PRE-OPERATIONAL TESTING PLAN

SAN JOAQUIN RENEWABLES

1. Facility Information and Introduction

Facility name: San Joaquin Renewables
Injection Well: SJR-I1

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Well location: McFarland, Kern County, California
35.688330, -119.276642

Pre-operational formation testing will include a suite of logging, coring, geohydrologic testing and other activities during the drilling and completion of the well listed below. Electrical logging will support reservoir rock and fluid properties characterization. Formation pressure testing will determine current reservoir pressure and permeability.

The other pre-operational tests will determine the depth, thickness, mineralogy, lithology, porosity, permeability, and geomechanical attributes of the "Vedder" sandstone (target injection zone), and the overlying "Pyramid Hills", "Freeman-Jewett", "Olcese" and "Round Mountain" formations. The results of the testing activities will be documented in a report and submitted to the U.S. EPA after the well drilling and testing activities have been completed, but before carbon dioxide injection commences.

SJR will notify the Director at least 30 days prior to conducting any testing.

Methods for tests will be consistent with U.S. EPA (2013), and testing methods listed in the Testing and Monitoring Plan.

2. Injection Well Testing

Wireline logging of the injection well will consist of conventional and advanced open-hole logs of the surface, intermediate, and injection hole sections. 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 hole to provide a baseline water-to-gas saturation to support saturation and injection modeling over the life of the project.

2.1. Wireline logs prior to running casing

Surface Hole Section

- Triple combo – GR, neutron porosity, bulk density, resistivity
- Caliper Log
- Deviation Checks

Intermediate Hole Section

- Triple combo - GR, neutron porosity, bulk density, resistivity
- Dipole full-wave sonic – rock properties and seismic tie-in
- Spectral gamma ray
- NMR – movable fluids and permeability modeling
- Resistivity based image log – facies, fracture identification, fault identification
- Caliper Log
- Deviation Checks

Injection Hole Section

- Triple combo - GR, neutron porosity, bulk density, resistivity
- Dipole full-wave sonic – rock properties and seismic tie-in
- Spectral gamma ray
- NMR – movable fluids and permeability modeling
- Formation pressure testing – reservoir pressure and permeability indicator
- Resistivity based image log – facies, fracture identification, fault identification
- Caliper Log
- Deviation Checks

2.2. Wireline logs after running casing

Surface Casing

- Cement bond log with variable density
- Cased hole pressure and temperature

Intermediate Casing

- Cement bond log with variable density
- Radial mapping – to determine if cement channeling exists
- Cased hole pressure and temperature

<u>Injection Casing</u>

- Cement bond log with variable density
- Radial mapping – to determine if cement channeling exists
- Cased hole pressure and temperature
- Pulsed neutron capture log – baseline gas saturation to calibrate against open hole logs and for an initial measurement for future time lapse gas injection mapping

2.3. Additional Injection Well Testing

Additional injection well testing will include the following:

- Standard annulus pressure test (SAPT).
- Leak-off test or step rate test to determine fracture pressure after the well has been perforated, as described in the Narrative
- Pressure fall-off, pump test, or injectivity tests to determine the injection zone hydrogeologic characteristics as described in the Testing and Monitoring Plan.

3. Coring Program

Several 30' whole cores should be taken to evaluate fluid and rock properties to calibrate against open hole logs. The objective of the coring zones is to determine the nature of sand reservoir containers and their transitions to shales. Cores should be taken across sealing interfaces and across the injection zones. Targets include the "Freeman- Jewett" to "Pyramid Hill", "Vedder 1" through "Vedder 3", the "Round Mountain" to "Olcese" expansion zone interface, and the "Vedder 2" shale to "Vedder 3" sand interface.

<u>Proposed Coring Zones (see Figure 1)</u>

- "Round Mountain" into "Olcese"
- "Olcese" into "Freeman-Jewett"
- "Freeman-Jewett" into "Pyramid Hills"
- "Pyramid Hills" into "Vedder 1"
- "Vedder 2" into "Vedder 2" shale
- "Vedder 2" shale into "Vedder 3"

<u>Proposed Core Analyses:</u>

- Porosity
- Permeability to air
- Saturations
- Grain density – to calibrate porosity logs
- Gamma ray – to correlate to open hole logs

- Core descriptions
- Computerized tomography (CT) scanning before slabbing to ensure core quality

Proposed Special Core Analysis:

- Capillary pressure on select plugs to determine pore throats and relate water saturations to permeability (K) and porosity (φ)
- X-ray diffractograms (XRD) to determine clay mineralogy and validate petrophysical clay volume calculations
- CO_2 to water relative permeability
- Geomechanical measurements of containment and injection zones
- Tri-axial stress test to validate frac pressure
- Pore compressibility
- Thin section and scanning electron microscopy (SEM) analyses

4. Additional Pre-Operational Testing

Additional pre-operational testing will include the following.

Regional Geology and Geologic Structure:

- Determine, based on pre-operational testing, which of the Vedder Formation intervals will ultimately be selected as the injection zones (anticipated testing methods: whole core analyses).

Hydrologic and Hydrogeologic Information:

- Groundwater sample collection and analysis during well construction to establish the depth of the lowermost USDW within the AoR (analytes and testing methods in the Testing and Monitoring Plan).
- Sample all formations during drilling of the injection well and deep monitoring wells to confirm that no other formations are USDWs.

Geochemistry/Geochemical Data

- Characterize the baseline geochemistry of the USDW and the Vedder Formation and in all wells to be monitored for all parameters (and methods) described in the Testing and Monitoring Plan to: (1) confirm the inputs to the geochemical modeling, and (2) establish a baseline for monitoring.

Geomechanical and Petrophysical Characterization (see Section 3 above).

- Gather site-specific measurements during drilling of the injection well and deep monitoring well of: capillary pressure; information on fractures, stress, ductility, rock strength, elastic properties; and in situ fluid pressures within the confining zone to support an evaluation of confining zone integrity (anticipated testing methods: logging and core analyses, e.g., tri-axial tests, pore compressibility, etc.).

- Confirm/characterize the geomechanical and petrophysical properties (including porosity and permeability) of the Vedder and Freeman-Jewett Formations and other relevant formations to confirm the representativeness of data from nearby oil fields (anticipated testing methods: core analyses, e.g., porosity/permeability analyses, core descriptions, saturations, etc.).

Mineralogy of the Injection and Confining Zones (see Section 3 above)

- Perform a mineralogic analysis of the injection zone and confining zone solids that represents the project site (anticipated testing methods: core analyses, e.g., porosity/permeability analyses, core descriptions, saturations, etc.)

Seismic History and Seismic Risk

- Establish pressure in the injection zone (anticipated testing methods: geomechanical measurements of the injection and confining zones, pressure gauge measurement).
- Continue to establish baseline seismicity using methods listed in the Narrative Application Report.

Facies Changes in the Injection or Confining Zones

- Confirm the thickness of the Vedder Formation sands at the location of the injection and monitoring wells to provide additional information on their suitability for injection, including facies changes that could facilitate preferential flow (anticipated testing methods: cores and well logging data, see Sections 2 and 3 above).

CO2 Stream Compatibility with Subsurface Fluids and Minerals

- Confirm the composition of the carbon dioxide injectate as part of baseline sampling and provide verification that it will not react with the formation matrix (anticipated testing methods: injectate analysis and core sampling, geochemical modeling).
- Generate fluid chemistry and mineralogic data, pressure, temperature, and pH conditions at depth to confirm the inputs to the geochemical modeling (anticipated testing methods: core sampling and formation testing in the injection and monitoring wells).

Confining Zone Integrity

- Determine the maximum allowable injection pressure (anticipated testing methods: fall-off testing and injectivity testing).
- Confirm the fracture pressure of the injection zone via one or more of the following methods:
    - Triaxial stress test for rock mechanics for a static measurement from the rock core.
    - Dipole full wave sonic log, to provide a dynamic result that can be calibrated back to the static triaxial test.

- Leak-off test or step rate test to determine fracture pressure after the well has been perforated.

References

United States Environmental Protection Agency (U.S. EPA), 2013. Underground Injection Control (UIC) Program Class Six Well Testing and Monitoring Guidance. Office of Water (4606M) EPA 816-R-13-001, March 2013.

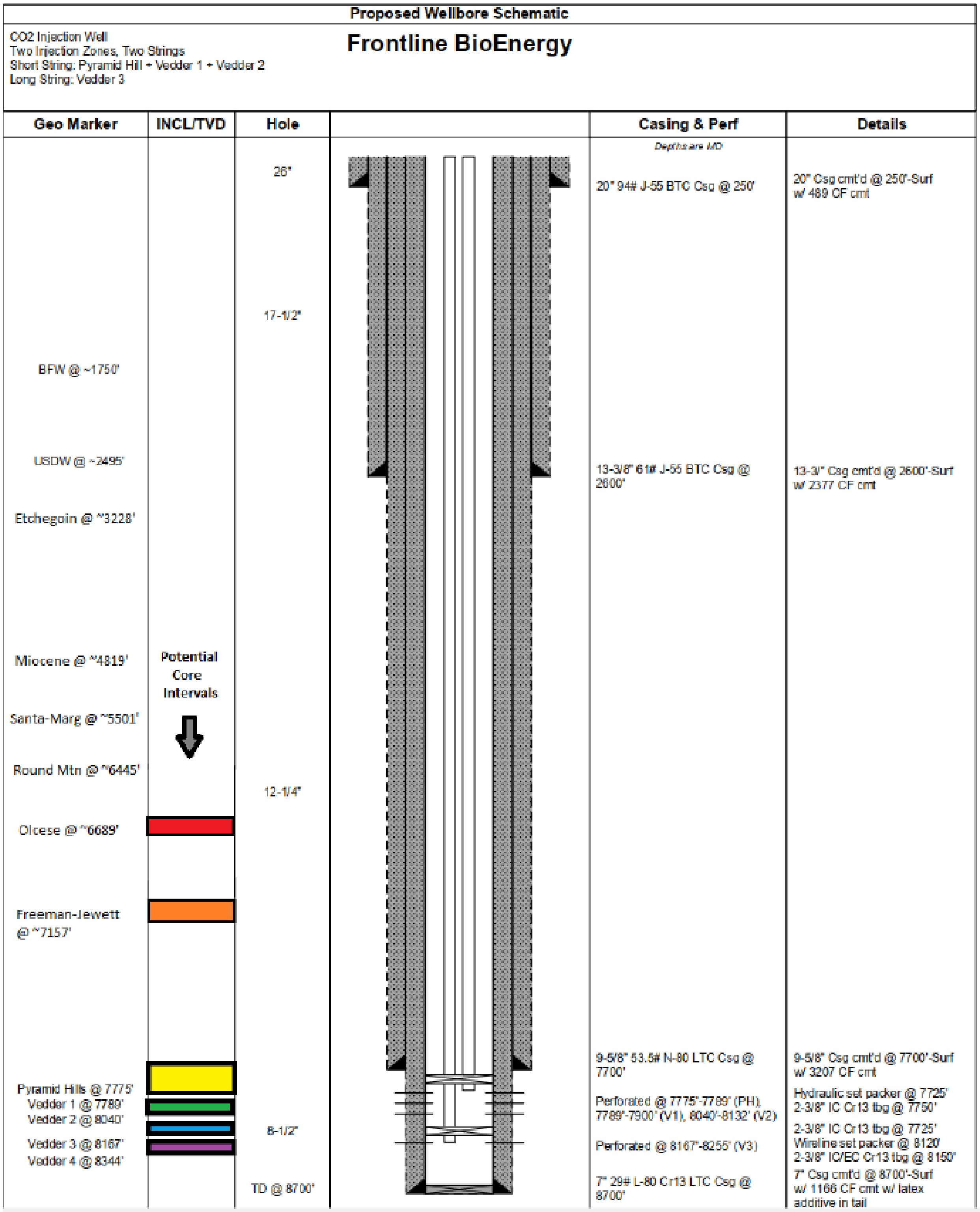

Figure 1 - Proposed Injector Casing Design with Geologic Markers