

April 17, 2019

Tennessee Valley Authority  
1101 Market Street  
Chattanooga, Tennessee 37402

**Closure and Post Closure Plan  
New CCR Landfill (Cell 1)  
EPA Final CCR Rule  
TVA Paradise Fossil Plant  
Drakesboro, Kentucky**

**1.0 PURPOSE**

This letter documents AECOM's certification of the closure and post-closure plan for the TVA Paradise Fossil Plant's New CCR Landfill (Cell 1).

**2.0 CLOSURE AND POST-CLOSURE PLAN**

The closure plan describes the steps necessary to close the CCR unit at any time during the life of the unit, and is subject to the requirements described in 40 CFR 257.102(b). The post-closure plan describes the monitoring and maintenance activities to be performed during the post-closure period of the unit, and is subject to the requirements of 40 CFR 257.104(d).

**3.0 SUMMARY OF FINDINGS**

The attached closure and post-closure plan demonstrates compliance with the requirements set forth in 40 CFR § 257.102(b) and 257.104(d).

**4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION**

I, Nicholas Golden, PE, being a Professional Engineer in good standing in the State 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;
3. that the closure plan for the TVA Paradise Fossil Plant's New CCR Landfill (Cell 1) meet(s) the requirements described in 40 CFR 257.102(b) and
4. that the post-closure plan for the TVA Paradise Fossil Plant's New CCR Landfill (Cell 1) meet(s) the requirements of 40 CFR 257.104(d).



SIGNATURE \_\_\_\_\_

DATE 4/17/19

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ATTACHMENTS: Closure (40 CFR 257.102(b)(1)) and Post-Closure Plan (40 CFR 257.104(d)(1)) for Coal Combustion Residuals (CCR) New CCR Landfill



**Tennessee Valley Authority – Paradise CCR Landfill  
Muhlenberg County, Kentucky**

**Closure Plan [40 CFR 257.102(b)(1)] and  
Post-Closure Plan [40 CFR 257.104(d)(1)]  
for Coal Combustion Residuals (CCR)  
New CCR Landfill  
TVA Paradise Fossil Plant**

Prepared for



Tennessee Valley Authority  
1101 Market Street  
Chattanooga, TN 37402-2801

April 17, 2019



Prepared by  
**AECOM**



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DRAFT

## 1.0 Introduction

This U.S. Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule) closure and post-closure plan is conceptual and is subject to change. It describes the CCR closure and post-closure activities at the TVA Paradise Fossil Plant (PAF) to demonstrate that the New CCR Landfill will be closed and maintained in accordance with the CCR closure and post-closure requirements of 40 CFR 257.102 and 104, respectively.

## 2.0 Written Closure Plan - 40 CFR 257.102(b)(1)

**40 CFR 257.102(b)(1).** *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 CCR 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 estimate timeframes to complete each step or phase of CCR unit closure.*



## 2.1 Closure Activities- §257.102(b)(1)(i)

The PAF Landfill is being developed in a series of four cells, each of which will be constructed into two sub-cells. Each cell will be lined in accordance with 40 CFR 257.72. As areas are filled, an interim cover layer will be provided until final CCR grades are achieved and final cap can be installed. Closure operations will involve the following subsequent activities;

- Regrading of fill as needed to create design grades for the final cover system
- Installation of the final cover system (geomembrane, geocomposite drainage layer, cap cover soil, and topsoil)

## 2.2 Closure Type/Closure in Place - §257.102(b)(1)(iii)

The closure of the PAF CCR Landfill will be accomplished by leaving the CCR in place, thus requiring a final cover system and closure design elements enabling it to meet the CCR closure in-place performance standards outlined in 40 CFR 257.102(d)(1) and described in **Section 2.9**.

## 2.3 Maximum CCR Inventory - §257.102(b)(1)(iv)

The plant currently produces approximately 420,000 cubic yards of CCR per year, with the following breakdown by material:

Fly Ash -	48,000 Tons/Yr
Boiler Slag (net) -	28,000 Tons/Yr
Gypsum -	344,000 Tons/Yr

The majority of the station's boiler slag is taken off-site for beneficial use in making of various products. The estimated future maximum inventory of CCR ever on-site over the active life of the PAF Landfill is approximately 13.6 million cubic yards (CY).

## 2.4 Largest Area Requiring Final Cover - §257.102(b)(1)(v)

The estimated largest area of the PAF Landfill requiring a final cover at any time during the active life of the CCR unit is approximately 81.6 acres.

## 2.5 Schedule of Closure Activities - §257.102(b)(1)(vi)

The following sequential steps necessary for completing the closure activities of 40 CFR 257.102 and their estimated scheduled completion dates are provided below.



Table 1: Schedule of Closure Activities

	Closure Activity	Estimated Date
1.	Commence Closure Activities	2051
2.	Regrading of Fill, Installation of Final Cover System	2051
3.	All Closure Activities Complete	2052
4.	Post Closure Period Complete	2082

Notes:

The schedule reflected above is based upon TVA's operational plan as of the date of this document. Operational needs may arise that may require this schedule to be adjusted.

### 2.6 Estimated year of Closure Completion- §257.102(b)(1)(vi)

The estimated year for completion of all closure activities is 2052.

### 2.7 Request for Time Extension

If it is estimated that the time required to complete closure will exceed the regulatory timeframes, site-specific information, factors and considerations will be provided to support any time extensions.

### 2.8 Amendment of Closure Plan – §257.102(b)(3)

The owner or operator may amend the closure plan at any time, and must do so at least 60 days prior to any planned change in the operation of the CCR unit that would substantially affect the written closure plan in effect. The closure plan must also be amended no later than 60 days after unanticipated events necessitate a revision of the written closure plan (30 days after, if the triggering event takes place after closure activities have commenced). The amended closure plan requires a new certification from a qualified professional engineer that it meets the requirements of 40 CFR 257.102.

### 2.9 Performance Standards: CCR Closure In-Place - 40 CFR 257.102(d)(1)

**40 CFR 257.102(d)(1).** 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.*

### **2.9.1 Control of Infiltration and Releases - §257.102(d)(1)(i)**

TVA will 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 groundwater, surface water, or atmosphere through the installation of a closure cap system.

PAF lies within the watershed of the Green River. The plant's northeast border is the Green River. Jacob's Creek flows along the south portion of new proposed landfill and empties into the Green River. The drainage area for the new proposed landfill is approximately 108.4 acres and encompasses the area directly east and west of the new proposed landfill surface and surrounding areas.

The cover system slopes promote precipitation run-off by maintaining positive drainage to minimize the ponding of water. Surface water benches will intercept surface water run-off from the cover slopes, which will be conveyed to letdown channels, and then to perimeter drainage ditches located at the toe of the cover system. Each perimeter drainage ditch is sloped to convey run-off to one of two sediment basins, one of which is located to the northwest of the facility, the other to the east of the facility. The sediment basins discharge into the Green River via drainage channels leading to Kentucky Pollutant Discharge Elimination System (KPDES) permitted outfalls.

All drainage structures have been designed to accommodate at least a 25-year, 24-hour storm event. Additional details of the run-on/run-off controls are provided in the drawings included in Appendix A2 of the Run-on/Run-off Control System Plan for the CCR Landfill.

### **2.9.2 Prevention of Future Impoundment of Water, Sediment, or Slurry - §257.102(d)(1)(ii)**

TVA will preclude the probability of future impoundment of water, sediment, or slurry at the PAF Landfill. The cover system slopes promote precipitation run-off by maintaining positive grading to minimize the ponding of water.

As soon as practicable after final grading, TVA will take necessary steps to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding or the use of reinforcement matting on steeper slopes and drainage ways if necessary. Temporary erosion control blankets may be used if necessary to provide seedbed protection and prevent wash-out of seed and fertilizer during vegetation establishment.

### **2.9.3 Slope Stability Measures - §257.102(d)(1)(iii)**

The landfill configuration has been designed to meet the appropriate factors of safety, as confirmed by global stability analyses. TVA will 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 period. Preconstruction testing of the cover materials will be conducted to verify

that all materials meet the minimum interface strength requirements established by stability analyses. Furthermore, each layer of the final cover system will be placed such that it meets applicable specifications established by the slope stability analysis.

#### 2.9.4 CCR Unit Maintenance - §257.102(d)(1)(iv)

TVA will minimize the need for further maintenance of the CCR unit by:

- Adequately maintaining the leachate collection system;
- Constructing the final cover in accordance with site-specific design requirements;
- Grading surfaces to promote proper surface water management;
- Implementing erosion and sediment control measures; and
- Maintaining the groundwater monitoring network.

#### 2.9.5 Completion of Closure - §257.102(d)(1)(v)

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

### 2.10 Final Cover System Design (or Alternative) - §257.102(d)(3)

**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.*
- (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  $1 \times 10^{-5}$  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.*

### **2.10.1 Final Cover System Design Standards - §257.102(d)(3)(i)**

The final cover system must be designed to minimize infiltration and erosion, consisting of the following minimum elements:

- Cap Cover Soil: A minimum 18-inch infiltration layer of earthen materials with permeability no greater than  $1 \times 10^{-5}$  cm/sec;
- Top Soil: A minimum 6-inch erosion layer that contains earthen material that is capable of sustaining native plant growth; and

Disruption of the integrity of the final cover system will be minimized through a design that accommodates settling and subsidence.

The final cover system for the PAF Landfill will consist of an alternative cover design, as described in **Section 2.10.2** below.

### **2.10.2 Alternative Final Cover System Design - §257.102(d)(3)(ii)**

An alternative final cover system design may be selected provided it achieves an equivalent standard to **Section 2.10.1** for the following:

- An infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in **Section 2.10.1**.
- An erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in **Section 2.10.1**.
- The minimization of any disruption of the integrity of the final cover system through a design that accommodates settling and subsidence.

The alternative final cover system to be installed at the new CCR landfill may include the following components (see detail in Figure 1);

- A 40-mil LLDPE geomembrane
- A geocomposite drainage layer
- 18-inch infiltration layer of earthen materials
- A 6-inch erosion layer of earthen materials

TVA has obtained a written certification from a qualified professional engineer verifying that the design of the final cover system meets the requirements of the EPA Final CCR Rule. It can be found in Appendix A.

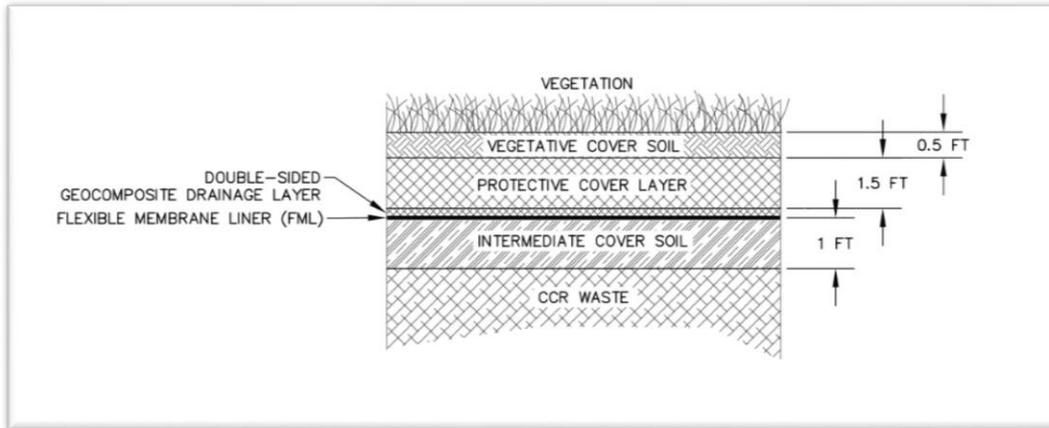


Figure 1: Alternative Final Cover System

### 2.10.3 Methods and Procedures for Installation of Final Cover - §257.102(b)(1)(iii)

As required by 40 CFR 257.102(b)(1)(iii), the following methods and procedures will be used in the installation of the final cover.

The final cover system may be constructed in phases as large areas of each cell are brought to final grade. Initially, the lower elevations of outer side slopes will receive a final cover, to be followed later by upper side slopes and finally the crest of the landfill. In this manner, the area of exposed CCR material is reduced as the landfill approaches closure.

The sequence of final cover construction will begin by compacting the intermediate cover soil or CCR subgrade layer in a controlled manner. It is noted that intermediate cover may not be required in areas where final cover will be constructed reasonably soon within final placement of CCR. The 40-mil LLDPE geomembrane barrier layer and double-sided geocomposite will be installed above the compacted interim soil or CCR subgrade layer. The protective cover soil and vegetative cover soil layers will be installed above the geocomposite drainage layer and in a manner that prevents damage to the underlying geosynthetics. Finally, the surface of the cover will be seeded and vegetated.

### 2.10.4 Professional Engineer Certifications - §257.102(d)(3)(iii)

**40 CFR 257.102(d)(3)(iii).** *The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.*

A qualified professional engineer has provided a written certification stating that the design of the final cover system meets the requirements of 40 CFR 257.102. It is contained in Appendix

A. A new certification will be included in the facility's notification of intent to close the PAF Landfill, as per 40 CFR 257.102(g).

**40 CFR 257.102(f)(3).** *Upon completion, the owner or operator of the CCR unit must obtain a certification from a qualified professional engineer verifying that closure has been completed in accordance with the closure plan specified in paragraph (b) of this section and the requirements of this section.*

A professional engineer will provide a written certification stating that the construction of the final cover system meets the requirements of the closure plan and 40 CFR 257.102.

### 3.0 Written Post-Closure Plan - 40 CFR 257.104(d)(1)

**40 CFR 257.104(d)(1).** *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 paragraph (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;*
- (i) 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 system 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.*

#### 3.1 Monitoring and Maintenance Activities - §257.104(d)(1)(i)

**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;*
- (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.*

In accordance with 40 CFR 257.104(d)(1)(i), post-closure for the PAF Landfill will address the following systems as required under 40 CFR 257.104(b), along with the frequencies for the identified monitoring and maintenance activities:

- Final cover system;
- Leachate collection and removal system; and
- Groundwater monitoring system.

### **3.1.1 Final Cover System - §257.104(b)(1)**

Following closure of the PAF Landfill, visual inspections of the site will be completed for the duration of the post-closure period. Inspections will be completed on an annual basis. Maintenance or other corrective measures needed to prevent the deterioration of the closure system will be identified during the inspections.

The cap system will be maintained for a minimum of 30 years following final closure of the PAF Landfill. The integrity and effectiveness of the cap system will be maintained by making repairs to the cover as necessary to correct the potential effects of subsidence and erosion, as well as preventing run-on and run-off from eroding or otherwise significantly damaging the cap system. If settlement or other structural problems occur in the final cover system, the cover will be re-graded. In addition, the vegetative cover will be inspected to maintain a healthy stand of vegetation. Until vegetation of the final cover is fully established, sediment transport will be retarded by temporary silt fences. Other temporary sediment control measures will be installed as needed to reduce the sediment load until the vegetative cover is fully established.

### **3.1.2 Leachate Collection and Removal System - §257.104(b)(2)**

TVA will maintain the integrity and effectiveness of the leachate collection and removal system, and properly operate it in accordance with 40 CFR 257.70.

Maintenance and monitoring of the leachate collection system during the post-closure period will include inspecting the leachate collection pump systems and side slope risers, removing sediment and debris (if needed), verifying operation of pumps, and ensuring that outlets are clear and unobstructed. Inspections will be completed on an annual basis.

### **3.1.3 Groundwater Monitoring System - §257.104(b)(3).**

The groundwater monitoring system will be designed and maintained in accordance with the EPA Final CCR Rule, 40 CFR 257.90 through 98. Groundwater monitoring locations will be inspected annually. Repairs will be made as needed.



### **3.2 Contact Information - §257.104(d)(1)(ii)**

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

Contact: Civil Projects & CCP Management, Strategy and Engineering  
Tennessee Valley Authority  
Paradise Fossil Plant  
1101 Market Street  
Chattanooga, Tennessee, 37402  
Phone: 844-342-0012  
Email: tvainfo@tva.com

### **3.3 Planned Uses - §257.104(d)(1)(iii)**

The new proposed landfill will be used for green space after the closure. The vegetative cover will be inspected regularly to maintain healthy stand of vegetation, and site inspections will be required to evaluate stressed vegetation.

It is anticipated that following development and closure of the PAF Landfill, the property will not be used and it will not be accessible to the public.

Post-closure use of the property will 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 of the EPA Final CCR Rule under 40 CFR Part 257.

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.

### **3.4 Amendment of Post Closure Plan - §257.104(d)(3)**

The owner or operator may amend the post closure plan at any time, and must do so at least 60 days prior to any planned change in the operation of the CCR unit that would substantially affect the written post closure plan in effect. The post closure plan must also be amended no later than 60 days after unanticipated events necessitate a revision of the written post closure plan (30 days after, if the triggering event takes place after post closure activities have commenced). The amended post closure plan requires a new certification from a qualified professional engineer that it meets the requirements of 40 CFR 257.104.



### **3.5 Certification of Post Closure Plan - §257.104(d)(4)**

A qualified professional engineer has provided a written certification stating that the post closure plan meets the requirements of 40 CFR 257.104.

### **3.6 Notification of Completion of Post Closure Care Period - §257.104(e)**

No later than 60 days following the completion of the post-closure care period, the owner or operator of the CCR unit must prepare a notification verifying that post-closure care has been completed. The notification must include a certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the post closure plan and the requirements of 40 CFR 257.104. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(13).