6.0 WELL OPERATIONS PLAN

40 CFR 146.82(a)(8) 146.88 146.89

BONANZA SEQUESTRATION

Facility Information

Facility name:	Bonanza BioEnergy
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Well name:	Doll INJ-1
Well location:	FINNEY COUNTY, KANSAS [redacted]

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6.0 Well Operations Plan

The Well Operations Plan describes the steps Bonanza Carbon Capture, LLC will take to ensure that injection pressure does not exceed 90 percent of the fracture pressure of the storage formation to reduce that risk that injection does not initiate new fractures or propagate existing fractures in the storage area. No injection will occur between the outermost casing protecting underground sources of drinking water (USDWs) and the well bore in accordance with 40 CFR 146.88 (b). The injection well construction is detailed in the Injection Permit Section 4 – Injection Well Construction Plan which addresses 40 CFR 146.88 (c).

The Well Operations Plan describes the source of the carbon dioxide (CO_2) that will be delivered to the storage site, its chemical and physical properties, and flow rate at the piping outlet. In addition, this section provides the monitoring that will be performed on the injection well to confirm mechanical integrity (40 CFR 146.89).

6.1 Daily Rate, Volumes and Mass of the CO_2 Stream (40 CFR 146.82 (a)(7))

The design basis of this project is to capture and inject CO_2 produced at Bonanza Bioenergy Ethanol Facility. The maximum injection volume for this project is detailed in **Table 1-3** of the Permit Section 1 - Project Narrative and the planned injection period of this project is [redacted] years. Operational parameters of the injection well (**Table 6-1**) are based on modeled data derived from the stratigraphic test well (STW) which will subsequently be converted to the injection well. Average bottom hole injection pressure is derived from the dynamic reservoir model and maximum bottomhole injection pressure is a simple calculation of [redacted]% of the fracture gradient. The corresponding calculated surface pressures are modeled utilizing nodal analysis software based on the bottomhole pressures.

Table 6-1: Proposed operational procedures.

6.2 Characteristics and Source of CO_2 Delivered to the Storage Site (40 CFR 146.82(a)(7)(iii) and (iv))

6.2.1 Source of the CO_2 Stream

[redacted]

6.2.2 Chemical and Physical Characteristics of the CO_2 Stream

The composition of CO_2 in the fermentation off-gas stream has been analyzed and results from three samples shown in **Figure 6-2**.

[redacted]

Table 6-2: CO_2 Stream Composition.

The temperature of the CO_2 stream measured at the compressor discharge ranges from a low of 98.6°F to a high of 138.5°F, with an annual average of 113.8°F. Prior to injection, the chemical and physical characteristics of the injectant CO_2 stream will be confirmed using appropriate analytical methods. Further information on injection stream analysis can be found in Section 7.2 of the Testing and Monitoring Plan.

The injection stream will be monitored during the baseline and operational phases of the project. Prior to the start of the injection phase, the CO_2 stream will be sampled for analysis during capture and compression operations to obtain representative CO_2 samples that will serve as a baseline dataset. Once the injection phase commences, the CO_2 injection stream will be sampled from the CO_2 delivery piping on a defined frequency for analysis throughout the life of the injection period.

6.3 Shutdown Procedure

The shutdown procedure will occur at three locations:

1. The wellhead. In a controlled shutdown situation, the master valve and/or wing valve on the wellhead will be shut trapping the CO_2 in the well. A gauge at the wellhead will allow measurement of the pressure below the valve in the well. This is important so that during re-startup the pressure can be equalized across the valve before opening the valve and continuing injection.

2. The piping from compression facility to wellhead. The wellhead will have (at a minimum) two shut-off valves During an emergency shutdown both shut-off valves will close automatically due to upset conditions. During a controlled shutdown the valves will be shut in sync with the compressor shutdown and the well head valves to ensure the CO_2 in the piping is trapped until injection commences again. During re-startup, the pressure at each end of the piping will be equalized across the valve and the valve opened to allow continued injection.

3. The capture and compression system will be designed to shutdown safely with positive control of the CO2 in the event of an emergency shutdown. Over-pressure protection will be incorporated into the compression system design such that any CO2 that cannot be contained during a shutdown is vented to atmosphere at a safe distance from operating staff. During re-startup the compressor will be brought online and compress against the closed isolation valves until the pressure equalizes and then the valves will be open, and injection will continue.

6.4 Well Annulus Pressure Maintenance System

The purpose of the tubing-casing annulus monitoring and pressure system is to maintain the annular fluid at a prescribed pressure. The automated annulus monitoring system that has been designed for this purpose is part of the comprehensive well annular pressure maintenance system. The well pressure maintenance system includes piping, instrumentation valves, controls, and other equipment to accomplish several functions, including the following:

- Maintain a prescribed pressure on the annular fluid in the well to achieve a positive pressure differential across the packer
- Automatically deliver annular fluid to the well when the fluid volume in the well decreases due to temperature and/or pressure changes
- Automatically remove annular fluid from the wells when the fluid volume in the well increases due to temperature and/or pressure changes
- Monitor parameters (e.g., pressure, temperature, fluid levels, nitrogen pressure) associated with the pressure-maintenance system
- Automatically cease CO_2 injection to the wells when injection pressure or annulus pressure fall outside of prescribed limits.

The annular monitoring system will maintain the wellhead pressure of the annular fluid between the tubing and the long string of casing within the pre-determined levels as specified in the permit. The system will maintain the annular pressure 50-100 psi above the pressure of the CO_2 in the injection tubing at the depth of the packer. The annular fluid pressure will be continuously monitored so that CO_2 injection can be halted when the annular fluid pressure falls outside the pre-determined range for a period that exceeds allowable limits. The annular monitoring system will conceptually consist of a continuous annular pressure gauge, a pressurized annulus fluid reservoir (annulus head tank), pressure regulators, and tank fluid level indication. The annulus system will maintain annulus pressure by controlling the pressure on the annulus head tank using compressed nitrogen. The system will be monitored by the annular pressure gauges and the Supervisory Control and Data Acquisition (CONTROL) system. The pressure and fluid level in the annulus head tank will be monitored and recorded continuously. The annulus head tank pressure will be controlled by pressure regulators–one set of regulators to maintain the pressure above 50 psi over tubing head pressure by adding compressed nitrogen and the other to relieve pressure above 100 psi by venting gas off the annulus head tank. Any changes to the composition of annular fluid will be reported in the next report submitted to the permitting agency. When the injection system is shut down, the annular pressure will be reduced to reduce collapse pressure on the tubing string.

6.5 Injection Well Operational Monitoring

Bonanza Carbon Capture will install and use sensors to monitor injection pressure, mass injection rate, and volume (calculated). Bonanza Carbon Capture will also monitor the pressure on the annulus between the tubing and the long string casing, the backside pressure of all surface and intermediate casing strings, the annulus fluid volume added, and the temperature of the CO_2 stream, as required by 40 CFR 146.88(e)(1), 146.89(b), and 146.90(b). If one of these monitoring devices (except for the mass flow meter) fail, manual readings and recordings of the data will be made daily until the sensor is repaired. If the mass flow meter fails, a secondary or backup flow meter will be used to gather and record the data. Further details of the proposed Operational monitoring is in Permit Section 7.0 – Testing and Monitoring Plan.

6.6 Control and Alarm System

This section describes the process that will be implemented to safely halt CO_2 injection in the event of an injection well or equipment failure, or if the injection pressure exceeds the predetermined maximum level. The injection process will be monitored by pressure, temperature, and flow measuring devices connected from the capture facility and compression to the injection well over the control system. The monitoring system will be capable of detecting when injection conditions are out of acceptable limits and responding by either adjusting conditions or halting injection. The system is designed to operate automatically with minimal operator intervention. This section presents the following:

- A brief overview of the monitoring and control

- A description of the automatic shutdown of the capture facility, including the annular pressure, injection pressure, and flow rate that will trigger operations shutdown

The well control architecture and functionality, including process alarms, plant interlocks, shutdown alarms, and automatic shutdown sequence are described below. For further details on shutdown steps for potential failures refer to Permit Section 10.0 – Emergency & Remedial Response Plan.

6.6.1 Control Overview

The proposed control for the well consists of a control system connected to all sensors within the compression facility, injection piping, and injection well. Alarms, open/close, position, temperature, pressure, and other critical signals will be passed between the capture facility, system and the injection well through the control system. User privileges and other security measures will be implemented to limit access to and control of the well control equipment.

Injection pressure will be determined by the pressure of the CO_2 near the wellhead of the injection well. The compressor station will be controlled to limit the CO_2 injection pressure and flow rate within normal operating ranges.

6.6.2 Process Alarms and Automatic Shutdown

Alarms will be implemented throughout the injection system and monitored by the control system. Alarms are of three types: process (non-shutdown) flags/alarms, shutdown alarms, and interlock alarms. Process alarms will be used to alert the control room operator whenever process variables are out of the accepted operating range and operator, or maintenance action may be required. Shutdown alarms will indicate operation outside of acceptable parameters, including a loss of mechanical integrity. An active shutdown alarm and/or plant interlock will trigger an automatic shutdown sequence in which the CO_2 injection process is automatically shut down by the well control procedures. Further details about risk scenarios, notification plans and emergency response can be found in Section 10 ERRP.

6.6.2.1 Process Alarms (Non-Shutdown)

Process alarm designations will indicate the relative value of the process variable versus the normal value. For instance, a low-pressure alarm will indicate that the process pressure is lower than the normally expected pressure. Process alarms will include low and/or high alarms that notify if a process variable deviates from the set point or expected value. Discrete inputs from binary devices such as pressure switches, vibration detection, or alarm contacts may require action. Process (non-shutdown) alarms will be triggered by monitoring wellhead temperature and pressure, compressor discharge, and annular fluid conditions as necessary.

6.7.2.2 Shutdown Alarms

The CO_2 injection process will be automatically shut down under two conditions. One shutdown condition will occur when the annular fluid pressure falls outside the pre-determined range for a period that exceeds allowable limits. The other primary shutdown condition will occur when the CO_2 injection pressure exceeds the maximum allowable injection pressure specified in the permit. Additional automatic shutdowns may be implemented because of plant interlocks outside of the well operations, as described below. Operator intervention will be necessary to restart the injection process after an automatic shutdown sequence. Shutdown alarms will be used for the following parameters:

- Annular fluid pressure, injection well (low-low or high-high alarm)
- CO_2 injection pressure (high-high alarm).

6.6.2.3 Plant Interlocks

Plant interlock status signal(s) will be sent from the well control to the control system. The plant interlock will indicate whether conditions in the system are acceptable for the injection process to occur. During injection operations, the plant interlock will be used to initiate an automatic shutdown sequence in the event of equipment malfunctions, critical alarms, or other conditions in the system that warrant a shutdown of the injection process. During startup operations, the plant interlock will act as a run permission command for the injection process to start up. Any capture system shutdowns will cause ethanol plant emissions to revert to atmospheric discharge until such time the capture system can be brought back online.

6.6.2.4 Shutdown Planning

If a shutdown is triggered or a loss of mechanical integrity is discovered, the owner or operator will immediately investigate and identify as expeditiously as possible the cause of the shutoff. If, upon such investigation, the well appears to be lacking mechanical integrity, or if monitoring required under 40 CFR 146.88(e) otherwise indicates that the well may be lacking mechanical integrity, the owner or operator must:

- Immediately cease injection
- Take all steps reasonably necessary to determine whether there may have been a release of the injected carbon dioxide stream or formation fluids into any unauthorized zone
- Notify the Director within 24 hours
- Restore and demonstrate mechanical integrity to the satisfaction of the Director prior to resuming injection
- Notify the Director when injection can be expected to resume