

File D - Proposed Injection Well Plugging Plan

Note: This document contains Proposed Injection Well Plugging Plan information for the Kansas Small Scale Test Wellington Field. The contents were extracted from the original KGS permit document that was prepared prior to the new EPA submission format introduced to KGS on June 3rd 2014. This explains why the information in this Proposed Injection Well Plugging Plan document may contain references to figures, tables, and sub-sections in other permit sections that may not be included in this Proposed Injection Well Plugging Plan document. Therefore, to facilitate the review process, the entire original permit application has been submitted as a separate document titled “L - Other Information Required by the UIC Program Director”, which also contains an Executive Summary, cover letter, application forms, complete table of contents, list of tables and figures, appendices, and a cross reference table which lists sub-sections that address all Class VI 40 CFR sections 146.82 – 146.93 requirements.

The Proposed Injection Well Plugging Plan is documented in the following section:

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Section 11
Injection Well and Arbuckle Monitoring Well Plugging
and Abandonment Plan

11.1

Facility name: Wellington Field Small Scale Carbon Capture
and Storage Project

Injection well location: Latitude 37.319485, Longitude -97.4334588
Township 31S, Range 1W, Section 28 NE SW SE SW

Facility contact: Dana Wreath, Vice President

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11.2 Introduction

As stated in §146.89, owners of Class VI injection wells are required to appropriately plug and abandon permitted injection well(s). Permittees are required to prepare a Plugging and Abandonment Plan that must specify the following information:

- (1) Appropriate tests or measures for determining bottomhole reservoir pressure;
- (2) Appropriate testing methods to ensure external mechanical integrity as specified in §146.89;
- (3) The type and number of plugs to be used;
- (4) The placement of each plug, including the elevation of the top and bottom of each plug;
- (5) The type, grade, and quantity of material to be used in plugging. The material must be compatible with the CO₂ stream; and
- (6) The method of placement of the plugs.

Further, Section (c) requires the permittee to notify the director in writing pursuant to §146.91(e) at least 60 days before plugging a well and to modify the plugging and abandonment plan at that time, if necessary. Within 60 days after plugging, the owner or operator must submit, pursuant to §146.91(e), a plugging report to the director.

To fulfill the above requirements, the Wellington injection well KGS 1-28 will be plugged and abandoned prior to site closure to prevent any brine and CO₂ from entering the USDW. The well-plugging plan is presented below and lists steps for testing bottomhole reservoir pressure and external mechanical integrity, the type/number/method and placement of plugs, and type/grade/quantity of CO₂-resistant material to be used. In the event that the CO₂ plume reaches the Arbuckle monitoring well (KGS 2-28) as predicted by the model simulations in Section 5, then this well will also be plugged in accordance with Class VI requirements specified in §146.92. Therefore, the information provided in this plan applies to both KGS 1-28 and KGS 2-28. As discussed in Section 10.2, the design and construction of KGS 2-28 is expected to be almost identical to KGS 1-28 (injection well) as the geologic formations are expected to be similar at the two sites. Therefore, the plugging details specified below are applicable to both Arbuckle wells. This will be confirmed after construction of KGS 2-28, and if the design of KGS 2-28 is different from KGS 1-28, the well-plugging plan will be revised and resubmitted to the EPA.

11.3 Planned Tests/Measures to Determine Bottomhole Pressure (146.92[a], [b][1])

The bottomhole pressure and temperatures are to be continuously monitored in the injection and Arbuckle monitoring wells throughout the injection and post-injection periods as specified in Section 10.3.2. The bottomhole reservoir pressure at the time of well abandonment will therefore be obtained as part of these operational activities and will be readily available for reporting.

11.4 Planned External Mechanical Integrity Tests (146.92[a],[b][2])

Before abandonment, a temperature log will be compared with the baseline log of temperature as well as temperature logs acquired during and after injection to demonstrate external mechanical integrity. (See Section 10.3.4 for additional information about mechanical integrity testing.)

11.5 Well Plugging (146.92[b])

The injection well (KGS 1-28), and potentially the Arbuckle monitoring well (KGS 2-28), will be plugged to the top of the Pierson formation, which corresponds to the top of the confining zone at the Wellington site as illustrated in Figure 8.2. Both wells may be used in the future for other oilfield operations in the locally producing Mississippian formation, so plugging will occur from the bottom of the injection well (5,155 ft at KGS 1-28) to the base of the intended oil recovery zone (top of Pierson formation) at 3,930 ft. Should this secondary use of the well occur, the well will be re-permitted to the appropriate status with the Kansas Corporation Commission. If it is determined that the well should be abandoned at the end of the EPA permitted CO₂ disposal project with no future use, a revised well-plugging plan will be submitted to the EPA for review and approval.

The well-plugging plan will be submitted to the EPA 60 days before field operations commence to allow the agency time to witness the plugging operations. Any amendments to the well-plugging plan described below will be incorporated in the latest well-plugging plan.

The wells will first be flushed with brine to force the CO₂ injectate into the formation. A minimum of two wellbore volumes (tubing and casing below packer) will be injected without exceeding 90% of the fracture gradient of 0.75 psi/ft (or 3,408 psi at the bottom of the injection interval at 5,050 ft). The bottomhole pressure will be recorded and the well temperature will be logged to ensure external mechanical integrity as indicated in Section 11.3. If a loss of mechanical integrity is discovered, the well may be repaired if the integrity issue has the potential to yield a problem with plugging operations (or future plug effectiveness) in consultation with the EPA program director before proceeding with the plugging operations.

Attempts will be made to remove the packer before cementing operations begin. However, if the packer cannot be released or removed from the cased hole, initial stages of the plugging operation may take place through the injection tubing before using a wire line tubing cutter to cut off the tubing above the injection packer or to cut the tubing above the packer with the packer left in the wellbore casing.

After the packer has been removed, plugging will commence at the bottom of the well (5,155 ft) by squeezing cement into the perforations and spotting balanced cement plugs. If the injection tubing has been removed, a cement retainer will be set approximately 25 ft above the packer cut-off or 25 ft above the highest perforation, stringing into the retainer with work string tubing. Thirty sacks of CO₂-compatible cement plug will be placed through the retainer, cementing the hole from the bottom up to the cement retainer. This will be followed by 100 sacks of CO₂-compatible cement plug from the top of the retainer to at least the top of the Pierson formation at a depth of approximately 3,930 ft. Assuming a density of 15 ppg slurry with a yield of approximately 1.3 cf/sack, approximately 130 sacks of AA-2 cement will be required for the entire plugging operation. Field conditions encountered at the time of plugging will be used to verify quantities. Both wet and dry samples will be collected for each plug spotted to ensure the quality of the plug. Table 11.1 summarizes plugging information for plugging KGS 1-28 (and KGS 2-28).

Table 11.1—Plugging information KGS 1-28 and KGS 2-28

Zone of Interest	Depth	Formation	Plugging Method	Plug Description	
Description	Cemented Interval	Name	Description	Type	Quantity
TD-Base of plug, including 4,910–5,050 perforated interval	4,910–5,155	Arbuckle	Retainer/work string	AA-2, CO ₂ -compatible cement	30 sacks
Retainer plug	3,930–4,910	Simpson to top of Pierson	Balanced plug	AA-2 cement plug	100 sacks

11.6 Notice of Intent to Plug (146.92 [c])

The director shall be notified in writing at least 60 days before the well is plugged. At that time, if any changes have been made to the original well-plugging plan, the revised plugging plan will be sent to the EPA for review and approval.

11.7 Injection Well Plugging Report (146.92 [d])

The well-plugging report will be submitted to the EPA within 60 days of completion of plugging activities. The plugging report shall be certified as accurate by the operator. The report will document the bottomhole pressure and temperature log, the details of the plugging operation, and the quantity and specifications of the CO₂-resistant cement. Complete plugging forms and all laboratory information will be submitted to the EPA. The report will be retained by Berexco for a period of 10 years after site closure.