



Stantec Consulting Services Inc.
3052 Beaumont Centre Circle, Lexington KY 40513

March 26, 2021
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Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

**RE: Closure and Post-Closure Plan
New CCR Landfill
TVA Shawnee Fossil Plant
Paducah, McCracken County, Kentucky**

1.0 PURPOSE

As described in 40 CFR § 257.102 and § 257.104, an owner or operator of a new CCR landfill is required to demonstrate that certain measures will be adopted to close and maintain the facility. This letter documents Stantec's certification that the Closure and Post-Closure Plan for the TVA Shawnee Fossil Plant's (SHF) New CCR Landfill complies with requirements in the EPA Final CCR Rule 40 CFR § 257.102 and § 257.104.

2.0 SUMMARY OF FINDINGS

The attached plan documents the closure and post-closure measures for the New CCR Landfill that meet the requirements specified in 40 CFR § 257.102 and § 257.104.

3.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Michael J. Steele, being a Professional Engineer in good standing in the Commonwealth of Kentucky, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and
3. that the Closure and Post-Closure Plan for the TVA SHF New CCR Landfill meets the requirements specified in 40 CFR § 257.102 and § 257.104.



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**RE: Closure and Post-Closure Plan
New CCR Landfill
TVA Shawnee Fossil Plant
Paducah, McCracken County, Kentucky**

SIGNATURE  _____

DATE 3/26/2021

ADDRESS: Stantec Consulting Services Inc.
3052 Beaumont Centre Circle
Lexington, Kentucky 40513

TELEPHONE: (859) 422-3000

ATTACHMENTS: Closure and Post-Closure Plan



**Closure and Post-Closure Plan
TVA Shawnee New CCR
Landfill**

New CCR Landfill
TVA Shawnee Fossil Plant
Paducah, McCracken County,
Kentucky



Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

March 26, 2021
Revision 0

**CLOSURE AND POST-CLOSURE PLAN
TVA SHAWNEE NEW CCR LANDFILL**

March 26, 2021

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CLOSURE AND POST-CLOSURE PLAN TVA SHAWNEE NEW CCR LANDFILL

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1.0 INTRODUCTION

On April 17, 2015, the Environmental Protection Agency (EPA) published the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" final rule (EPA Final CCR Rule) in the Federal Register. The Tennessee Valley Authority (TVA) contracted with Stantec Consulting Services Inc. (Stantec) to provide a closure and post-closure plan for the Shawnee Fossil Plant's (SHF) New CCR Landfill that meets requirements of the EPA Final CCR Rule § 257.102 and § 257.104.

1.1 OBJECTIVE

As required by § 257.102 and § 257.104 of the EPA Final CCR Rule, an owner or operator of new CCR landfills is required to demonstrate that certain measures will be adopted to close and maintained the facility. The objective of this plan is to document these measures.

1.2 UNIT DESCRIPTION

SHF is a coal-fired, electric-generating plant. The plant is located in McCracken County, Kentucky, along the south shore of the Ohio River near river mile 946, just east of the confluence of Little Bayou Creek with the Ohio River.

The New CCR landfill will be located on the Shawnee East Site, which consists of about 205 acres that TVA acquired in 2016 next to the eastern boundary of the SHF reservation. The landfill will be constructed in three stages over a total footprint of 88 acres. The embankment will be about 115 feet tall with maximum 4H:1V slopes and will accommodate about 8 million cubic yards of CCR material (fly ash, bottom ash, and gypsum) across an estimated 25-year operational life.

2.0 CRITERIA AND DEMONSTRATION

The EPA Final CCR Rule § 257.102 and § 257.104 requirements for the Closure and Post-Closure Plan are listed below in italics. A description of how the New CCR Landfill meets these requirements follows.

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2.1 CLOSURE PLAN

2.1.1 Content of the Plan

40 CFR § 257.102(b). *Written Closure Plan – (1) Content of the Plan. The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.*

- (i) *A narrative description of how the CCR unit will be closed in accordance with this section.*
- (ii) *If closure of the CCR unit will be accomplished through the removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.*
- (iii) *If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.*
- (iv) *An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.*
- (v) *An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life.*
- (vi) *A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CRR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phase of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR unit closure. When preparing the written closure plan, if the owner or operator of a CCR unit estimates that the time required to complete closure will exceed the timeframes specified in paragraph (f)(1) of this section, the written closure plan must include the site-specific information, factors and considerations that would support any time extensions sought under paragraph (f)(2) of this section.*

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2.1.1.1 Closure Activities

The landfill will be closed in place and capped with final cover (details below). Prior to installing the cap system, stripping of intermediate cover soil may occur along with minor grading of existing ditches, removal of temporary flumes, and installation of permanent flumes to improve drainage of the closed facility.

2.1.1.2 Closure Type

The landfill will be closed in place and capped with final cover (details below).

2.1.1.3 Maximum CCR Inventory

The landfill is designed to store about 8 million cubic yards of CCR.

2.1.1.4 Largest Area Requiring Final Cover

The estimated largest area requiring final cover during the active life of the CCR unit will be 88 acres. However, it is anticipated that closure of selected portions of the landfill will occur as final design configurations are realized.

2.1.1.5 Schedule of Closure Activities

Table 1 provides the estimated schedule of closure activities.

Table 1. Estimated Schedule of Closure Activities

	Closure Activity	Start Date
1.	Start of construction prior to waste placement	2019
2.	Start of initial waste placement (Stage 1)	2021
3.	Start of final cover installation	2046 ⁽¹⁾
4.	Completion of closure activities	Per § 257.102(f)(1)(i)
5.	Completion of post-closure care period	30 years after final cover is installed

(1) Based on CCR production estimates and design capacity of the landfill, subject to change.

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2.1.2 CCR Closure-in-Place Performance Standards

40 CFR § 257.102(d). *Closure performance standard when leaving CCR in place —*

(1) *The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:*

(i) *Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;*

(ii) *Preclude the probability of future impoundment of water, sediment, or slurry;*

(iii) *Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;*

(iv) *Minimize the need for further maintenance of the CCR unit; and*

(v) *Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.*

2.1.2.1 Control of Infiltration and Releases

The landfill design provides for control of post-closure infiltration into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere, through the site grading plan, construction of an engineered final cover system, and the establishment of a stormwater management system in accordance with generally accepted engineering practices. The cap system is intended to cover, control, and prevent the release of CCR from the unit. The site grading plan and stormwater management system promote positive drainage and limit infiltration into the CCR.

The design final cover system will consist of the following materials and thicknesses, as listed in order of construction (bottom to top):

- Soil base (minimum 6 inches)
- 40-mil thick textured Liner Low Density Polyethylene (LLDPE) flexible geomembrane
- Geocomposite drainage layer
- 18 inches of protective cover soil
- 6 inches of vegetative cover soil

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2.1.2.2 Prevention of Future Impoundment of Water, Sediment, or Slurry

The design provides for positive drainage and a cover system that is intended to mitigate this concern. Infiltration that passes through the cap soil layers will be captured in the geocomposite layer and conveyed through a design drainage system.

2.1.2.3 Slope Stability Measures

Stability calculations indicate that the design slopes are stable under static loads. Maintenance of the vegetative cover will further reduce the potential for erosion and sloughing.

Infinite-slope analyses were used to evaluate the seismic stability of various material interfaces within the design final cover system. Based on available manufacturer's data, the required interface strength between the geomembrane and soil cover is attainable. However, it will be challenging to achieve the required strength in other material interfaces in the final cover system. Portions of the cap may slip during an earthquake and require repair. Because the cap's geomembrane remains intact, the CCR and associated leachate will be contained. This condition is within acceptable performance standards defined in the preamble to the CCR Rule, which allows for a certain amount of damage due to an earthquake, provided that the facility is designed to not release CCR, leachate, and contaminants.

2.1.2.4 CCR Unit Maintenance

The design mitigates against the need for additional maintenance (beyond preventative maintenance) of the CCR unit through selection of various facility components and configurations.

2.1.2.5 Completion of Closure

Closure will be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

2.1.3 Final Cover System Design (or alternative)

40 CFR § 257.102(d)(3). *Final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.*

(i) *The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.*

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(A) *The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.*

(B) *The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.*

(C) *The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.*

(D) *The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.*

(ii) *The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (d)(3)(ii)(A) through (C) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.*

(A) *The design of the final cover system must include an infiltration layer that provides an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (d)(3)(i)(A) and (B) of this section.*

(B) *The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (d)(3)(i)(C) of this section.*

(C) *The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.*

An alternative final cover system was designed for the New CCR Landfill as described below.

2.1.3.1 Infiltration Layer

The design final cover system involves the installation of a geocomposite drainage layer and LLDPE flexible geomembrane that meets the definition of an alternative final cover system under the EPA Final CCR Rule. This layer achieves an equivalent reduction in infiltration as the infiltration layer specified in 257.102(d)(3)(i)(A) and (B) by having a permeability value ranging from 10^{-13} to 10^{-14} cm/sec. Infiltration that is not captured by the cap's drainage system will migrate through the embankment and be conveyed by the leachate collection and removal system, which will be constructed above the bottom liner located at the base of the landfill. Engineering models for this condition show no negative impact on the facility.

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2.1.3.2 Erosion Layer

A 6-inch layer of vegetative cover meeting the requirements stated in 257.102(d)(3)(i)(C) is included within the alternative final cover system to provide protection from wind or water erosion.

2.1.3.3 Settling and Subsidence

The final cover system will be constructed across a suitable subgrade to reduce the potential for damage to the geomembrane. The design requires that the CCR embankment (cap subgrade) be compacted in controlled lifts to mitigate issues associated with settling and subsidence.

2.2 POST-CLOSURE PLAN

2.2.1 Content of the Plan

40 CFR § 257.104(d). *Written Post-Closure Plan – (1) Content of the Plan. The owner or operator of a CCR unit must prepare a written post-closure plan that includes, at a minimum, the information specified in paragraphs (d)(1)(i) through (iii) of this section.*

(i) *A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed;*

(ii) *The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and*

(iii) *A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart. Any other disturbance is allowed if the owner or operator of the CCR unit demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration must be certified by a qualified professional engineer, and notification shall be provided to the State Director that the demonstration has been placed in the operating record and on the owner's or operator's publicly accessible internet site.*

2.2.1.1 MONITORING AND MAINTENANCE ACTIVITIES

40 CFR § 257.104(b). *Post-closure care maintenance requirements. Following closure of the CCR unit, the owner or operator must conduct post-closure care for the CCR unit, which must consist of at least the following:*

(1) *Maintaining the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover;*

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(2) *If the CCR unit is subject to the design criteria under § 257.70, maintaining the integrity and effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements of § 257.70; and*

(3) *Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of § 257.90 through 257.98.*

Final Cover System

The integrity and effectiveness of the final cover system will be maintained through annual (minimum) inspections and maintenance. This will include inspecting for signs of erosion, cracking, settlement, pooling, sloughing, burrows, excessive plant growth, wet areas, seeps, bare areas, and other visual structural issues. Mowing of established grass covered surfaces will be conducted.

Leachate Collection and Removal System

Inspections will be performed annually (minimum) to maintain the integrity and effectiveness of the leachate collection and removal system. If significant reduction of leachate quantities occurs or there are other indicators of potential clogging, the leachate collection lines will be inspected with a camera. Maintenance of the leachate pipe system will include: removing sediment and debris if needed, sealing cracks in concrete structures or re-coating the interior as needed, removing sediment and debris from leachate pipes through junction boxes, and cleanout of the leachate pond as needed.

Groundwater Monitoring System

The groundwater monitoring system will be maintained and monitored in accordance with the EPA Final CCR Rule, 40 CFR § 257.90 through 98.

2.2.1.2 CONTACT INFORMATION

The following contact information is provided for the post-closure period:

Owner: Tennessee Valley Authority (TVA)

Contact: Civil Projects & CCP Management, Strategy and Engineering
Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

Phone: 844-342-0012

Email: tvainfo@tva.com

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2.2.1.3 PLANNED USES

TVA will retain ownership and control access to the site following closure. The closed facility shall remain undeveloped.

2.3 CLOSURE AND POST-CLOSURE PLAN

This document constitutes the written closure plan and written post-closure plan as required by § 257.102(b) and § 257.104(d).

2.4 AMENDMENTS TO PLAN

If there is a change in conditions that would substantially affect the current version of Closure and Post-Closure Plan, or if unanticipated events necessitate a revision of the plan, then the plan will be amended and placed in the operating record as required by § 257.105(i)(4).

3.0 CONCLUSION

This plan for the proposed CCR landfill located at SHF meets the requirements of § 257.102 and § 257.104 of the EPA Final CCR Rule.