure, temperature, and fluid samples of the storage reservoir, monitoring zone and USDW.
 - Fluid sampling - for all analytes to be monitored during injection operations, per the Testing and Monitoring Plan
- Step rate test of the storage reservoir and confining zone to define fracture gradients.
- Perform pressure build-up testing as part of the Pre-Operational Testing plan (anticipated testing method: pressure build-up test).

2. Wireline Logging Program

Wireline logging of new injection wells and monitoring wells will consist of conventional and advanced open-hole and cased-hole logs of the surface, intermediate, and injection sections.

Open-hole logging program:

- Triple combo (gamma ray, neutron porosity, bulk density, resistivity) will be run on the surface, intermediate and injection intervals for all injection and monitoring wells.
- Advanced logs like Spectral gamma ray, dipole full-wave sonic and nuclear magnetic resonance (NMR) logs will be run over the intermediate and injection intervals for one of the injection or monitoring wells.

Cased-hole logging program:

- Cement bond logs will be run on the surface, intermediate and injection casing sections to verify cement integrity and zonal isolation.
- A pulsed neutron capture log should be run on the injection zone to provide a baseline water-to-gas saturation to support saturation and injection modeling over the life of the project.

3. Coring Program

A whole core / sidewall core will be taken on one well to evaluate fluid and rock properties to calibrate against open-hole logs. The objective of the coring zones is to determine the nature of the storage reservoir and the confining layer properties.

Proposed Core Analyses for the Confining Layer and Storage Reservoir:

- Porosity
- Permeability to air
- Saturations
- Grain density – to calibrate porosity logs
- Core descriptions

Proposed Special Core Analysis:

- Capillary pressure on select plugs to determine pore throats and relate water saturations to permeability (K) and porosity (ϕ) for the storage reservoir and confining layer
- X-ray diffraction (XRD) to determine clay mineralogy and validate petrophysical clay volume calculations for the storage reservoir and confining layer
- CO₂ to water relative permeability for the storage reservoir
- Thin section and scanning electron microscopy (SEM) analyses for the confining later and storage reservoir

4. CO₂ Stream Compatibility with Subsurface Fluids, Minerals and Materials

- Confirm the composition and water content of the CO₂ injectate as part of baseline sampling and verify that it will not react with the formation matrix (anticipated testing methods: various geochemical analyses).
- Confirm that the properties of the CO₂ stream are consistent with the AoR delineation model inputs (anticipated testing methods: various geochemical analyses).

- Confirm that the analytes for injectate and ground water quality monitoring are appropriate based on the results of geochemical modeling evaluation (anticipated testing methods: various geochemical analyses).
- Following the pre-construction measurement of the composition, properties, and corrosiveness of the injectate, review the well construction materials and cement in the context of the results of these tests (anticipated testing methods: various geochemical analyses).

5. Seismic History and Seismic Risk

Provide a seismicity monitoring plan and establish baseline seismicity (anticipated testing method: existing seismic network/historic seismicity database).

6. Financial Responsibility

Updated cost estimates based on third party assessment and confirmation of insurance and credit line.

7. Alternative PISC Timing Determination

Acquisition of data gathered as part of preoperational testing will aid in refining plume stability in support of alternative PISC timing.