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LATA:23:147

April 6, 2023

Mr. Steve Wagner, Manager
R&D SE, Performance Assessment and Decision Analysis
Sandia National Laboratories, Dept. 8881
4100 National Parks Hwy.
Carlsbad, NM 88220

Subject: BOREHOLE PLUGGING PRACTICES WHITE PAPER

Dear Mr. Wagner:

The purpose of this memo is to address the data quality associated with the white paper entitled, *Proposed Option for Borehole Plugging Area to be used for Determining Plugging Type Frequency Used in the Waste Isolation Pilot Plant Performance Assessment.* The data presented in Tables 1 through 3 of the white paper, current as of December 1, 2022, were collected under the Delaware Basin Drilling Surveillance Program (DBDSP). The monitoring activities of the DBDSP, including the tracking of well plug types and frequencies, are conducted in accordance with the appropriate provisions of the Carlsbad Field Office *Quality Assurance Program Document* (DOE/CBFO 94-1012) and the Nuclear Waste Partnership LLC *Quality Assurance Program Description* (WP 13-1). Additionally, the WIPP implementing procedure, WP 02-EC002, *Delaware Basin Drilling Database Upgrade Process* controls the process of updating the DBDSP database. Therefore, the data contained in Table 3, *Plug types and frequencies in the WIPP Nine-Township Area, the proposed method,* are suitable for use in future Performance Assessments that support WIPP compliance demonstrations.

If you have any questions, please contact me at (575) 234-3245.

Sincerely,

KAREN DAY (Affiliate) Digitally signed by KAREN DAY (Affiliate) Date: 2023.04.06 09:14:35 -06'00'

Karen A. Day, Project Manager, EPA Compliance
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Proposed Option for Borehole Plugging Area to be used for Determining Plugging Type Frequency Used in the Waste Isolation Pilot Plant Performance Assessment

Background

Plugging and abandonment of boreholes is an important step in the process to permanently close a well. In New Mexico, state and federal regulations require abandoned boreholes to be properly plugged and abandoned. To plug and properly abandon a well, Section 19.15.25.10 of the New Mexico Administrative Code (NMAC), issued by the Oil Conservation Commission (OCC) requires an operator to plug the well in a manner that permanently confines all oil, gas and water in the separate strata in which they are originally found and to protect potash mining activities. This may be accomplished by using mud-laden fluid, cement and plugs singly or in combination as approved by the division on the notice of intention to plug and abandon. As considered in the inadvertent human intrusion scenarios of the Waste Isolation Pilot Plant (WIPP) Performance Assessment (PA), deep exploratory boreholes in search of oil and gas resources can create pathways for repository releases if they intersect the repository waste area. As such, borehole plug length(s) and the locations of plugs within the borehole are important to the performance of the WIPP repository system because they determine when (or if) long-term flow of brine can occur through an abandoned borehole into the repository and subsequently out of the repository into the accessible environment.

The WIPP facility is located on federal land on the eastern edge of the Designated Potash Area (DPA; also called the potash enclave, (Interior) Secretary's Potash Area or, historically as the "Known Potash Lease Area). Oil and gas activities on federal land are subject to Bureau of Land Management (BLM) regulations. However, plugging and abandonment of wells in this area follow the methods prescribed by the New Mexico Oil Conservation Division's (OCD) Order R-111-P (OCD 1988). This order was adopted by the BLM to protect potash mining activities from water or gas intrusion on federal land. This regulation requires all deep boreholes within the DPA to be continuously plugged within the salt section. Areas outside the DPA have less stringent plugging requirements, generally only requiring cement plugs placed at casing transitions. Such boreholes may have two, three, or more plugs placed intermittently within the length of the borehole.

History – 1996-2014

In preparation for the Compliance Certification Application (CCA) (U.S. DOE 1996), a survey of plugged and abandoned boreholes was conducted to help determine the appropriate plug configuration(s) and properties to assign to the intrusion borehole as modeled in the WIPP PA. The question, "How would an intrusion borehole at the WIPP site be plugged in the future?" helped focus this survey. As data on plugged boreholes were gathered, it became apparent that boreholes are plugged based on a few key factors. These are: 1) site-specific geologic and hydrologic conditions; 2) the presence or absence of other resources (e.g., potash); and 3) applicable regulations. Using these key factors and the applicable regulatory criteria found in Title 40 Code of Federal Regulations (CFR) §194.25(a) and 40 CFR §194.33(c)(1), it was determined that an appropriate plugging analogue for the WIPP facility would be boreholes that: 1) were on federal land; 2) within the potash enclave; 3) in a "barren" area; and 4) plugged since the most recent plugging rules (OCD 1988). However, using these criteria only one plugged borehole was identified, undoubtedly because the oil field near the WIPP facility was in the early stages of development. Therefore, the criteria were relaxed, and the geographic area of interest

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was enlarged to include wells that were not within the potash enclave. This resulted in a geographic target area that consisted of the entire New Mexico portion of the Delaware Basin, considering only wells that had been plugged after 1988. This resulted in 188 plugged wells being included in the dataset. It was acknowledged at the time that while the size of the dataset was sufficient, it was dominated by wells that were not subject to the plugging rules in place near the WIPP facility and would therefore misrepresent plugging techniques and types used for boreholes within the DPA. Nonetheless, it was this geographic area and resulting dataset that was used for the CCA, the CRA-2004, the CRA-2009, and the CRA-2014.

As time passed with each recertification cycle, it was understood by the DOE that the dataset for plugged boreholes was growing significantly as oil production continued and more wells reached the end of their useful life. However, the borehole plugging dataset collected over the initially selected target area was becoming increasingly dominated by borehole plug configurations that were not expected to be implemented near the WIPP facility.

Changes for CRA-2019

In preparation for the CRA-2019, it was noted that the dataset had grown to 794 plugged boreholes, with the majority of these wells located beyond the WIPP vicinity and outside the DPA (U.S. DOE 2017). Therefore, the DOE chose to focus on a geographic area where wells were: 1) on federal land; 2) within the potash enclave; and 3) plugged since the most recent plugging rules (1988). This area yielded a population of 154 plugged wells. This dataset included wells within productive areas of the DPA as well as "barren" areas. The basis for this decision was that the identification of "barren" is largely based on current economics, not whether any potash is present. It is noted that potash reserves currently identified as non-economic may be viewed as economically attractive in the future. Based on this area, plugging configurations (types) were identified and probabilities for each plug type were assigned and used in the PA calculations that accompanied the CRA-2019 (U.S. DOE 2018).

During the EPA's review of the CRA-2019, the geographic area used to derive plugging probabilities was criticized, as documented in the Technical Support Document for Section §194.33 of the CRA (EPA 2022). The EPA stated that focusing the target area on only the DPA may not adequately represent future plugging practices. The EPA posited that while the WIPP indeed resides within the DPA, variances to the more stringent plugging requirements may be granted on a case-by-case basis, especially within the barren areas. Therefore, the EPA concluded that the plugging pattern frequency calculations should be based on all plugged and abandoned boreholes over a broader area, such as was done with the historic methodology, i.e., the New Mexico portion of the Delaware Basin, rather than only the subset of samples within the DPA. As a result, the EPA recommended reverting back to the pre-CRA-2019 methodology.

Target Areas and Shortcomings of Sampling Methodologies

Two different target areas have been used to determine plugging frequencies. The first methodology used from 1996 through 2014 considers all wells in the New Mexico portion of the Delaware Basin that have been plugged since 1988 (see Table 1). This method is considered the poorest analog to the WIPP vicinity because most of the wells in this area lie outside the DPA and have not been plugged with consideration for potash protection according to the R-111-P requirements. This dataset is and will continue to be dominated by wells plugged in a manner that is not representative of regulatory conditions near the WIPP facility.

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The second methodology used by the DOE in 2019 considers only wells within the DPA and includes both productive and barren areas (see Table 2). The DOE believes this second dataset to be consistent with regulatory guidance and current conditions near the WIPP facility. However, the DOE acknowledges that this method does not capture the possibility of deviations from the R-111-P plugging requirements in the future.

During the DOE/EPA Technical Exchange held in Albuquerque, New Mexico on October 25-27, 2022, the presentation titled, "Addressing EPA Issues Concerning Drilling Rate and Borehole Plugging Patterns" provided the history and technical and regulatory basis for selecting the geographic area and resulting dataset used for deriving borehole plugging types, patterns, and frequency in the PA. Discussion between the EPA staff and the DOE representatives during this meeting acknowledged the limitations and shortcomings of both methodologies used to date. One method is biased in a way that doesn't accurately represent plugging techniques employed near the WIPP site, while the other method may overestimate the utilization of the R-111-P-type plug, should a high instance of deviations from these requirements occur in the future.

Proposed Path Forward

A more appropriate geographic target area is proposed to address the shortcomings of previously used methodologies. Currently, the Delaware Basin Monitoring Program, which implements key elements of 40 CFR 194.33 and provides data for input parameters used in WIPP PA, uses the "WIPP Nine-Township Area," to gather data for several drilling-related activities that may be suitable for plugging data as well. This area refers to the nine townships that surround the WIPP, truncated on the northern edge by the Delaware Basin boundary. This area has been used to gather and report data that relate to:

- Drill bit diameter
- Casing sizes and depths
- Drilling method (i.e., underbalanced (air) versus overbalanced (mud) drilling)
- Fluid injection (for enhanced oil recovery)
- Salt-water disposal

The WIPP Nine-Township Area is proposed as a target area to gather borehole plugging data because it includes plugged boreholes that are both inside and outside the DPA, yet the general geology and stratigraphy are more similar to the WIPP facility than target areas used previously. This target area is provided below as Figure 1.

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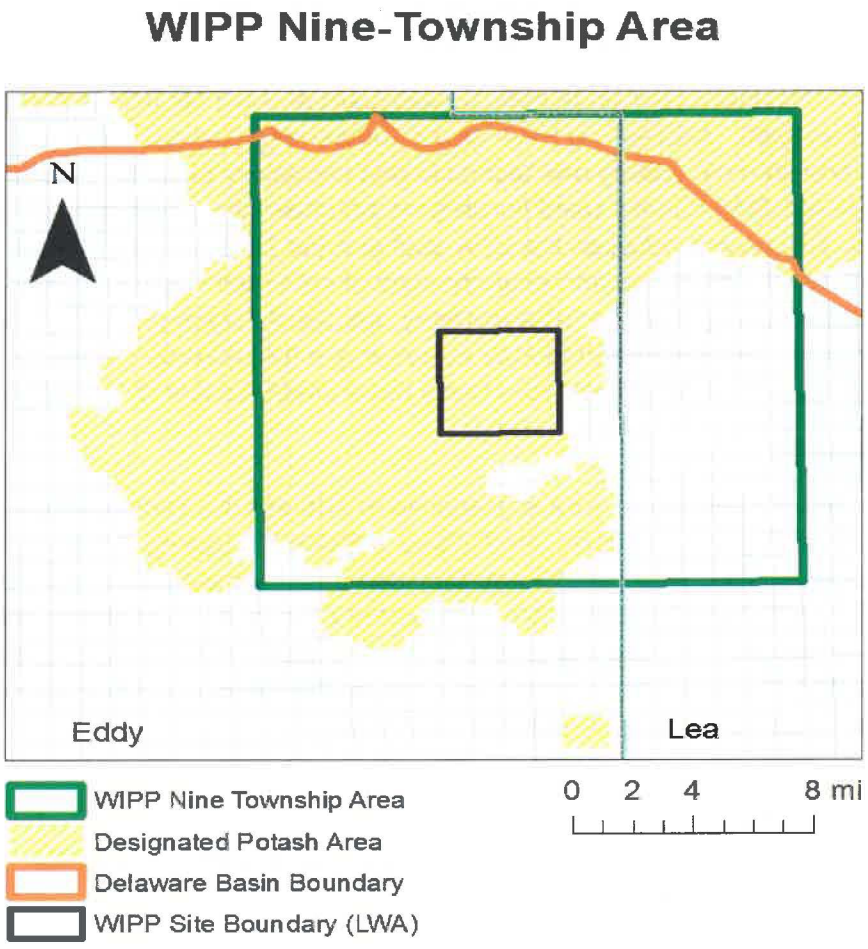

Figure 1: WIPP Nine-Township Area

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The following tables present plug types[1] and frequencies for the three different geographic target areas. Table 1 shows the plug types and frequency for the target area used from 1996 through 2014. Table 2 shows the data for the target area used in 2019. Table 3 shows the data for the proposed WIPP Nine-Township Area. Data in these tables are current as of December 1, 2022.

Table 1. Plug types[1] and frequencies in the NM Portion of the Delaware Basin, the method used in the period 1996-2014.

PLUG TYPE	WELL COUNT	PLUG TYPE FREQUENCY
I	273	18.3%
II	398	26.8%
III	312	21.0%
IV	229	15.4%
V	29	2.0%
VI	245	16.5%
TOTAL	1,486	100.0%

Table 2. Plug types[1] and frequencies in the DPA only, the method used in the CRA-2019.

PLUG TYPE	WELL COUNT	PLUG TYPE FREQUENCY
I	25	10.2%
II	26	10.6%
III	11	4.5%
IV	13	5.3%
V	8	3.3%
VI	162	66.1%
TOTAL	245	100.0%

Table 3. Plug types[1] and frequencies in the WIPP Nine-Township Area, the proposed method.

PLUG TYPE	WELL COUNT	PLUG TYPE FREQUENCY
I	93	20.6%
II	73	16.2%
III	79	17.5%
IV	19	4.2%
V	22	4.9%
VI	165	36.6%
TOTAL	451	100.0%

The DOE proposes to use the 9-township area surrounding the WIPP to derive plugging pattern frequencies for use in future PAs that support the WIPP compliance demonstrations.

[1] Note that plug types are described in the Compliance Certification Application (CCA) Appendix MASS, Attachment 16-1 (U.S. DOE 1996). Frequencies of these plug types are updated annually in the Delaware Basin Monitoring Annual Report (U.S. DOE 2022).

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