Plan revision number: 1
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INJECTION WELL STIMULATION PLAN
40 CFR 146.82(a)(9)

BRP CO_2 Sequestration Project

1.0 Facility Information

Facility name: Brown Pelican CO_2 Sequestration Project
BRP CCS 1, 2 and 3 Wells

Facility contact: [redacted]

Well location: Penwell, Texas

BRP CCS1	31.76479314	-102.7289311
BRP CCS2	31.76993805	-102.7332448
BRP CCS3	31.76031163	-102.7101566

2.0 Introduction and Purpose

Oxy Low Carbon Ventures (OLCV) may stimulate the injection zone for the Brown Pelican (BRP) Project to enhance the injectivity potential of CO_2 injection wells and the productivity of water withdrawal wells. Stimulation may involve, but is not limited to, flowing fluids into or out of the

well, increasing or connecting pore spaces in the injection/production formation, or other activities that are intended to allow CO_2 to move more readily into the injection zone and for the water to be more efficiently produced.

OLCV will adhere to all applicable regulatory requirements for any stimulation treatment that may be required. Specifically, and without limitation, OLCV will comply with the following:

- 40 CFR 146.82(a)(9): OLCV will submit the proposed stimulation program, a description of stimulation fluids to be used and a determination that stimulation will not interfere with containment.
- 40 CFR 146.88(a): Except during stimulation, OLCV will ensure that injection pressure does not exceed 90 percent of the fracture pressure of the injection zone(s) so as to ensure that the injection does not initiate new fractures or propagate existing fractures in the injection zones(s). In no case will injection pressure initiate fractures in the confining zones(s) or cause movement of injection or formation fluids that endanger a USDW.
- 40 CFR 146.91(d)(2) and (e): OLCV will notify the Director in writing 30 days in advance of any planned stimulation activities, other than stimulation for formation testing conducted under 40 CFR 146.82. Regardless of whether a state has primary enforcement responsibility, OLCV shall submit all required reports, submittals, and notifications under subpart h of this part to EPA in an electronic format approved by EPA.

The information provided in this section specifically addresses the stimulation fluids, additives, and proposed stimulation procedures OLCV may implement. This plan includes multiple stimulation methodologies that may be selected based on site-specific technical and operational conditions that may impact future well performance. The methods provided below may also be used to remediate scaling or perforation occlusion in the well.

2.1 Purpose of Stimulation

Perforated intervals in the Lower San Andres CO_2 injection / water production zone may require stimulation periodically throughout the project life to enhance performance with the aim to restore it to initial or optimum conditions. For example, stimulation may be needed to remediate injectivity loss resulting from mineral scales, clay fragments, metallic sulfide, or oxide particulates. Stimulation may also be necessary to remove any near-wellbore damage resulting from drilling and completion operations. Following well construction, remedial stimulation may be conducted before the commencement of CO_2 injection or water withdrawal.

3.0 Stimulation Fluids

At BRP, OLCV will use acid blends for matrix stimulation that are typical for the industry. These include, but are not limited to, mixtures of acetic, hydrochloric, hydrofluoric, and/or other organic acids. These blends have been historically proven to remove near-wellbore damage caused by

mineral scales, drilling muds, completion fluids, and clay fines while minimizing negative impacts to permeability. There is also a potential for near-wellbore halite precipitation in the CO_2 injectors, which may require remediation by periodic flushes with less saline water.

All chemical treatments will be evaluated and selected for compatibility with the treatment method. For example, mineral acids will be treated with chemical inhibitors to prevent corrosion damage to the tubing string. In addition, chemical systems will be evaluated and selected to avoid damage to the down hole packer sealing elements, casing, and other seals within the injection system that might be exposed to the chemicals.

3.1 Additives

Additives may be utilized with the stimulation fluids to aid matrix stimulation while mitigating corrosion of tubulars and potential damage to the sequestration zone. These additives include, but are not limited to, corrosion or acid inhibitors, scale inhibitors, clay stabilizers, biocides, demulsifiers, chelating agents, mutual solvents, iron sequestrants, retarders, and/or surfactants. Compatibility of these additives with the stimulation fluids, tubulars and the reservoir will be confirmed prior to their use in any stimulation activities.

3.2 Diverters

Nitrogen or CO_2 may be added to stimulation fluids to achieve improved diversion and effective treatment for the target zone by diverting the stimulation fluids to the most impaired (*i.e.*, low injectivity/productivity) perforations. Depending on the well-specific requirements and stimulation design, organic or polymeric diverting agents may also be selected. These diverters provide temporary restrictions during stimulation operations and degrade or break-down with time due to water solubility and temperature.

The most suitable diverting agent will be selected based on one or more factors, including, anticipated pump rates, the length of the perforated interval, perforation density, and the selected technique for conveying acid to the injection zone (*e.g.*, pumping through regular tubing or pumping down coiled tubing).

4.0 Mechanical Stimulation

In addition to chemical stimulation, mechanical stimulation of the well may be required independently, or in conjunction with chemical stimulation. Mechanical stimulation may be required if there is deposition that cannot be easily remediated with chemicals, or if mechanical means may be more effective. These mechanical options include, but are not limited to, backflow, adding perforations, or re-perforating. Perforating operations may be further enhanced with the use of propellants. Propellant stimulations will be designed for nominal height growth, and to

remain within the injection zone and avoid fracture growth into the confining layer (Wieland, 2006).

5.0 Ensuring Containment

Except during stimulation, injection pressure will not exceed 90% of the established fracture pressure for the injection zone. Injection pressure at the downhole tubing pressure gauge and tubing/annulus surface gauges will be continuously monitored during the stimulation operation.

Stimulation of the injection interval will be conducted to avoid affecting the confining layers. Perforations in the injection zone will be vertically separated from the base of the confining layers by a minimum of 10 feet. Chemicals injected into perforations in the injection zone will not come into contact with the confining layers.

6.0 Standard Stimulation Procedure

If injection rates decline below expected values at any time during the project life, OLCV may investigate the cause to determine whether stimulation may be required. Investigation activities may include, without limitation, the following:

- Logging operations, including but not limited to, evaluation of the injection/production profile, mechanical spinner surveys, caliper logging, downhole camera investigation, etc.
- Collecting downhole samples when necessary or feasible with wireline, slickline or coiled tubing conveyed sampling equipment, to be followed by analytical testing as appropriate to determine remediation options.

A standard stimulation procedure is outlined below. This procedure may be modified depending on site-specific operational and technical conditions and the specific treatment requirements. The conveyance methods may include coil tubing, tubing-conveyed retrievable straddle packer assembly, snubbing unit, tubing flush, or bullheading.

1. Test the potential stimulation fluids blends for compatibility with well materials, reservoir rock, and fluids.
2. Design the stimulation program.
3. Provide the recommended work procedure and stimulation program to the UIC Program Director in writing at least 30-days prior to the planned date for start of the work (40 CFR 146.91(d)(2)).
4. Perform pre-job planning.
5. Discuss job safety and monitoring assignments.
6. Prepare the location for rig up of stimulation equipment.
7. Shut-in the injection or water withdrawal well, allowing the pressures to stabilize at the well and for other wells and the facility to absorb rate and pressure changes.

8. Rig up the stimulation well intervention equipment.
9. Prepare the well for stimulation.
10. Perform the matrix stimulation as specified in this plan.
11. Flush the wellbore with treated water and prepare the well to return to normal operation.
12. Rig down and return the well back to injection or water production.

A similar procedure would be utilized for flowbacks with prior operation-specific planning for well control as well as other job-specific safety and environmental protection control practices.

7.0 References

Wieland, C. W., Miskimins, J. L., Black, A. D., and S. J. Green. "Results of a Laboratory Propellant Fracturing Test in a Colton Sandstone Block." Paper presented at the SPE Annual Technical Conference and Exhibition, San Antonio, Texas, USA, September 2006.