

INJECTION AND MONITORING WELL PLUGGING PLAN
40 CFR 146.92(b)

NBU CCS Site

Facility Information

Facility name: NBU CCS Site

- NBU- CCS 1 Arbuckle
- NBU- CCS 2 Arbuckle

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Well location: Osage County, Oklahoma

NBU- CCS 1: 36.8292741/ -96.7251231
NBU- CCS 2: 36.8228557/ -96.7251776

The proposed plugging plan details for two injection wells (NBU CCS 1 and NBU CCS 2) plus one in-zone monitoring well is described in this section. The two proposed injection wells will consist of two Arbuckle injection wells. The in-zone monitoring well will be designed to measure the injection zone pressure and temperature in the Arbuckle injection zone using down hole and surface gauges and sensors. The in-zone monitoring well is to be located between the two proposed injection wells. The wells will be plugged in accordance with 40 CFR 146.92(b). The planned procedures and wellbore diagrams are provided to illustrate what the proposed wellbore conditions will look like after the plugging and abandonment of the wells. The plugging schedule of the wells will occur at different times during the project life cycle. The last well to be plugged will be the in-zone monitoring well and this will occur after verification that the CO₂ plume and pressure front have stabilized. CapturePoint Solutions, LLC will conduct injection well plugging and abandonment according to the procedures below.

1 Planned Tests or Measures to Determine Bottom-Hole Reservoir Pressure

A bottomhole reservoir pressure will be determined prior to commencing injection well plugging operations [40 CFR 146.92(b)(1)]. The monitoring well that is located between the two injection wells will be used to obtain a representative bottom hole pressure (BHP).

The bottomhole pressure measurement will be used to calculate the density of the workover fluid required to safely complete the plug and abandonment procedure. Determination of BHP is described in Section 4 for each well to be plugged.

2 Planned External Mechanical Integrity Test(s)

CapturePoint Solutions, LLC will conduct at least one of the tests listed in **Table 1** to verify external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(b)(2).

An active pulsed-neutron log will be run and then the well will be pressure-tested to ensure integrity both inside and outside of the casing prior to plugging. Production logging tools (PLTs), tracers, noise or temperature logs could be run as substitutions.

Pulsed-neutron logs are used to evaluate the CO₂ or water saturations over time and the temperature surveys could detect the movement of fluid behind cement and casing. If such a condition is detected the location of fluid movement in the well can be evaluated and corrected. Pressure tests are used to ensure the casing is sufficiently sealed to prevent the loss or addition of formation fluids into the well. If a pressure decrease is observed, it may indicate that the well does not have sufficient mechanical integrity and that the well needs to be repaired.

If a loss of mechanical integrity is discovered, the well will be further evaluated and repaired prior to proceeding further with the plugging operations. Testing criteria to determine whether mechanical integrity test results are successful or not are described in Module E.1. Testing and Monitoring Plan, Details for MITs are also described below in Section 4.

All casing strings in each well will have been cemented to the surface at the time of construction and will not be retrievable at abandonment.

Details regarding equipment, precision and MITs are described in section 6.6 of the Testing and Monitoring Plan.

Table 1. Planned MITs.

Test Description	Location
Pulsed-Neutron Log	Monitoring and injection well locations
Noise or Temperature Log	
Oxygen-Activation Log	

3 Information on Plugs

40 CFR 146.92(b) reads as follows

CapturePoint Solutions, LLC will use the materials and methods noted in Tables 2 and 33, to plug the two Arbuckle injection wells and the in-zone monitoring well, respectively. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well as assessed during construction. The proposed plugging plans are illustrated in Figures 1 – Arbuckle injection wells, and, Figure 2- In-zone monitoring. The cement(s) formulated for plugging will be designed to prevent any unwanted fluid movement, resist the corrosive aspects of CO₂ with water mixtures and protect all USDWs. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. The owner or operator will report the wet density and will retain duplicate samples of the cement used for each plug. Volume calculations will be based upon the final dimensions of the long string casing. The balance method will be used to spot the Plugs. Plugs will be tagged at the cement plug top to verify location and integrity.

Volume calculations for determining the quantity of cement and slurry volume are as follows:

Cement plug volume calculation (sacks) = Casing capacity (cu ft/ft) * plug height/cement yield (cu ft/sack)

Example for surface casing plug 7" casing with 6.276" ID using 11.8 ppg cement with 2.018 yield (cu ft/sack)

Plug volume in sacks = $(0.2148 \text{ cu ft/ft}) * (700 \text{ ft} - 5 \text{ ft}) / (2.018 \text{ cu ft/sack}) = 73.9 \text{ sacks}$
round up to 75 sacks

Details regarding materials used to prevent detrimental interactions because of contact with formation fluids and injectate are described in the following procedures and detailed in tables 2 through 5 in Section 4.

4 Narrative Description of Plugging Procedures

Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), CapturePoint Solutions, LLC will notify the regulatory agency at least 60 days before plugging the well and provide updated Injection Well Plugging Plan, if applicable. §1

Inspections will be made available to the regulatory authority at their request. A closure report certifying that the well or wells were closed in accordance with applicable requirements will be submitted to the proper agencies within 60 days of plugging each well. The report will include records for any newly constructed or discovered wells within the Area of Review.

When plugging and abandonment is complete, CapturePoint, LLC will submit certification to the authorized regulatory body (by the facility and by a licensed, professional engineer with current registration, who is knowledgeable and experienced in practical drilling engineering and who is familiar with the special conditions and requirements of injection well construction) that the injection well has been closed in accordance with the regulations. Plugging reports will be submitted within 60 days of well plugging and CapturePoint, LLC will retain a copy of the plugging report for a minimum of 10 years following site closure [40 CFR 146.92(d)].

5. Preparation and Plugging Procedures

Preparation Procedures for Arbuckle injection wells to be plugged:

1. After ceasing injection, bottomhole pressure measurements will be taken by using the historical and current BHP data taken from the in-zone monitoring well, prior to starting the P&A process on the well. Use the recorded bottomhole pressure to calculate the density of workover fluid required to safely complete the proposed plug and abandon procedure.
2. Run active pulsed-neutron log. Production logging tools (PLTs) such as tracers, noise or temperature logs could be run in substitution.
3. Move rig in. Pump into well with the calculated density of the workover fluid based on BHP survey in Step 1. A minimum of three tubing volumes will be injected into the formation without exceeding the fracture pressure.
4. The injection wells all have a well head and tubing installed. A packer is set in the casing within 75' of the top injection interval. Test casing/ tubing annulus to 200 psi or pressure required. Bleed casing pressure to 0 psi.
 - a. If a loss of mechanical integrity is discovered, the well will be repaired prior to proceeding further with the plugging operations.
 - b. All casing in the well has been cemented to surface at the time of construction and will not be retrievable at abandonment.
 - c. If the tubing and casing pressure measures 0 psi, continue with well plugging procedures for the Arbuckle CO₂ injection zone.

Table 2 and **Figure 1** contain the individual cement plug details and a proposed wellbore diagram for a Sparta Injection well, respectively.

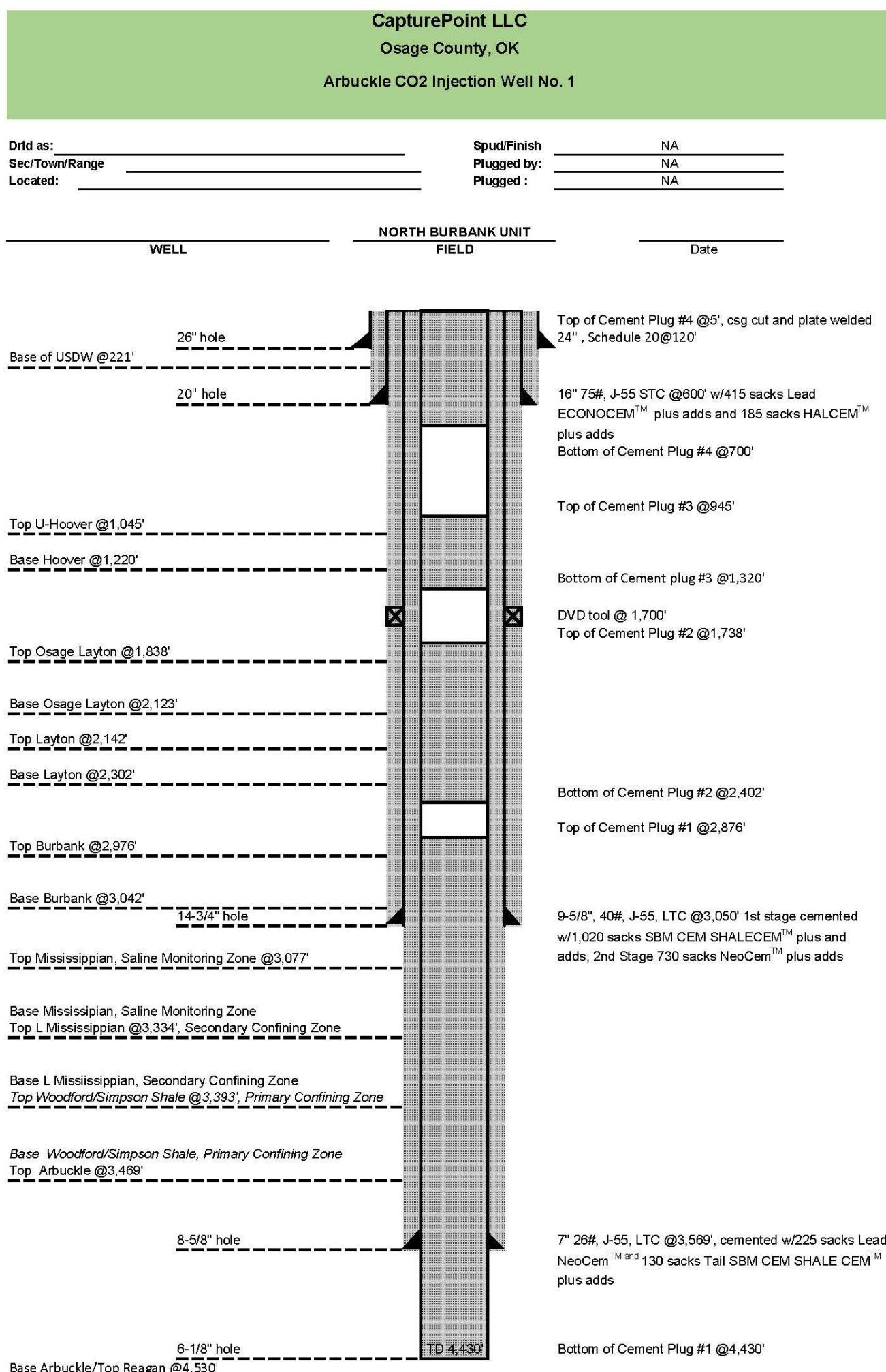
1. ND tree and NU BOP's. Test BOPs per regulations. Pull injection tubing and packer.
2. RIH with work string to TD @4,430'. Set balance plug #1 from TD to 2,876'. Use a total of approximately 310 sacks of cement per Table 2. Displace cement with calculated workover fluid. Allow cement to set and tag top of cement. If cement top is not 2,876', place more cement.
3. Move work string to base of cement plug #2 @2,402'. Set balance plug #2 from 2,402' to 1,738' with 75 sacks cement. Allow cement to set and tag top of cement. If cement top is not at 1,738', place more cement.

4. Move work string to base of cement plug #3 @1,320'. Set balance plug #3 from 1,320' to 945' with 40 sacks of cement. Allow cement to set and tag top of cement. If cement top is not 945', place more cement.
5. Move work string to base of cement plug #4 @700'. Set balance plug #4 from 700' -5' with 75 sacks of cement. Allow cement to set and tag top of cement. If cement top is not at 5', place more cement.
6. Cut casing off 5 feet below ground level. Clean cellar and weld on plate with well information. Clean location.

Table 2. Injection Well Plugging Details

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4
Diameter of casing in which plug will be placed (Inches)	7" & 6 1/8"	7"	7"	7"
Depth to bottom of tubing or drill pipe (Feet)	4,430	2,402	1,320	700
Sacks of cement to be used	310	75	40	75
Slurry weight (lb/gal)	14.5	11.8	11.8	11.8
Calculated top of plug (Feet)	2,876	1,738	945	5
Bottom of plug (Feet)	4,430	2,402	1,320	700
Type of cement or other material	SBM CEM SHALECEM or equivalent	NeoCem or equivalent	NeoCem or equivalent	NeoCem or equivalent
Method of emplacement (e.g., balance method, retainer method, or two-plug method)	Balance Plug	Balance Plug	Balance Plug	Balance Plug

Figure 1. Proposed Injection Well Plugging Diagram



5.1 Well Plugging Procedures In-Zone Monitoring Well

Preparation Procedures for in-zone monitoring wells to be plugged:

1. Use the historical and current BHP data taken from the in-zone monitoring well, prior to starting the P&A process on the well. Use the recorded bottomhole pressure to calculate the density of workover fluid required to safely complete the proposed plug and abandon procedure.
2. Run active pulsed-neutron log. Production logging tools (PLTs) such as tracers, noise or temperature logs could be run in substitution.
3. Move rig in. Pump into well with the calculated density of the workover fluid based on BHP survey in Step 1. A minimum of three tubing volumes will be injected into the formation without exceeding the fracture pressure.
4. The monitoring well has a well head, tubing, packer, cable, and BHP equipment installed. A packer is set in the casing within 75' of the top monitoring interval. Test casing/tubing annulus to 200 psi or pressure required. Bleed casing pressure to 0 psi.
 - a. If a loss of mechanical integrity is discovered, the well will be repaired prior to proceeding further with the plugging operations.
 - b. All casing in the well has been cemented to surface at the time of construction and will not be retrievable at abandonment.
 - c. If the tubing and casing pressure measures 0 psi, continue with well plugging procedures for the Arbuckle CO₂ injection zone.

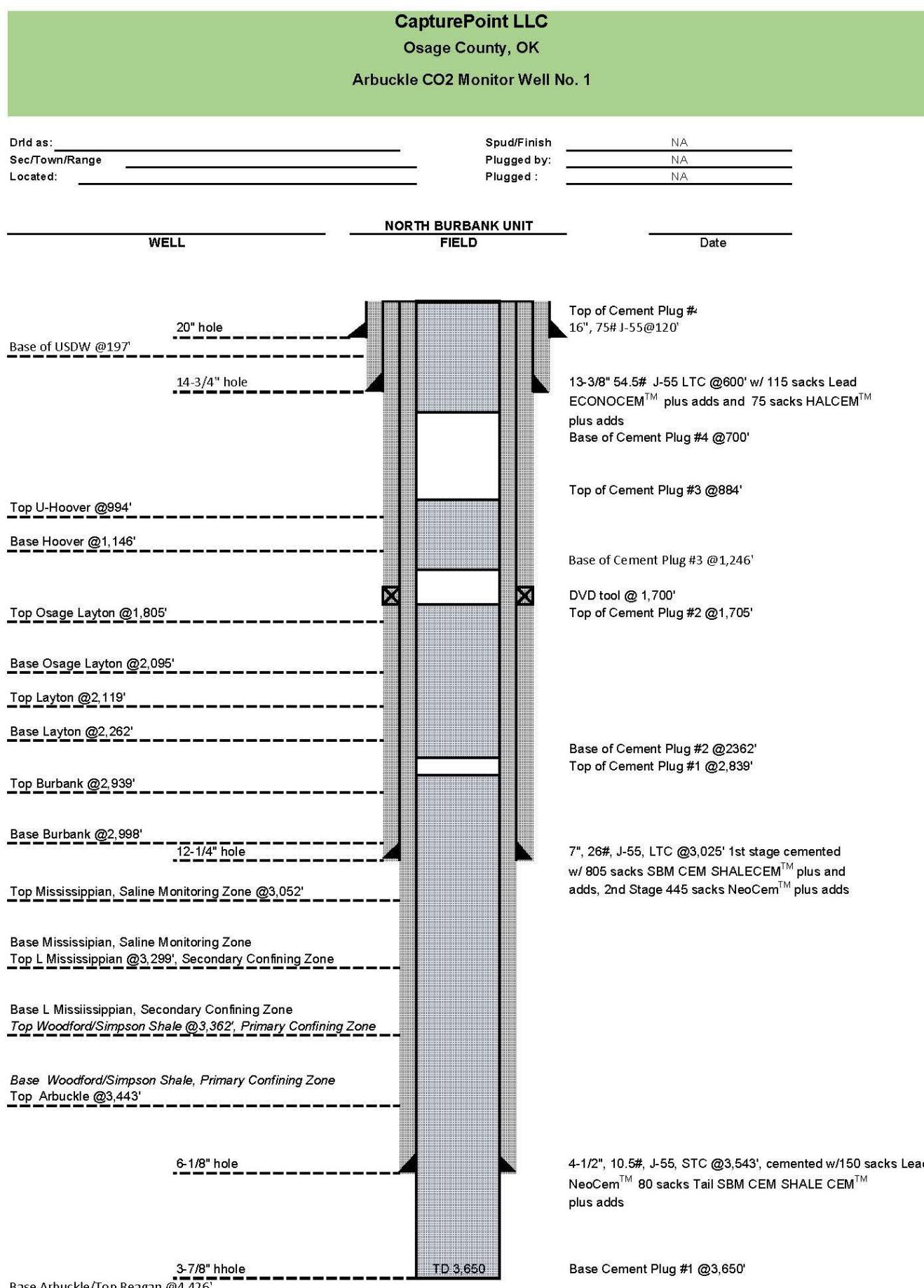
Table 3 and **Figure2** contain the proposed cement plug details and a proposed wellbore diagram for an in-zone monitoring, well.

1. ND tree and NU BOP's. Test BOPs per regulations. Pull cable, pressure monitoring equipment, tubing and packer.
2. RIH with work string to TD @3,650'. Set balance plug #1 from TD to 2,839'. Use a total of approximately 80 sacks of cement per Table 3. Displace cement with calculated workover fluid. Allow cement to set and tag top of cement. If cement top is not 2,839', place more cement.
3. Move work string to base of cement plug #2 @2,362'. Set balance plug #2 from 2,362' to 1,705' with 30 sacks cement. Allow cement to set and tag top of cement. If cement top is not at 1,705', place more cement.
4. Move work string to base of cement plug #3 @1,246'. Set balance plug #3 from 1,246' – 884' with 25 sacks of cement. Allow cement to set and tag top of cement. If cement top is not 884', place more cement.
5. Move work string to base of cement plug #4 @700'. Set balance plug #4 from 700' -5' with 35 sacks of cement. Allow cement to set and tag top of cement. If cement top is not at 5', place more cement.
6. Cut casing off 5 feet below ground level. Clean cellar and weld on plate with well information. Clean location.

Table 3. Plugging details In-Zone Monitoring Well

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4
Diameter of casing in which plug will be placed (Inches)	4 1/2 & 3 7/8	4 1/2	4 1/2	4 1/2
Depth to bottom of tubing or drill pipe (Feet)	3,650	2,362	1,246	700
Sacks of cement to be used	60	30	25	35
Slurry weight (lb/gal)	14.5	11.8	11.8	11.8
Calculated top of plug (Feet)	2,839	1,705	884	5
Bottom of plug (Feet)	3,650	2,362	1,246	700
Type of cement or other material	SBM CEM SHALECEM or equivalent	NeoCem or equivalent	NeoCem or equivalent	NeoCem or equivalent
Method of emplacement (e.g., balance method, retainer method, or two-plug method)	Balance Plug	Balance Plug	Balance Plug	Balance Plug

Figure 2. Proposed Wellbore Diagram In-Zone Monitoring Well



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