

ATTACHMENT G: PRE-OPERATIONAL TESTING PROGRAM**Facility Information**

Facility name: One Carbon Partnership, LP
CCS1

Facility address: 1554 N. 600 E. Union City, IN 47390

Well location: Section 17, Township 20 N, Range 15 E
Latitude: 40.1874°
Longitude: -84.8646°

One Carbon Partnership, LP (OCP) will be constructing a new well, CCS1, for the injection of CO₂ into the Mt. Simon Sandstone and Eau Claire Silt between 3,100 and 3,659 ft. OCP is required to implement the Pre-Operational Testing Program as described in this Attachment G prior to operation of CCS1 in order to meet the requirements of 40 C.F.R. § 146.87.

The Pre-Operational Testing Program is required under 40 C.F.R. § 146.82(a)(8). Data and analysis generated will be provided to EPA prior to granting approval for the operation of CCS1, in accordance with 40 C.F.R. § 146.82(c). This Pre-Operational Testing Program includes a combination of logging, coring, fluid sampling, and formation hydrogeologic testing that OCP will complete during the drilling of four wells:

- USDW1: Lowermost USDW monitoring well
- CCS1: CO₂ injection well
- OBS1: Injection zone monitoring well
- ACZ1: Above confining zone monitoring well

Data acquired during drilling and testing from OBS1 will be used for comparison purposes while interpreting the data that will be obtained during the drilling and completion of CCS1.

Should the necessary data fail to be collected in the first above listed three wells, the ACZ1 well will be used to collect missing overburden data.

The Pre-Operational Testing Program will enable OCP to determine and verify the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical information of the injection zone, confining zone, and other relevant geologic formations via petrophysical logging and analysis, and core testing. The site-specific data will be used to update the critical delta pressure for the site and used to update the static and computational models for the project. In addition, formation fluid characteristics will be obtained from the injection zone, USDW1 well, and ACZ1 well to establish accurate baseline data against which future measurements may be compared after the start of injection operations.

As part of the Pre-operational Testing Program, OCP will also conduct a 3D seismic survey to evaluate the presence of faults or structural features and determine their potential impact on the injection zone or containment and confirm that the siting criteria of 40 C.F.R. § 146.83(a)(3)(ii) is being met. This survey will also serve as a baseline survey for subsequent monitoring activities per 40 C.F.R. § 146.90(g)(2).

Pre-Operational Testing Program Requirements:

Per 40 C.F.R. § 146.87(a), OCP must run appropriate logs, surveys, and tests, and determine or verify the depth, thickness, porosity, permeability, and lithology of, and the salinity of any formation fluids, in all relevant geologic formations in a manner that (1) conforms with the injection well construction requirements under 40 C.F.R. § 146.86 and this Permit and (2) that establishes accurate baseline data against which future measurements may be compared. These logs and test must include:

Deviation Surveys (40 C.F.R. § 146.87(a)(1))

Per 40 C.F.R. § 146.87(a)(1), OCP must perform deviation checks on all holes constructed by using a pilot hole which is enlarged by reaming or another method. Such checks must be at sufficiently frequent intervals to determine the location of the borehole and to ensure that vertical avenues for fluid movement in the form of diverging holes are not created during drilling.

Deviation surveys will be obtained as CCS1 and OBS1 are drilled to determine the wellbore path from the surface to the total depth of the wells, at the frequencies specified in Table 1 below.

Deviation surveys will be performed by running a survey tool on wireline to measure the inclination. The tool has an electronic timer that is set at the surface to allow enough time to run the tool in the drill pipe to the desired depth. Following the set time, the tool is removed from the well. The result of the survey will then be reviewed prior to continuation of drilling

Alternatively, deviation surveys may be performed by placing a measurement while drilling (MWD) tool, used to take well path surveys, on the bottomhole assembly (BHA) just above the drill bit. This tool records the inclination (deviation) and azimuth (direction) and then transmits this information to the surface in real-time.

Hole deviation will be maintained at less than five degrees. If necessary, the wellbore will be steered back to acceptable deviation with directional tools, with a downhole motor or rotary steerable system added to the BHA. Surveys will be taken at the frequency shown in Table 1. In general, a survey will be performed every 300 ft during the drilling of the borehole unless deviation of the borehole becomes apparent.

Should the deviation increase, more frequent surveys will be performed, and remedial actions will occur as necessary to bring the well within specification. More frequent surveys will also be performed while drilling through zones that are likely to cause the bit to “walk” creating a greater risk for deviation.

Table 1. CCS1 and OBS1 Deviation Survey Frequencies

Range of Deviation	Frequency of Survey
<1 degree	1 survey per every 300 ft. of hole
≥1 degree, but <2 degrees	1 survey per every 240 ft. of hole
≥2 degree, but <3 degrees	1 survey per every 120 ft. of hole
≥3 degree, but <4 degrees	1 survey per every 90 ft. of hole
≥4 degree, but <5 degrees	1 survey per every 30 ft. of hole

Logging and Testing Before and Upon Installation of Surface Casing and Long String Casing (40 C.F.R. § 146.87(a)(2) and (3))

Per 40 C.F.R. § 146.87(a)(2) OCP must complete the following logs and tests before and upon installation of the surface casing of CCS1:

- (i) Resistivity, spontaneous potential, and caliper logs before the casing is installed; and
- (ii) A cement bond and variable density log to evaluate cement quality radially, and a temperature log after the casing is set and cemented.

Per 40 C.F.R. § 146.87(a)(3), OCP must complete the following logs and tests before and upon installation of the long string casing of CCS1:

- (i) Resistivity, spontaneous potential, porosity, caliper, gamma ray, fracture finder logs, and any other logs the Director requires for the given geology before the casing is installed; and
- (ii) A cement bond and variable density log to evaluate cement quality radially, and a temperature log after the casing is set and cemented.

Tables 2 through 8 summarize the well sections and casing details of CCS1 and the open and cased hole well logs that will be acquired in the surface casing and long string casing sections, as well as an intermediate section if required.

Table 2. Major Well Sections/Casing Details of CCS 1

Casing String	Casing Depth (MD feet)	Borehole Diameter (inches)	Casing Diameter (OD- inches)	Wall Thickness (inches)	Casing Material	String Weight
Conductor	0-120	N/A	20	0.438	94 lbs/ft H40	11,280 lbs
Surface	0-560	17-1/2	13-3/8	0.38	54.5 lbs/ft, J55	30,520 lbs
Long String	0-2,600	8-1/2	7	0.408	29 lbs/ft, 13Cr85	75,400 lbs

Long String	2600-3609	8-1/2	7	0.408	29 lbs/ft, 25Cr125	29,261 lbs
-------------	-----------	-------	---	-------	--------------------	------------

Table 3. Surface Section Open Hole Testing

Test Performed	Purpose/Comments
Gamma Ray	Lithology
Spontaneous Potential	Permeability
Resistivity	Fluid Saturation, permeability
Caliper	Borehole diameter, stress

Table 4. Surface Section Cased Hole Testing

Test Performed	Purpose/Comments
Cement Bond Log (CBL) – with radial arms	Cement Integrity
Ultrasonic Cement Evaluation	Cement Integrity
Temperature	Temperature, external mechanical integrity

Intermediate Section¹**Table 5. Intermediate Section Open Hole Testing**

Log Performed	Purpose/Comments
Caliper	Bore Hole Diameter/Volume/Condition
Neutron Porosity	Porosity
Density	Porosity, density
Gamma Ray	Lithology
Image Log	Lithology, porosity, borehole diameter, fracture characterization, stress
Spontaneous Potential	Permeability

¹ Tables 5 and 6 are applicable in the event that a lost circulation zone is encountered in the Potosi Formation and an intermediate casing string is run.

Resistivity	Fluid saturation, permeability
Sonic Log	Porosity, formation velocities
Elemental Spectroscopy (optional)	These logs may be run over the injection zone and confining interval in order to further characterize these formations.
Magnetic Resonance (optional)	
Dipole Sonic (optional)	
Vertical Seismic Profile (VSP) (optional)	

Table 6. Intermediate Section Cased Hole Testing

Test Performed	Purpose/Comments
Cement Bond Log (CBL) or Ultrasonic Imaging Tool (USIT)	Cement Integrity
Ultrasonic Cement Evaluation	Cement Integrity
Temperature Log	Determine natural geothermal gradient outside well for comparison to future temperature logs for external mechanical integrity evaluations

Long String Section**Table 7. Long String Open Hole Testing**

Log Performed	Purpose/Comments
Caliper	Bore Hole Diameter/Volume/Condition
Neutron Porosity	Porosity
Density	Porosity, density
Gamma Ray	Lithology

Image Log	Lithology, porosity, borehole diameter, fracture characterization, stress
Spontaneous Potential	Permeability
Resistivity	Fluid saturation, permeability
Sonic Log	Porosity, formation velocities
Elemental Spectroscopy (optional)	These logs may be run over the injection zone and confining interval in order to further characterize these formations.
Magnetic Resonance (optional)	
Dipole Sonic (optional)	
Vertical Seismic Profile (VSP) (optional)	

Table 8. Long String Cased Hole Testing

Test Performed	Purpose/Comments
Cement Bond Log – Variable Density Log (CBL-VDL)	Cement Integrity
Ultrasonic Cement Evaluation	Cement Integrity
Temperature Log	Determine natural geothermal gradient outside well for comparison to future temperature logs for external mechanical integrity evaluations
Pulsed Neutron	Lithology, baseline fluid saturation, porosity

The well logs that are acquired to characterize the injection zone and confining zone will be run in the first deep well drilled for the project. A minimal logging suite will be acquired in the second deep well to correlate to the data acquired in the first well.

As recognized in Table 7, in addition to the required well logs, the project may run other specialty well logs over the injection zone and confining interval in order to further characterize these formations. Specialty logs may include, but are not limited to, elemental capture spectroscopy (ECS), nuclear magnetic resonance (NMR), dipole sonic in multiple modes, or zero offset vertical seismic profiles (ZVSP).

Injection Well Mechanical Integrity (40 C.F.R. § 146.87(a)(4))

Per 40 C.F.R. § 146.87(a)(4), OCP must complete a series of tests designed to demonstrate the internal and external mechanical integrity of the injection well, which may include:

- (i) A pressure test with liquid or gas;
- (ii) A tracer survey such as oxygen-activation logging;
- (iii) A temperature or noise log;
- (iv) A casing inspection log.

Internal mechanical integrity will be demonstrated by way of an annulus pressure test (APT). The APT will be performed after the tubing, packer, downhole equipment, and the wellhead have been installed. Prior to the installation of the wellhead, the annulus will be filled with fluid. The APT will then be performed by pressuring up the annulus after the well has reached thermal equilibrium. Once this has occurred, the annulus will be pressured up to 1,500 psi. A calibrated digital gauge will be installed on the annulus, and the pressure will be monitored for a period no less than 60-minutes. During this period, the casing and tubing pressure will be monitored at 5-minute intervals. Following the conclusion of the test, the gauge will be removed, and the casing pressure will be lowered to the normal operational pressure. The test will be considered successful if the pressure has deviated by less than 5% of the initial value.

In addition to this standard internal integrity monitoring, inspection of the tubing will be performed as it is being installed to monitor the tubing for corrosion.

Once authorization to inject has been issued, injection pressure, annular pressure, and annular fluid volumes will be monitored continuously to ensure internal well integrity and proper annular pressure is maintained.

For external mechanical integrity, after completion, a baseline temperature log will be run from surface to the bottom of the long string casing (approximately 3,569 ft and 3,619 ft in CCS1 and OBS1, respectively) to provide initial temperature conditions over the well. In addition to the baseline temperature log, a CBL, and advanced ultrasonic cement evaluation log will be run across the entire long casing string after completion of the injection well to confirm that the casing string was properly cemented. Cement Bond Logs-Variable Density Logs (CBL-VDLs) are recorded with sonic tools that detect the bond of the casing and formation to the cement between the casing and wellbore to identify damage. Ultrasonic tools provide higher accuracies and resolutions for cement evaluation.

OBS1 and CCS1 Well Core Program (40 C.F.R. § 146.87(b))

Per 40 C.F.R. § 146.87(b), OCP must take whole cores or sidewall cores of the injection zone and confining system.

Targeted intervals for whole core collection from the injection and confining zones are set forth in Table 9. The well logs from OBS1 will be analyzed and used to pick the optimal intervals to obtain whole core from the confining zone and the injection zone in CCS1 (Figure 4).

Approximately 50 ft of core will be acquired in the Eau Claire Shale across selected intervals to provide an evaluation of facies types and lithologic heterogeneity and for Geomechanical and mercury injection capillary pressure (MICP) analyses. An attempt will be made to collect approximately 50 ft of whole core across the Eau Claire Silt and Mt. Simon Sandstone contact. Approximately 50 ft of whole core will be collected deeper within the Mt. Simon Sandstone to represent portions of the formation that will be targeted for perforation and injection. The whole cores from the confining zone and injection zone will be augmented by additional side wall coring.

Table 9: Core collection plan

Core Type	Target Interval MD (feet)	Formation	Core Size
Whole Core	2,675 to 2700; 2,900 to 2,925	Eau Claire Shale	4 inches
Whole Core	3,125 to 3,175	Eau Claire Silt/Mt. Simon Sandstone	4 inches
Whole Core	3,300 to 3,325; 3,500 to 3,525	Mt. Simon Sandstone	4 inches
Sidewall Core	Selected locations: 2,613 to 3,619	Eau Claire Shale; Eau Claire Silt; Mt. Simon Sandstone	1.5 inches

Sidewall core intervals will be selected to augment whole core if unable to obtain the desired whole core intervals and to select specific intervals of interest. The well log data will be used to determine the sidewall core locations and to fill any gaps in the whole core program.

Sidewall cores collected will provide a comprehensive set of routine rock property data for calibrating geophysical wireline logs and to supplement formation property data where whole core data are not available. Sidewall cores will be collected using a wireline conveyed tool prior to the installation of long string casing.

Additional core will be collected if:

- Interpretation of the characterization well data indicates that additional data are needed to meet Class VI permit requirements.
- As required by the Director.

Planned core analysis is set forth in Table 10, subject to change based on site-specific data. OCP will provide formal core plans and numbers of cores to be utilized for each analysis listed below will be provided to the Director with the Schedule of Activities described below, following finalization with a coring contractor prior to well installation.

Core samples will provide information on geologic properties in the immediate area. The laboratory-derived core measurements will be integrated with wireline logs and used for petrophysical calibration.

The integrated dataset will then be correlated with wireline logs from offset wells to support the correlation and confirmation of stratigraphy, rock properties, and site characterization.

Table 10: Summary of potential core analyses and associated parameters

Core Analysis Type	Parameters Obtained	Formations
Routine Core Analysis	Porosity, Permeability, Grain Density	Mt. Simon Sandstone Eau Claire Silt Eau Claire Shale Intervals TBD
Tight Rock Analysis	Porosity, Permeability, Grain Density	Eau Claire Shale Intervals TBD
Thin-Section Petrography	Minerology, Lithology, Porosity, Grain Size, Textural Maturity, Oil Staining	Mt. Simon Sandstone Eau Claire Silt Eau Claire Shale Intervals TBD
X-Ray Diffraction	Minerology, Clay Identification	Mt. Simon Sandstone Eau Claire Silt Eau Claire Shale Intervals TBD
Core Gamma Ray Log	Lithology, Porosity, Grain Size, Geologic Contacts	All Whole Core Intervals
Relative Permeability	Relative Permeability, Wettability	Mt. Simon Sandstone Intervals TBD
Mercury Injection Capillary Pressure	Capillary Pressure	Mt. Simon Sandstone Eau Claire Silt Eau Claire Shale Intervals TBD
Triaxial Tests	Rock Strength, Ductility, Poisson's Ratio, Young's Modulus	Mt. Simon Sandstone Eau Claire Silt Eau Claire Shale Intervals TBD
Rock Compressibility	Rock Compressibility	Mt. Simon Sandstone Eau Claire Shale Intervals TBD

Formation Fluid Sampling and Analysis (40 C.F.R § 146.87(b), (c), (d)(3))

Per 40 C.F.R. § 146.87, OCP must take formation fluid samples from the injection zone, record the fluid temperature, pH, conductivity, reservoir pressure, and static fluid level of the injection zone(s) and determine or calculate the physical and chemical characteristics of the formation fluids in the injection zone(s).

Characterization of formation fluids will be based on analysis of fluid samples acquired from USDW1, ACZ1, and CCS1 or OBS1. These samples will be collected through swabbing, drill stem tests (DSTs), or downhole pumps and will provide information on the baseline geochemistry of the subsurface fluids. The sampled formations will include, but are not limited to, the injection formation, the first ACZ monitoring interval within the Knox Group, Trenton Limestone/Black River Group, and the lowermost USDW (Table 11).

When the first deep well is drilled for the project, well logs will be used to identify the first porous zone below the lowermost USDW. Resistivity logs will be used to establish the salinity of the porous zones. The first formation that may have sufficient porosity to obtain a fluid sample is the Trenton Limestone, although if porosity is not encountered, the underlying Black River Group will be sampled. Note that the brines of the Trenton Limestone in the region have TDS values >35,000 mg/L. The expected depth range for this sampling will be 1,100 - 1,300 ft BGS.

To confirm the lowermost USDW, the project will attempt to collect a formation water sample from strata below the expected lowermost USDW (i.e., Maquoketa formations).

Table 11: Wells and Proposed Fluid Sampling

Well	Fluid Sample Formation
CCS1 or OBS1	Mt. Simon Sandstone
ACZ1	Trenton Limestone/Black River Group; Knox Formation (TBD)
USDW1	Lowermost USDW

All fluid samples will be analyzed for TDS and other major analytes. This list of analytes is provided below in Table 12. Isotope analysis will be completed for the lowermost USDW, the Knox Formation ACZ monitoring zone, and the Mt. Simon Sandstone.

Table 12. Summary of analytical and field parameters for groundwater samples

Parameters	Analytical Methods ²
Cations: Al, Ba, Mn, As, Cd, Cr, Cu, Pb, Sb, Se, Zn, Ti Ca, Fe, K, Mg, Na, and Si	ICP ² -MS ³ , EPA Method 6020 ICP-OES ⁴ , EPA Method 6010B
Anions: Br, Cl, F, NO ₃ , and SO ₄	Ion Chromatography EPA Method 300.0
Dissolved CO ₂	Coulometric Titration ASTM D513-11
Stable Isotopes of $\delta^{13}\text{C}$ Dissolved Inorganic Carbon	Isotope Ratio Mass Spectrometry
Total Dissolved Solids	Gravimetry

² Or equivalent with prior approval from the UIC Program Director.

	APHA 2540C
Water Density (field)	Oscillating Body Method
Alkalinity	APHA 2320B
pH (field)	EPA 150.1
Conductivity/Resistivity (field)	APHA 2510
Temperature (field)	Thermocouple

USDW1 will be drilled with a water well rig to collect baseline water samples of the lowermost USDW.

- USDW1 will be drilled to the depth of the lowermost USDW which is expected to be at approximately 450 ft below ground surface (BGS) based on local well data. This is expected to be within the upper section of the Maquoketa Group. A USDW is defined by the EPA as an aquifer with less than 10,000 mg/L total dissolved solids (TDS).

The estimated total depth (TD) of this well is not expected to exceed 600 ft. This depth will serve to provide a depth to set surface casing for CCS1 and OBS1.

- USDW1 will be completed with polyvinyl chloride (PVC) casing and PVC screen across the deepest aquifer.
- Water samples will be collected to characterize the water quality and to establish baseline values to which future surveys may be compared as per 40 C.F.R. § 146.82(a)(6).

Injection and Confining Zone Fracture Pressure Testing (40 C.F.R. § 146.87(d)(1), (2))

Per 40 C.F.R. § 146.87(d)(1), (2), OCP must determine or calculate the following information concerning the injection and confining zone(s):

- (1) Fracture pressure;
- (2) Other physical and chemical characteristics of the injection and confining zone(s).

The geomechanical characterization of the injection and confining zones for the project will be assessed by analyzing one or more of the following data sets: core analyses, log data, and in-situ field tests. These analyses may include, but are not limited to, triaxial compressive strength tests of core samples, dipole sonic and image logs, and step rate testing (SRT). The SRT and pressure fall-off tests will provide in-situ measurements for vertical stress and maximum horizontal and minimum horizontal stresses as per 40 C.F.R. § 146.82(a)(3)(iv), in addition to the fracture gradient. Additional geomechanical data may be collected from OBS1 if problems are encountered with data acquisition in CCS1.

An SRT will be performed on the Mt. Simon Sandstone interval to determine the following information:

- Fracture opening pressure (to determine the fracture gradient)
- Fracture closure pressure.

This will be done by analyzing the pressure response to increasing rates. Injection at each of these rates will be performed on CCS1 for the same period as the high-level procedure below.

A formal procedure will be provided to the EPA prior to the running of the SRT.

1. Record static pressure and temperature for a minimum of one hour.
2. Rig-up pump truck, ensure sufficient volume of fluid is present at location to begin testing.
3. Pressure test lines above maximum anticipated operating pressure, but below equipment rating.
4. Begin SRT.
 - a. Pump first step of test at first desired rate (ex: 0.5 bpm) for a defined time (ex: 0.5 hours)
 - b. After the first step is completed, increase rate to next step (ex: 1.0 bpm) for the same defined step time (0.5 hours).
 - c. Repeat until the end of the test.
5. Shut-in well at the wing valves(s). Record the time of shut-in, the rate prior to shut-in and the shut-in pressure.
6. Rig-down pump truck.
7. Monitor pressure falloff for minimum of 24-hours.

The data from this test will be analyzed using appropriate analysis software, and the results will be included in the post installation reporting. Gauge calibration records will be provided at this time as well.

OCP will use the site-specific data acquired including dipole sonic logs, density logs, triaxial tests performed on the core collected from the confining zone and determine fluid gradients in order to calculate the fracture gradient in the confining zone. OCP will use a modified Eaton approach to calculate fracture gradient, which will allow them to calculate the fracture pressure of the confining zone.

Testing to Verify Hydrogeologic Characteristics of the Injection Zone (40 C.F.R. § 146.87(e))

Per 40 C.F.R. § 146.87(e), OCP must upon completion but prior to operation, conduct the following tests to verify hydrogeologic characteristics of the injection zone(s):

- (1) A pressure fall-off test; and,
- (2) A pump test; or
- (3) Injectivity tests.

A pressure fall-off test (FOT) will be run on CCS1 following the completion of the SRT. The purpose of this test is to further characterize the injection zone. During this test, fluid will be injected at a constant rate for a predetermined length of time, after which the well is shut in, and the FOT monitored for an equal amount of time as the injection lasted. Injection zone pressure will be measured as part of the FOT as per 40 C.F.R. § 146.82(c). The static fluid level of the injection zone will be determined either after the well completion or after the FOT as per 40 C.F.R. § 146.82(c) pending scheduling of well service providers.

The data from this test will be evaluated using rate superposition analysis to determine reservoir information such as permeability, skin factor (damage), and flow regimes present. This test analysis will

act as a “baseline” measure to determine the change in overall effectiveness and injectivity of the injection zone over time. These tests will also help evaluate whether the presence of any structural features in the injection zone, such as faults, are transmissive or present a barrier to flow. A high-level procedure is provided below. Note that a formal procedure will be provided to the EPA prior to the running of the FOT.

1. Record static pressure and temperature for a minimum of one hour.
2. Rig-up pump truck, ensure sufficient volume of fluid is present at location to begin testing.
3. Begin injection. Inject at constant rate for predetermined duration.
4. At the end of the injection period, shut the well in at the wing-valve(s). Record the time of shut-in, rate prior to shut-in, and the shut-in pressure.
5. Secure the well.
6. Rig-down pump truck
7. After the pressure has been allowed to decline for approximately the same duration as the injection the test can conclude.

The data from this test will be analyzed using pressure transient analysis software, and the results will be included in the post installation reporting. Gauge calibration records will be provided at this time as well.

Table 13 below provides a summary of formation testing to be performed in accordance with 40 C.F.R. § 146.87(c)-(e).

Table 13 Formation Testing

Test Performed	Purpose/Comments
Fluid Temperature	Determine natural geothermal gradient outside well for comparison to future temperature logs for external mechanical integrity evaluations
Fluid pH	Provide baseline of formation pH for reference to future samples
Fluid Conductivity	Provide baseline of formation Conductivity for reference to future samples
Reservoir Native Pressure	Provide baseline of formation pressure for comparison during injection activities and CO2 plume monitoring
Static Fluid Level	Determination of bottomhole pressure

Pressure Fall Off Test	Verification of connectivity of sequestration field
Step Rate Test	Determination of Fracture Pressure, Frac Gradient and highest allowable injection pressure
Injectivity Test	Verification of the injectivity rates used in the Plume and AOR simulations

Testing of Site Compatibility of Minerals, Fluids, and Well Materials

The formation water chemistry and mineralogical data obtained from core and well logging of the injection zone and confining zone will be used to perform geochemical modeling using PHREEQ or comparable software to establish potential reaction pathways resulting from injected CO₂. These analyses will indicate the compatibility of the CO₂ stream with fluids in the injection zone and the minerals of the injection and confining zone as per 40 C.F.R. § 146.82(c)(3). These analyses will also identify if there are components of the injection zone mineralogy that have the potential to release trace metals through dissolution resulting from injection.

In addition, well log and core data will be used to evaluate mineralogical components and heterogeneity within the injection and confining zones and to identify facies variations. OCP must assess the impact that facies variations and heterogeneity may have on mineral reactions and the resultant confining zone characteristics during the pre-operational testing program as per 40 C.F.R. §§ 146.82(a)(3)(iii) and 146.84(c)(1)(i) and (ii). Additional data that may supplement these assessments include image logs and 3D seismic data.

The compatibility of the well cement and the CO₂ stream will also be evaluated based on injection zone fluid compositions and pressure and temperature characteristics as per 40 C.F.R. § 146.86. The well logging and fluid sampling programs described in this pre-operational testing program are designed to:

- Determine the salinity in relevant geologic formations, such as the lowermost USDW, ACZ interval, and injection zone,
- Ensure conformance of injection well construction requirements (40 C.F.R. § 146.86),
- Establish baseline data that can be used for comparison against future measurements as per 40 C.F.R. § 146.87(a).

Characterization of Faults and Subsurface Stress

A 3D seismic survey will be conducted as part of the Pre-operational Testing Program to:

- Augment the existing 2D seismic survey,
- Evaluate the presence of faults or structural features,
- Determine the potential impact of faults or structural features on injection or containment,

- Confirm that the siting criteria of 40 C.F.R. § 146.83(a)(3)(ii) is being met.

The 3D seismic survey will provide an assessment of the orientation, geometry, depth, and displacement of structural features including the Precambrian topography and allow a reevaluation of faults as interpreted using 2D seismic data. This 3D seismic data will be used to characterize any potential basement faults, faults that may transect the injection zone, and how such faults are positioned relative to the CO₂ plume and pressure front.

Any faults identified in the AoR will be included in the static modeling. If a fault is identified in the injection zone with the 3D seismic data, pressure fall-off tests may be able to determine if the feature is transmissive or a barrier to flow. Using other geomechanical data obtained from CCS1 and OBS1, including step-rate tests and pressure fall-off tests, core analyses, and log data, the magnitudes and orientations of subsurface stresses will be refined and used to evaluate fault stability and potential fault re-activation in the AoR. These data, including the in-situ tests, will be used to determine vertical and maximum and minimum horizontal stress values as per 40 C.F.R. § 146.82(a)(3)(iv) to establish pressure thresholds to provide evidence for fault stability and assess the potential for induced seismicity as per 40 C.F.R. § 146.82(a)(3)(ii). These data, along with mineralogical and facies data collected as part of the pre-operational testing program, will also confirm fault sealing characteristics in the Eau Claire Shale confining interval as per 40 C.F.R. § 146.82(a)(3)(ii).

The 3D seismic survey will also be evaluated to examine whether there is any indication that the postulated Auglaize Fault is present in the project AoR.

The 3D seismic survey and any identified structural features will be integrated into updated static and computational models with all the new site-specific data gathered from CCS1 and OBS1 wells. A computational model simulation will be performed using the updated models to compare results with the previously determined AoR.

Schedule of Activities (40 C.F.R. § 146.87(f))

Per 40 C.F.R. § 146.87(f), OCP must provide the Director with the opportunity to witness all logging and testing by this subpart or in this section. OCP must submit a schedule of such activities to the Director 30 days prior to conducting the first test and submit any changes to the schedule 30 days prior to the next scheduled test.

Data Analysis and Reporting

OCP will submit to the Director a report of the results of all testing performed under this Pre-Operational Testing Program, including a detailed report prepared by a log analyst that includes well log analyses (including well logs), core analyses, and formation fluid sample information. Data will be presented in the pre-operational testing report submitted to the Director per Permit Section J.