

**2009 Compliance Recertification Application (2009 CRA)**  
**Compliance Application Review Document (CARD) No. 33**  
**Consideration of Drilling Events in Performance Assessments**

### **33.0 BACKGROUND**

Section 194.33 requires U.S. Department of Energy (DOE or Department) to make specific assumptions about future deep and shallow drilling in the Delaware Basin. In conducting its analysis, DOE must incorporate assumptions specified in U.S. Environmental Protection Agency (EPA or Agency) Compliance Criteria regarding timing and duration of drilling, frequency of drilling, drilling practices and technology, and the effects of natural processes on boreholes.

Drilling in the near future within the Delaware Basin will most likely be for oil and gas exploration/exploitation, which constitutes a deep drilling event. Shallow drilling may occur for other resources (e.g., water). Drilling is incorporated in the performance assessment as a single event or combinations of events based upon different scenarios. Deep and shallow drilling rates and related activities directly affect the cumulative potential for radionuclide releases to the surface or to subsurface geologic units around Waste Isolation Pilot Plant (WIPP)

Deep drilling is defined by EPA as events that terminate 2,150 feet or more below ground surface, while shallow drilling events terminate no deeper than 2,150 feet below ground surface.

### **33.1 REQUIREMENTS**

(a) "Performance assessments shall examine deep drilling and shallow drilling that may potentially affect the disposal system during the regulatory time frame."

(b) "The following assumptions and process shall be used in assessing the likelihood and consequences of drilling events, and the results of such process shall be documented in any compliance application:

(1) Inadvertent and intermittent intrusion by drilling for resources (other than those resources provided by the waste in the disposal system or engineered barriers designed to isolate such waste) is the most severe human intrusion scenario.

(2) In performance assessments, drilling events shall be assumed to occur in the Delaware Basin at random intervals in time and space during the regulatory time frame.

(3) The frequency of deep drilling shall be calculated in the following manner:

(i) Identify deep drilling that has occurred for each resource in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared

(ii) The total rate of deep drilling shall be the sum of the rates of deep drilling for each resource.

(4) The frequency of shallow drilling shall be calculated in the following manner:

(i) Identify shallow drilling that has occurred for each resource in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared.

(ii) The total rate of shallow drilling shall be the sum of the rates of shallow drilling for each resource.

(iii) In considering the historical rate of all shallow drilling, the Department may, if justified, consider only the historical rate of shallow drilling for resources of similar type and quality to those in the controlled area.”

(c) “Performance assessments shall document that in analyzing the consequences of drilling events, the Department assumed that:

(1) Future drilling practices and technology will remain consistent with practices in the Delaware Basin at the time a compliance application is prepared. Such future drilling practices shall include, but shall not be limited to: the types and amounts of drilling fluids; borehole depths, diameters, and seals; and the fraction of such boreholes that are sealed by humans.

(2) Natural processes will degrade or otherwise affect the capability of boreholes to transmit fluids over the regulatory time frame.”

(d) “With respect to future drilling events, performance assessments need not analyze the effects of techniques used for resource recovery subsequent to the drilling of the borehole.”

### **33.2 1998 CERTIFICATION DECISION**

To meet the requirements of Section 194.33, EPA expected DOE’s Compliance Certification Application (CCA) to discuss how deep and shallow drilling is conducted in the Delaware Basin. DOE was expected to discuss the drilling rate for the past 100 years and methodology for calculating those rates for deep and shallow drilling. DOE was also expected to show how deep and shallow drilling effects were incorporated into the performance assessment.

DOE identified the following drilling-related activities as being present in the Delaware Basin and potentially near the WIPP CCA (Appendix DEL.5, Tables DEL-3 through DEL-7):

- ∅ Oil/Gas exploration/exploitation and extraction, including enhanced oil recovery (shallow and deep drilling).

- ∅ Potash exploration/exploitation (shallow and deep drilling).
- ∅ Fluid injection related to oil/gas production (deep drilling).
- ∅ Sulfur coreholes (deep and shallow drilling).
- ∅ Hydrocarbon (gas) storage in geologic reservoirs, gas reinjection (deep drilling).
- ∅ Brine wells for solution mining (shallow drilling).
- ∅ Water supply wells (shallow drilling).
- ∅ Geothermal resources (deep drilling).

In the CCA, DOE identified oil and gas exploration/exploitation and water and potash exploration as the principal human activities that must be considered within the performance assessment. The remaining human initiated activities—such as exploration for geothermal energy, water supplies, and sulfur and brine extraction (solution mining)—were eliminated based upon low probability, low consequence, or for regulatory reasons. See CCA CARD 32—Scope of Performance Assessments for additional information on features, events and processes considered in the performance assessment.

DOE considered three different combinations of deep drilling as part of the PA, referred to as E1, E2, and E1E2:

- ∅ The E1 Scenario—one or more boreholes penetrate a Castile brine reservoir and also intersect a repository panel.
- ∅ The E2 Scenario—one or more boreholes intersect a repository panel.
- ∅ The E1E2 Scenario—multiple penetrations of waste panels by boreholes of the E1 or E2 type, at many possible combinations of intrusions times, locations, and E1 or E2 drilling events.

Drilling was assumed to occur throughout the 10,000 year regulatory time period, although at lower drilling rates for the first 700 years (See CCA CARD 33).

No combinations of shallow drilling events were considered by DOE, because DOE screened shallow drilling effects from consideration in PA based on low consequences.

DOE also presented information on borehole sizes and depths (CCA Appendix DEL.5), as well as the impacts of borehole installation on radionuclide migration and transport via cuttings, cavings, spallings, and direct brine release.

EPA found that the documentation in the CCA demonstrated that DOE thoroughly considered deep and shallow drilling activities and rate within the Delaware Basin. DOE

appropriately screened out shallow drilling from consideration in the performance assessment. EPA also found that DOE appropriately incorporated the assumptions and calculations for drilling in to the performance assessment. In accordance with 194.33(c), DOE evaluated the consequences of drilling events assuming that drilling practices remain consistent with practices in the Delaware Basin at the time the CCA was prepared.

A complete description of EPA's 1998 Certification Decision for Section 194.33 can be obtained from EPA Air Docket, A-93-02, Items V-A-1 and V-B-2.

### **33.3 CHANGES IN THE 2004 COMPLIANCE RECERTIFICATION APPLICATION (2004 CRA)**

In the 2004 Compliance Recertification Application (2004 CRA) DOE reexamined all aspects of deep drilling and shallow drilling. DOE reviewed the CCA assumptions related to timing and duration of drilling, frequency of drilling, drilling practices and technology, and the effects of natural processes on boreholes.

DOE confirmed that oil and gas exploration/exploitation, water and potash exploration (See Section 33.A.5 of CCA CARD 33 for a complete list) are still the principal human-initiated (HI) activities to be considered in PA (see 2004 CRA Chapter 6, Section 6.2.5). DOE added solution mining for potash and other resources for consideration but then ruled it out of the PA based on regulatory requirements (2004 CRA Appendix PA, Attachment SCR-5.2.2.3 and SCR-5.2.2.4).

DOE reconsidered the E1, E2, and E1E2 deep drilling scenarios and found these scenarios sufficient for PA analysis and did make changes for the 2004 CRA (see 2004 CRA Chapter 6.3.2.2). DOE confirmed that cuttings, cavings, spallings, direct brine releases, and long-term releases mechanisms during and following drilling have not changed since the original CCA PA (see 2004 CRA Chapter 6, Section 6.4.7).

The 2004 CRA Chapter 6.2.5.2.2 and in 2004 CRA Appendix PA, Attachment SCR-5.1.1.2.3, DOE discussed the shallow drilling rate. DOE noted that drilling information is reported annually in its Delaware Basin Drilling Surveillance Program Annual Report (DOE 2003f). In 2002 DOE noted that the total number of water wells in the Delaware Basin decreased from 2,331 wells to 2,296 wells. DOE concluded that the shallow drilling rate is essentially the same as reported in the CCA (see 2004 CRA Appendix PA, Attachment SCR, page 74). DOE also continued to eliminate shallow drilling from the performance assessment because of low consequence to the performance of the disposal system (see 2004 CRA Appendix PA, Attachment SCR-5.1.1.2.3).

Through its Delaware Basin Drilling Surveillance Program (DBDSP) (See 2004 CRA Appendix DATA, Attachment A) DOE monitors deep drilling events, namely, drilling practices, borehole sizes, drill depths, plugging and abandonment practices, casing designs, and others drilling related parameters (For specifics see 2004 CRA Appendix DATA, Attachment A, page 1) in the vicinity of the WIPP. DOE collects the types and number of boreholes drilled in the deeper Delaware Basin, Castile brine encounters, and other drilling related data (such as bit size, casing size, rotation speed, penetration rate, mud density, mud viscosity, collar diameter, collar length, number of collars, record of any air drilling done, number of plugs, plug length, water

and CO<sub>2</sub> flooding used, gas storage activities, and solution mining for potash or other reasons) (see 2004 CRA Appendix Data, Attachment A).

DOE again concluded for the 2004 CRA that inadvertent and intermittent drilling is the most severe human intrusion scenario and included it in the performance assessment (see 2004 CRA Chapter 6.0.2.3, page 6-7). DOE continued to include hydrocarbon exploratory and development wells in its analysis (see 2004 CRA Appendix DATA, Attachment A, Table DATA-A-1). In the 2004 CRA performance assessment, DOE continued to include scenarios for human intrusion and calculated cumulative radionuclide releases assuming different intrusion events and combination of events (see 2004 CRA Chapter 6, Sections 6.2.2.3, 6.2.5, and 6.3.2). DOE also continued to consider five potential release mechanisms in the 2004 CRA PA: (cuttings, cavings, spallings, direct brine releases, and long-term release mechanisms (see 2004 CRA Chapter 6.0.2.3 and 6.4.7).

The 2004 CRA performance assessment adopted the performance assessment verification test (PAVT) parameter values used for borehole plug configuration permeabilities, for the probabilities of a borehole intersecting a brine reservoir, the Castile bulk compressibility range, the effective porosity, and the total volume of Castile brine (see 2004 CRA chapter 6, pages 6-141, 6-143, 6-143).

DOE changed the future drill rate in the 2004 CRA from 46.8 boreholes per square kilometer per 10,000 years to 52.5 boreholes per square kilometer per 10,000 years because of increased drilling for oil and gas in the Delaware Basin since the CCA (see 2004 CRA Chapter 6.0.2.3 and Appendix Data, Attachment A, page 3). The future drilling rate is expected to continue to increase for a number of years because of the continued increase in oil and gas exploration and development in the Delaware Basin. DOE continues to assume that current drilling practices continue unchanged into the future as required by Section 194.33(c)(1) (see 2004 CRA Chapter 6.0.2.3).

Based on DOE's Delaware Basin surveillance program DOE modified the probability of occurrence for each borehole plug configuration (see 2004 CRA Appendix PA, Attachment MASS-16.3.2; Appendix DATA, Attachment A, Table DATA-A-7; and WRES 2003, Attachment C). DOE changed the probability of occurrence for the continuous plug to 0.015, for the two-plug configuration to 0.289, and the three-plug configuration to 0.696 based on the observations of the Delaware Basin surveillance program.

### **33.3.1 EVALUATION OF COMPLIANCE FOR 2004 RECERTIFICATION**

EPA reviewed DOE's 2004 CRA documentation of continuing compliance with Section 194.33. EPA reviewed 2004 CRA Chapter 6, 2004 CRA Appendix PA, and 2004 CRA Appendix Data – in particular Appendix Data, Attachment A. EPA agreed that little had changed since the original CCA for the consideration of drilling events. DOE adopted EPA's PAVT parameter values and updated a few parameters based on its basin monitoring program.

EPA also agreed that the feature, events, and processes (FEPs) changed little in the 2004 CRA. DOE separated FEPs H58, Solution Mining for Potash and H59, Solution Mining for Other Resources from the original FEP H13, Potash Mining because of solution mining's

importance during the original CCA. However, solution mining was screened out in DOE's 2004 CRA FEP review. Air drilling, which was an important issue to commenters during the original CCA, has been monitored and reviewed by DOE and has been shown not to be a present practice near the WIPP.

EPA evaluated the resources considered by DOE in the 2004 CRA identified in 2004 CRA Chapter 2.3.1 and 2004 CRA Appendix DATA, Attachment A and verified them by comparing them to resources in the area. EPA agreed that there had been no significant changes since the original CCA review. Once again DOE considered the full spectrum of inadvertent and intermittent HI scenarios as done in the CCA PA. EPA found that DOE adequately demonstrated that it had considered inadvertent and intermittent drilling into the repository as the most severe HI scenario for the 2004 CRA PA. EPA concluded that exploratory and development wells were appropriately included in DOE's 2004 CRA analysis.

Since the original CCA, EPA has inspected annually DOE's site monitoring program, in particular the Delaware Basin drilling surveillance program (see 2004 CRA CARD 21 Inspections). Each year EPA found DOE's monitoring program to be adequate. EPA found DOE's compliance with the requirements of 40 CFR 194.33(4) related to shallow drilling to be adequate. EPA found DOE's documentation adequate to support their conclusion that drilling practices have not changed since the original CCA, that DOE's basin surveillance program is sufficient to evaluate and capture any changes in activities in the basin, and that three parameters needed to be updated because of additional wells drilled in the Delaware Basin.

EPA agreed that borehole plugging techniques used in the CCA and 2004 CRA PAs have not changed and therefore the way these are incorporated into the PA calculations is appropriate. EPA also agreed that the minor change in the occurrence probability of plug configurations is appropriate and is of no consequence to PA results.

Public comments expressed concern that the drilling rate was underestimated in the 2004 CRA's performance assessment calculations given the amount of drilling that is currently taking place throughout the Delaware Basin. Commenters suggested that the drilling rate be doubled to demonstrate compliance. Although EPA determined that DOE appropriately calculated and implemented a drilling rate of 52.2 boreholes/km<sup>2</sup>/year in compliance with Section 194.33 (b) for the 2004 recertification, EPA requested that DOE calculate the impacts of doubling the current drilling rate to respond to stakeholder concerns.

DOE performed the calculations for this analysis by assuming the drilling rate was increased to 105 boreholes per square kilometer per year for 10,000 years. The results of computer modeling showed that doubling the drilling rate would increase releases from the repository. However, this increase is relatively small and still well below EPA's regulatory release limits. (See 2004 CRA CARD 23)

### **33.3.2 2004 RECERTIFICATION DECISION**

Based on a review and evaluation of the 2004 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2004-0025, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.33.

### **33.4 CHANGES IN THE 2009 COMPLIANCE RECERTIFICATION APPLICATION (2009 CRA OR 2009 CRA)**

DOE noted in 2009 CRA Section 33.6 that only the drilling rate has changed based on drilling activities monitored in the Delaware Basin, and that the parameter MAXFLOW, duration of direct brine release (DBR), has been lowered from 11 days to 4.5 days to reflect current industry practice. Other aspects related to deep and shallow drilling have all remained the same since the 2004 CRA.

#### **33.4.0.1 40 CFR 194.33(a)**

DOE continues to assess deep and shallow drilling in the vicinity of the WIPP site for the 2009 CRA. For the 2009 CRA DOE documented that no features, events, or processes previously screened into the performance assessment (PA) have changed (see DOE 2009 CRA Section 33.6). DOE also stated that the scenarios and conceptual models used in PA have also not changed in the 2009 performance assessments.

#### **33.4.0.2 40 CFR 194.33(b)**

DOE did not change the way in which inadvertent human intrusions scenarios are implemented in the 2009 CRA PA. DOE documented that PA continues to include inadvertent and intermittent intrusions by resource drilling as the most severe human intrusions scenario as required in 40 CFR 194.33(b)(1).

As required by 40 CFR 194.33(b)(2) DOE did not change the way location and timing of intrusion boreholes are implemented in the 2009 CRA PAs. For the purposes of PA, drilling events are assumed to occur randomly in space and time as described in 2009 CRA Appendix PA-2009, Section PA.3.3.

DOE also documented that the same method was used to calculate the shallow and deep borehole drilling rates (see 2009 CRA Section 33.6.2, 2007 Delaware Basin Monitoring Annual Report and Clayton 2008a, Section 2.1.6). DOE calculated the deep drilling rate to be 58.5 boreholes/km<sup>2</sup> and the shallow drilling rate to be 22.87 boreholes/km<sup>2</sup> for the 2009 CRA PA calculations. DOE updated these values for the 2009 PA baseline calculations (2009 PABC) to calculate a deep drilling rate of 59.8 boreholes/km<sup>2</sup> (EPA 2010g).

#### **33.4.0.3 40 CFR 194.33(c)**

The Delaware Basin Monitoring Annual Reports for 2007 and 2008 both document that drilling practices have not change since the 2004 CRA. One parameter change has been included related to drilling events in the 2009 CRA. DOE changed the maximum time parameter (MAXFLOW) a direct brine release can take place from 11 days to 4.5 days to represent current drilling practice in the Delaware Basin (see Kirkes 2007). DOE documented the impact of this change in Kirkes and Clayton 2008 and showed that this change had a minor impact on performance assessment results in 2009 CRA Appendix PA-2009, Section PA 9.3.

#### **33.4.0.4 40 CFR 194.33(d)**

DOE notes that no changes have been included in the 2009 CRA related to effects of techniques used for resource recovery subsequent to drilling of the borehole (see 2009 CRA Section 33.6.4). As in the CCA and the 2004 CRA DOE continued to screen out three human intrusion FEPs as directed by this requirement: DOE screened out FEPs, H19, Explosions for Resource Recovery; H25, Oil and Gas Extraction; and H26 Groundwater Extraction (see 2009 CRA Appendix SCR-2009). DOE also documented that three new FEPs are screened out according to this requirement: H60, Liquid Waste Disposal-inside the WIPP boundary (IB); H61, Enhanced Oil and Gas Production-IB; and H62, Hydrocarbon Storage-IB.

### **33.4.1 EVALUATION OF COMPLIANCE FOR 2009 RECERTIFICATION**

EPA reviewed DOE's 2009 CRA documentation of continuing compliance with Section 194.33. EPA reviewed 2009 CRA Section 33, 2009 CRA Appendix PA,-2009, 2009 CRA Appendix Data-2009, and 2009 CRA Appendix SCR-2009. EPA agreed that little had changed since the original CCA and the 2004 CRA for the consideration of drilling events.

Solution mining became a concern in 2008 and 2009. Fresh water is injected into a shallow salt formation, dissolving it in order to produce salt-saturated brine used to drill oil and gas wells through salt strata such as the Salado Formation of the Delaware Basin. During 2008 and 2009, two brine production wells near Artesia, New Mexico and one well near Denver City, Texas (all outside the Delaware Basin and distant from WIPP) had surface collapse failures. This method of brine production is not a current practice in the vicinity of the WIPP site, however, EPA believed that such a failure is of sufficient concern to warrant additional review. In the second 2009 CRA completeness letter dated June 16, 2009 (EPA 2009b), EPA requested DOE to examine the likelihood and potential impact of such an activity near or even above the WIPP waste panels. DOE responded (DOE 2010a) and concluded that this technique of brine production is not likely in the vicinity of WIPP because of the cost to drill much deeper to acquire the salt. Even if it were to occur, the impact would be similar to that of potash mining, which is presently included in the performance assessment calculations. Therefore, this FEP did not need to be included in the WIPP performance assessment calculations.

EPA also agreed that the feature, events, and processes (FEPs) have undergone few changes in the 2009 CRA. DOE continued to screen out FEPs H19, H25, and H26, as well as screening out three new FEPs, H-60, H61, and H62, thus complying with the requirements of 40 CFR 194.33(d).

EPA verified that DOE continues to consider the full spectrum of inadvertent and intermittent human intrusion scenarios as done in the CCA PA. EPA found that DOE adequately demonstrated that it had considered inadvertent and intermittent drilling into the repository as the most severe human intrusion scenario for the 2009 CRA PA (see 2009 CRA Section 33.6.2). EPA continued to conclude that exploratory and development wells were appropriately included in DOE's 2009 CRA analysis.

Since the original CCA and the 2004 CRA, EPA has annually inspected DOE's site monitoring program, in particular the Delaware Basin drilling surveillance program (see 2009

CRA CARD 21 Inspections). Each year EPA found DOE's monitoring program to be adequate. EPA continues to find DOE in compliance with the requirements of 40 CFR 194.33(b) related to shallow drilling to be adequate. EPA found DOE's documentation adequate to support their conclusion that drilling practices have not changed since the original CCA and 2004 CRA, that DOE's basin surveillance program continues to be sufficient to evaluate and capture any changes in activities in the basin, and that two parameters needed to be updated because of additional wells drilled in the Delaware Basin: the drilling rate, because of recent drilling, and the parameter MAXFLOW, because of recent drilling experience in the Delaware Basin.

EPA agrees that borehole plugging techniques used in the CCA, 2004 CRA, and 2009 CRA PAs have not changed and therefore the way these are incorporated into the PA calculations continues to be appropriate

#### **33.4.2 2009 RECERTIFICATION DECISION**

Based on a review and evaluation of the 2009 CRA and supplemental information provided by DOE (FDMS Docket ID No. EPA-HQ-OAR-2009-0330, Air Docket A-98-49), EPA determines that DOE continues to comply with the requirements for Section 194.33.