ATTACHMENT G: PRE-INJECTION TESTING PLAN

Facility Information

Facility name: Marquis Biocarbon Project
MCI CCS 3

Facility address: 10000 Marquis Drive, Hennepin, IL 61327

Well location: S2, T32N, R2W
41.27026520° N, 89.30939322° W

As per 40 CFR § 146.87:

> During the drilling and construction of a Class VI injection well, the owner or operator must run appropriate logs, surveys and tests to determine or verify the depth, thickness, porosity, permeability, and lithology of, and the salinity of any formation fluids in all relevant geologic formations to ensure conformance with the injection well construction requirements under § 146.86 and to establish accurate baseline data against which future measurements may be compared.

The following Pre-Operational Testing Plan describes how the requirements of 40 C.F.R. § 146.87 and 40 C.F.R. § 146.86 will be fulfilled.

Marquis will be constructing a new well, MCI CCS 3, for the injection of CO_2 into the Mount Simon Sandstone of the Illinois Basin at ~3,094 ft MD. Prior to this construction, Marquis has completed the drilling and investigation of a stratigraphic test well, MCI MW 1, and included investigation of the geologic column to a depth of 4,854 ft MD. Data acquired during drilling and testing from MCI MW 1 will be used for comparison purposes while interpreting the data that will be obtained during the drilling and completion of MCI CCS 3.

Whole and side wall cores were collected from MCI MW 1. Analyses of these cores will be used as the primary geologic characterization of the injection site. Either whole core or sidewall core samples must be obtained from the confining zone and injection zone from MCI CCS 3 in accordance with 40 C.F.R. § 146.87(b).

The pre-operational testing will be performed in sequence with the well construction activities. As each portion of the well is constructed, a different suite of tests will be performed based on the bore hole conditions (open hole vs cased hole). This plan is broken into sections that will cover each major portion of the injection well and testing associated with each major section.

Table 1 provides the primary sections of the well along with estimated depths. The actual depths will be determined during the drilling operations based on input from well logs, geologist's inputs, and surrounding well data.

After the well has been completed, a cement bond log – variable density log (CBL-VDL) and advanced ultrasonic cement evaluation log will be run along the entire depth of the long casing string shortly after completion of the MCI CCS 3 well to confirm that the casing string was properly cemented. A baseline temperature measurement will also be acquired from surface to total depth (TD) to provide initial temperature conditions over the well.

Table 1: Major Well Sections/Casing Details.

Casing String	Casing Depth (MD feet)	Borehole Diameter (inches)	Casing Diameter (OD-inches)	Wall Thickness (inches)	Casing Material	String Weight (lb/ft)
Conductor	80	±36	30	0.375	X-42	118
Surface	350	26	20	0.438	J/K-55	94
Intermediate	2,735	17.5	13.375	0.38	J/K-55	68
Long String	2,690	12.25	9.625	0.482	13Cr80	47
Long String	4,854	12.25	9.625	0.482	25Cr80C	

Conductor

The bore hole for the conductor will be drilled to a depth of approximately 80 ft MD. Once the bore is established, the 30-inch conductor will be set and cemented to surface. Due to the shallow nature of the conductor section no pre-operational testing is proposed. Industry standards for cement setting time will be followed.

Surface Section

Surface casing will be set from 0 ft to 30 ft within the conductor and then from 30 ft to 350 ft in a 26-inch bore hole to ensure coverage of groundwater. Open hole well logs will be acquired prior to setting the surface casing. Table 2 shows all open hole testing planned for the surface casing section before the casing is installed and cemented. Additional cased well logs will be acquired for the surface casing section after the surface casing has been set and cemented. Table 3 shows all testing planned for the surface casing section after the casing is installed and cemented.

Table 2: Surface Section Open Hole Testing.

	Purpose/Comments
Gamma Ray (GR)	Lithology
Density	Porosity, Density
Neutron Porosity	Porosity
Spontaneous Potential (SP)	Permeability
Resistivity	Fluid Saturation, Permeability
Caliper	Borehole Diameter, Stress
Dipole Shear Sonic-Delta-T Compressional (DTC)	Used to Compare to 3D Seismic Data
Delta-T Shear (DTS)	Used to Compare to 3D Seismic Data

Table 3: Surface Section Cased Hole Testing.

Test Performed	**Purpose/Comments**
Cement Bond Log – Variable Density Log (CBL-VDL)	Cement Integrity
Pulse Neutron Log (PNL)	Lithology, Fluid Saturation, Porosity

Intermediate Section

The intermediate section will be from approximately 350 ft to 2,750 ft MD. The intermediate casing will be set from 0 ft to 350 ft within the surface casing and then from 350 ft to 2,735 ft in a 17.5-inch bore hole. Open hole well logs will be acquired in the intermediate section of the well from a depth of approximately 350 ft to 2,750 ft. Table 4 shows all open hole testing planned for the intermediate section before the casing is installed and cemented.

Table 4: Intermediate Section Open Hole Testing.

Test Performed	Purpose/Comments
Gamma Ray (GR)	Lithology
Density	Porosity, Density
Neutron Porosity	Porosity
Spontaneous Potential (SP)	Permeability
Resistivity	Fluid Saturation, Permeability
Caliper	Borehole Diameter, Stress
Dipole Shear Sonic-Delta-T Compressional (DTC)	Used to Compare to 3D Seismic Data
Delta-T Shear (DTS)	Used to Compare to 3D Seismic Data

After completion of the open hole logging, the intermediate casing will be set and cemented. Additional cased well logs will then be acquired for the intermediate section to evaluate the cement integrity and to ensure the protection of USDWs is maintained. Table 5 shows all testing planned for the intermediate section after the casing is installed and cemented.

Table 5: Intermediate Section Cased Hole Testing.

Test Performed	Purpose/Comments
Cement Bond Log – Variable Density Log (CBL-VDL)	Cement Integrity
Ultrasonic Cement Evaluation	Cement Integrity

Long String Section

The long string section will be from approximately 2,750 to 5,000 ft MD. The upper portion of the long string casing will be set from 0 ft to 2,690 ft within the intermediate casing. The lower portion of the long string casing will be set from 2,690 ft to 2,735 ft within the intermediate casing and 2,735 ft to 4,854 ft in a 12.25-inch bore hole. Open hole well logs will be acquired in the long string section of the well from a depth of approximately 2,750 ft to 5,000 ft. Table 6 shows all open hole testing planned for the long string section before the casing is installed and cemented.

Table 6: Long String Open Hole Testing.

Test Performed	Purpose/Comments
Gamma Ray (GR)	Lithology
Density	Porosity, Density
Neutron Porosity	Porosity
Spontaneous Potential (SP)	Permeability
Resistivity	Fluid Saturation, Permeability
Caliper	Borehole Diameter, Stress
Dipole Shear Sonic-Delta-T Compressional (DTC)	Used to Compare to 3D Seismic Data
Delta-T Shear (DTS)	Used to Compare to 3D Seismic Data

After completion of the open hole logging, the long string casing will be set and cemented. Additional cased well logs will then be acquired for the long string section to evaluate the cement integrity and to provide baseline data for external well integrity. The pulsed neutron capture log and temperature log will be performed after drilling muds are no longer present near the well and the temperature has stabilized to ensure accurate results from the logging effort. Table 7 shows all testing planned for the long string section after the casing is installed and cemented.

After cased hole logs in the long string sections are acquired, the dipole shear sonic log from the MCI CCS 3 well will be examined to determine if any faults or fractures are present. Any formations with fractures will be compared to similar formations from the MCI MW 1 well to determine consistency of findings. Any indication of faulting or fracture networks that may compromise the seal will be tied to the 3D seismic analysis to determine if they impact the integrity of the seal or may lead to heterogeneities in the injection zone that could affect plume development.

Table 7: 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
Pulse Neutron Log (PNL)	Lithology, Fluid Saturation, Porosity

After the packer, tubing, and downhole equipment have been installed, and the tubing/casing annulus of each well has been filled with a corrosion-inhibited fluid, a mechanical integrity test (MIT) will be conducted on the annular space of all the deep wells to ensure that there are no leaks in the tubing, casing, or packer. The MIT will be performed by pumping additional annular fluid into the annulus to increase the pressure to the maximum allowable injection pressure at the surface. The annular pressure will be monitored for 60 minutes to measure pressure loss. A pressure loss of less than 3% of the initial value would indicate proper internal mechanical integrity. If a pressure loss greater than 3% is observed, the test will be repeated, and if it fails again, the cause of the poor mechanical integrity will be identified and corrected.

Formation Testing

After all casing is set the lowermost interval will be perforated to allow for injection into the desired section of the Mount Simon Sandstone. After the casing is perforated a series of injectivity tests and formation fluid tests will be performed. Table 8 includes the testing planned before the commencement of operation of the injection well.

Drill stem tests (DSTs) will be performed on potential USDWs in the MCI CCS 3 well. Starting at the St. Peter, each major water-bearing sandstone formation will be sampled and tested. Once a non-USDW formation is found, one formation deeper will be sampled and tested to confirm non-USDW status. Field testing of TDS/salinity will be the indicator of USDW status. Water samples will then be sent to a lab for further analysis. These results will be compared to the analyses done at MCI MW 1 to confirm consistency of the USDWs and other water bearing zones across the project site. As a final step, a petrophysical analysis will be performed to tie the water salinity to key log measurements such as resistivity, porosity, and elemental analysis.

Table 8: Formation Testing.

Test Performed	Purpose/Comments
Pump Test or Injectivity Test	Verification of the injectivity rates used in the Plume and AOR simulations
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
Fluid Total Dissolved Solids/Salinity	Starting at the St. Peter Sandstone, each major water-bearing sandstone formation will be tested to determine USDW status. Once a non-USDW formation is found, one formation deeper will be sampled and tested to confirm non-USDW status.
Reservoir Pressure	Provide baseline of formation pressure for comparison during injection activities and CO_2 plume monitoring
Deviation Survey	Determine wellbore path and verticality from surface to total depth
Pressure Fall Off Test	Verification of connectivity of sequestration field
Static Fluid Level	Determination of bottomhole pressure

Injectivity testing is planned for the MCI CCS 3 well to confirm the flow of fluid into zones within the Mt. Simon Sandstone during injection. This data will be used to determine the best perforation strategy for the MCI CCS 3 well. The flowmeter testing will be performed by injecting brine into the open borehole after it has been drilled to TD and running a flowmeter tool across the open hole interval. Two flowmeter tests are planned for the MCI CCS 3 well. One test will examine the flow conditions across the entire open borehole (below the intermediate casing) and the other will focus on the Mt. Simon Sandstone by setting a packer at the base of the Elmhurst Formation.

Once the well is completed and perforated, a set of hydrogeologic tests will be performed. These include a pressure fall-off test and a pump test or injectivity test.

Data Analysis and Reporting

Marquis Carbon Injection will submit to the Director 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-injection testing report submitted to the Director per Permit Section J.