

Plan revision number: 1
Plan revision date: 10/08/2020

INJECTION WELL PLUGGING PLAN 40 CFR 146.92(b)

Wabash CCS Project

INSTRUCTIONS

This template provides an outline and recommendations for the Injection Well Plugging Plan.

In this template, examples or suggestions appear in **blue text**. These are provided as general recommendations to assist with site- and project-specific plan development. The recommendations are not required elements of the Class VI Rule. This document does not substitute for those provisions or regulations, nor is it a regulation itself, and it does not impose legally-binding requirements on the EPA, states, or the regulated community.

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Remember that, pursuant to 40 CFR 146.92(d), the requirement to maintain and implement an approved Injection Well Plugging Plan is directly enforceable regardless of whether the requirement is a condition of the permit. For more information, see the Class VI guidance documents at <https://www.epa.gov/uic/class-vi-guidance-documents>. It is the responsibility of the owner or operator to maintain records of previous revisions to this plan.

To avoid duplicative reporting, you are encouraged to provide relevant cross-references to other submissions made with the GSDT.

Facility Information

Facility name: Wabash Carbon Services
WVCCS#1

Facility contact: Rory Chambers Vice President Operations
444 W. Sandford Ave, West Terre Haute, IN 47885
(812) 281-2810 RChambers@wvresc.com

Well location: Clinton, Vermillion County, Indiana
39° 37' 27.88" N, 87° 29' 19.17" W

Wabash Carbon Services (WCS) will conduct injection well plugging and abandonment according to the procedures below.

Planned Tests or Measures to Determine Bottom-Hole Reservoir Pressure

Bottom-hole pressure measurements will be used to determine the pressure required to squeeze the cement from the well casing into the injection reservoir. In addition, these data will be used to determine the need for well control equipment. The weight of brine required to prevent the well from flowing (under balanced) will be calculated using this information. The pressure measurements will also be used to determine the formulation of cement to be used to plug the well.

During injection well operation there will be information pressure devices continuously monitoring the reservoir pressure. After cessation of injection activities these gauges will be used to obtain the final measurements of pressure in the injection zone. In the event that the originally installed gauges are not functioning properly after cessation of injection, bottom hole injection zone pressure and temperature will be obtained by running gauges in hole via wireline.

Planned External Mechanical Integrity Test(s)

The tubing and packer will be retrieved at the end of the injection period as part of the plugging operation. The well casings will be left in hole and abandoned in place as part of the plugging operation. To verify that the injection well has external mechanical integrity (no leakage or upward migration due to channeling outside of the casing from the injection zone as required by the regulations), WCS 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(a).

Table 1. Planned MITs.

Test Description	Location
Cement Bond Log (CBL)	Sensitive, Confidential, or Privileged Information
Ultrasonic Imaging Tool (USIT)	
Temperature Log	
Oxygen Activation Log	

The temperature log will be run over the entire depth of the injection well. Data from the logging run will be evaluated for anomalies in the temperature curve, which would be indicative of fluid migration along the well bore. These data will be compared to data from logs performed prior to injection of CO₂ into the well. Deviations between the temperature logs performed before and after injection of CO₂ may indicate issues related to the integrity of the well casing or cement.

Cement Bond Log (CBL) or UltraSonic Imaging Tool (USIT) logs will be run to verify the integrity of the cement primarily associated with the injection zone. The Oxygen Activation Log (also known as Water Flow Log (WFL) or Hydro-Log) is run to detect whether there is upward migration from the injection zone due to channeling or a bad cement job on the outside of the casing. If a significant channel is detected, appropriate remedial repair can be carried out.

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Temperature/CBL/ USIT logs and OA logs are all run with wire line-based tools supplied by a qualified well services company (both E-line or slickline in memory mode). The test results will be interpreted by the services company and the condition of cement and casing will be provided to WCS with a verification of the well having external mechanical integrity.

Information on Plugs

WCS will use the materials and methods noted in Table 2 to plug the injection well. 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 and during the active injection life of the well. The cement(s) formulated for plugging will be compatible with the carbon dioxide stream. 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. Figure 1 shows the proposed plugging schematic and relevant formation information.

Table 2. Plugging details.

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4	Plug #5	Plug #6	Plug #7	Plug #8	Plug #9
Outer Diameter of casing in which plug will be placed (in.) <small>Sensitive, Confidential, or Privileged Information</small>	Sensitive, Confidential, or Privileged Information								
Depth to bottom of tubing or drill pipe (ft)									
Sacks of cement to be used (each plug)									
Slurry volume to be pumped (ft ³)									
Slurry weight (lb./gal)									
Calculated top of plug (ft)									
Bottom of plug (ft)									
Type of cement or other material									
Method of emplacement (e.g., balance method, retainer method, or two-plug method)									

Figure 1 Plugging Schematic

Sensitive, Confidential, or Privileged Information



Narrative Description of Plugging Procedures

Notifications, Permits, and Inspections

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

Notifications, Permits, and Inspections are the same for plug and abandonment during construction and post-injection.

1. Notify Indiana EPA and/or US EPA (as appropriate) 48 hours prior to commencing operations. Ensure proper notifications have been given to all regulatory agencies for rig move.
2. Make sure all permits to P&A have been duly executed by all local, State & Federal agencies and Wabash have written permission to proceed with planned ultimate P&A procedure.
3. Ensure in advance that a pre-site inspection has been performed and the rig company has visited the site and is capable of transporting rig, tanks & ancillary equipment to perform P&A operations. Notify all key third parties of expected work scope, and ensure third party contracts for work are in place prior to move in.
4. Have copies of all government permits prior to initiating operations and maintain on location at all times. Check to see if conditions of approval have been met.
5. Make sure partners (U.S. DOE, Indiana DEM (or Indiana DNR) and/or US EPA, and Wabash) approvals have been obtained, as applicable.
6. Make sure all necessary safety forms are on the rig, i.e., NPDES, safety meetings, trip sheets, etc.

Volumes will be calculated for specific abandonment wellbore environments based on desired plug diameter and length required. Volume calculations are the same for plug and abandonment during construction and post-injection.

1. Choose the following:
 - a. Length of the cement plug desired.
 - b. Desired setting depth of base of plug.
 - c. Amount of spacer to be pumped ahead of the slurry.
2. Determine the following:
 - a. Number of sacks of cement required.
 - b. Volume of spacer to be pumped behind the slurry to balance the plug.
 - c. Plug length before the pipe is withdrawn.
 - d. Length of mud freefall in drill pipe.
 - e. Displacement volume required to spot the plug.
3. Field cementing and wellsite supervisor will both review calculations prior to spotting any plug.

Plugging Procedures

1. Mobilize workover (WO) or Plugging Rig Equipment. Give appropriate notice before commencing operations.
2. Move in rig to well location. Notify the Project Coordinator before moving rig. Ensure all overhead restrictions (telephone, power lines, etc.) have been adequately previewed and managed prior to move in and rig up (MI & RU). All CO₂ pipelines will be marked and noted to Workover (WO) rig supervisor prior to moving in (MI) rig. Move rig onto location per operational procedures.
3. Conduct a safety meeting for the entire crew prior to operations, record date and time of all safety meetings and maintain records on location for review.
4. Make daily "Project Inspection" walks around the rig. Immediately correct deficiencies and report deficiencies during the regulatory discussion during morning meetings/calls. Maintain International Association of Drilling Contractors (IADC) or plugging reports daily at the WO rig logbook or doghouse.
5. MI rig package and finish rigging up hoses, hydraulic lines, etc.
6. Open up all valves on the vertical run of the tree. Check pressures.
7. Rig up pump and line and test same to 2,500 psi. Fill casing with kill weight brine [REDACTED]. Bleeding off occasionally may be necessary to remove all air from the system. Keep track and record volume of fluid to fill annulus (Hole should be full). If there is pressure remaining on tubing, rig to pump down tubing and inject two tubing volumes of kill weight brine. Monitor tubing and casing pressure for 1 hour. If both casing and tubing are dead then nipple up blowout preventers (NU BOP's). Monitor casing and tubing pressures.
8. If needed, if well is not dead nor pressure cannot be bled off of tubing, rig up (RU) slickline (SL) and set X-lock plug in X nipple located in X-Plug in tailpipe below packer. Circulate well with kill weight brine. Ensure well is dead. Nipple down (ND) tree. NU Blowout Prevention Equipment (BOP's) and function test same. [REDACTED] Test BOP's as per local, state or federal provisions or utilize higher standard, 30 CFR250.616. Test pipe rams and blind rams [REDACTED]. Test annular preventer [REDACTED]. Test all Texas Iron Works (TIW's), BOP's, choke and kill lines, choke manifold, etc. [REDACTED] **NOTE: Make sure casing valve is open during all BOP tests.** After testing BOPs pick up [REDACTED] tubing string and unlatch seal assembly from seal bore. Rig slick line and lubricator back to well and remove X-plug from well. Rig to pump via lubricator and keep well dead.
9. RU [REDACTED] rig hydraulic tubing tongs for handling of production tubing. Pick back up on tubing string and pull seal assembly from seal bore. Pull hanger to floor and remove same. Circulate bottoms up with packer fluid.

10. Pull out of hole (POOH) with tubing laying down same. **NOTE: Ensure well does not flow due to CO₂ “back flow”! Well condition is to be over-balanced at all times with at least 2 well control barriers in place at all times.**
11. Contingency: If unable to pull seal assembly, RU electric line and make cut on tubing string just above packer. Note: Cut must be made above packer [REDACTED] Several different sizes of cutters and pipe recovery tools should be on location due to possible tight spots in tubing. If successful pulling seal assembly then pick up [REDACTED] workstring and Trip in Hole (TIH) with packer retrieving tools. If tubing was cut in previous step, then skip this step. Latch onto packer and pull out of hole laying down same. If unable to pull packer, pull work string out of hole and proceed to next step. Assuming tubing can be pulled with packer with no issues, run CBL cement bond log or USIT ultrasonic imager to determine that there is no leakage around the wellbore above the caprock. If leakage is noted, perform diagnostics to determine whether there is actual leakage or micro-annulus etc. Rerun CBL/USIT under pressure, if necessary, to eliminate micro-annulus effects. If leakage is confirmed, prepare cement remediation plan and execute during plugging operations. Set [REDACTED] cement retainer on wireline just in Oneota above the Potosi formation. Trip into hole with work string and sting into cement retainer. Test backside [REDACTED] on chart. A successful casing test should have less than 10% bleed off over the 30 minute period. This will be considered a successful casing test. Establish injection with packer kill fluid [REDACTED] Sting out of retainer.
12. With pipe stung out of retainer, mix and pump EverCRETE CO₂ resistant cement [REDACTED] plus fluid loss additive as proposed by cementing company and actual downhole conditions (temperature, bottom hole pressure (BHP), etc.). Obtain fluid loss [REDACTED] Follow that with EverCRETE CO₂ resistant cement mixed at 12.7 ppg with dispersant. Circulate to within [REDACTED] work/tubing string, sting into retainer and finish mixing cement. Displace tubing and squeeze away [REDACTED] cement into the open perforations. Note: Do not squeeze at higher pressures than 2,000 psi. Sting out of retainer and reverse out a minimum of 2 pipe volumes. Note: Leave cement on top of retainer.
13. Pull out of hole (POOH) racking back work string. Shut down for 12 hours. Trip in Hole (TIH) open ended. Tag up on cement on top of retainer and note same.
14. Circulate well and ensure well is in balance. Place tubing just above cement top from previous day. Mix and spot [REDACTED] balanced plug of EverCRETE CO₂ resistant cement [REDACTED] Pull out of plug and reverse circulate tubing. Repeat this operation and spot a second [REDACTED] balance plug.
15. POOH racking back work string. Shut down for 12 hours. Trip in Hole (TIH) open ended. Tag up on cement on top of retainer and note same.
16. Circulate well and ensure well is in balance. Place tubing just above cement top from previous day. Mix and spot [REDACTED] balanced plug [REDACTED]. Pull out of plug and reverse circulate tubing. Repeat this operation until a total of 9 (including previously

set EverCRETE plugs) plugs have been set. If plugs are well balanced, then the reverse circulation step can be omitted until after each third plug. Lay down work string while pulling from well. If rig is working daylight only then pull 10 stands and rack back in derrick and reverse tubing before shutting down for night. The following morning, trip back in hole and tag plug and continue. After 9 plugs have been set pull tubing from well and shut in for 12 hours. Trip in hole with tubing and tag cement top. Calculate volume for final plug. Pull tubing back out of well. Nipple down BOPs and cut all casing strings below plow line (min 3 feet below ground level or per local policies/standards and Wabash requirements). Trip in well and set final cement plug. Lay down all work string, etc. Rig down all equipment and move out. Clean cellar to where a plate can be welded with well name onto lowest casing string at 3 ft or as per regulatory requirements. The steel plate/cap will have the well identification number, the UIC Class VI permit number, and the date of plug and abandonment inscribed on it. Soil will be backfilled around the well and the area planted with natural vegetation or as per regulatory requirements.

17. File all plugging forms to local state, federal and other agencies as required. After the completion of the plugging activities, a Plugging and Abandonment (P&A) Report as per EPA Form 7520-14 will be submitted to the UIC EPA Region 5 Office describing the details regarding the P&A job within 60 days of completing the plugging activities.

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WVCCS#2

Facility contact: Rory Chambers Vice President Operations
444 W. Sandford Ave, West Terre Haute, IN 47885
(812) 281-2810 RChambers@wvresc.com

Well location: West Terre Haute, Vigo County, Indiana
39° 33' 3.72" N, 87° 29' 16.60" W

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Bottom-hole pressure measurements will be used to determine the pressure required to squeeze the cement from the well casing into the injection reservoir. In addition, these data will be used to determine the need for well control equipment. The weight of brine required to prevent the well from flowing (under balanced) will be calculated using this information. The pressure measurements will also be used to determine the formulation of cement to be used to plug the well.

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Bottom of plug (ft)									
Type of cement or other material									
Method of emplacement (e.g., balance method, retainer method, or two-plug method)									

Figure 1 Plugging Schematic

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 - c. Amount of spacer to be pumped ahead of the slurry.
2. Determine the following:
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3. Conduct a safety meeting for the entire crew prior to operations, record date and time of all safety meetings and maintain records on location for review.
4. Make daily "Project Inspection" walks around the rig. Immediately correct deficiencies and report deficiencies during the regulatory discussion during morning meetings/calls. Maintain International Association of Drilling Contractors (IADC) or plugging reports daily at the WO rig log book or doghouse.
5. MI rig package and finish rigging up hoses, hydraulic lines, etc.
6. Open up all valves on the vertical run of the tree. Check pressures.
7. Rig up pump and line and test same to 2,500 psi. Fill casing with kill weight brine [REDACTED] [REDACTED] Bleeding off occasionally may be necessary to remove all air from the system. Keep track and record volume of fluid to fill annulus (Hole should be full). If there is pressure remaining on tubing rig to pump down tubing and inject two tubing volumes of kill weight brine. Monitor tubing and casing pressure for 1 hour. If both casing and tubing are dead then nipple up blowout preventers (NU BOP's). Monitor casing and tubing pressures.
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9. RU [REDACTED] rig hydraulic tubing tongs for handling of production tubing. Pick back up on tubing string and pull seal assembly from seal bore. Pull hanger to floor and remove same. Circulate bottoms up with packer fluid.

10. Pull out of hole (POOH) with tubing laying down same. **NOTE: Ensure well does not flow due to CO2 “back flow”! Well condition is to be over-balanced at all times with at least 2 well control barriers in place at all times.**
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13. POOH racking back work string. Shut down for 12 hours Trip in Hole (TIH) open ended. Tag up on cement on top of retainer and note same.
14. Circ well and ensure well is in balance. Place tubing just above cement top from previous day. Mix and spot [REDACTED] balanced plug of EverCRETE CO2 resistant cement [REDACTED] Pull out of plug and reverse circulate tubing. Repeat this operation and spot a second [REDACTED] balance plug.
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16. Circ well and ensure well is in balance. Place tubing just above cement top from previous day. Mix and spot [REDACTED] balanced plug [REDACTED]. Pull out of plug and reverse circulate tubing. Repeat this operation until a total of 9 (including previously set EverCRETE plugs) plugs have been set. If plugs are well balanced then the reverse circulation step can be omitted until after each third plug. Lay down work string while

pulling from well. If rig is working daylight only then pull 10 stands and rack back in derrick and reverse tubing before shutting down for night. The following morning trip back in hole and tag plug and continue. After 9 plugs have been set pull tubing from well and shut in for 12 hours. Trip in hole with tubing and tag cement top. Calculate volume for final plug. Pull tubing back out of well. Nipple down BOPs and cut all casing strings below plow line (min 3 feet below ground level or per local policies/standards and Wabash requirements). Trip in well and set final cement plug. Lay down all work string, etc. Rig down all equipment and move out. Clean cellar to where a plate can be welded with well name onto lowest casing string at 3 ft or as per regulatory requirements. The steel plate/cap will have the well identification number, the UIC Class VI permit number, and the date of plug and abandonment inscribed on it. Soil will be backfilled around the well and the area planted with natural vegetation or as per regulatory requirements.

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