538262

Sandia National Laboratories
Operated for the U.S. Department of Energy by
Sandia Corporation

4100 National Parks Highway
Carlsbad, NM 88220
Mail Stop: 1395
Phone: (505) 234-0033
Fax: (505) 234-0061
Internet: jfkanne@sandia.gov

date: December 20, 2004

to: David S. Kessel
Manager Performance Assessment and Decision Analysis (Dept. 6821)

from: Joseph F. Kanney
Performance Assessment and Decision Analysis (Dept. 6821)
Thomas B. Kirchner
Performance Assessment and Decision Analysis (Dept. 6821)

Technical Review: James W. Garner
Performance Assessment and Decision Analysis (Dept. 6821)

QA Review: Mario J. Chavez
Carlsbad Programs Group (Dept. 6820)

subject: Impact of Potential Drilling Rate Increases on WIPP Repository Performance

Introduction

The Waste Isolation Pilot Plant (WIPP) is a deep geologic repository operated by the Department of Energy (DOE) for the disposal of defense-generated transuranic radioactive waste. In 1996 the Department of Energy (DOE) completed a performance assessment (PA) calculation for the WIPP. The PA was part of the Compliance Certification Application (CCA) submitted to the Environmental Protection Agency (EPA) to demonstrate compliance with the radiation protection regulations of 40 Code of Federal Regulations (CFR) 191 and 40 CFR 194. DOE is required by the WIPP Land Withdrawal Act (Public Law 102-579) to submit documentation to EPA for the recertification of the WIPP every five years in order to continue operating the site. The 2004 Compliance Recertification Application (CRA) was submitted to the EPA in March 2004 (U.S. DOE 2004). The EPA is currently performing a review of the 2004 CRA to determine its completeness. The completeness determination is an administrative step to ensure that the CRA addresses all of the required regulatory elements and provides sufficient information for EPA to conduct a full technical review.

This memo reports the results of an investigation into the impact of potential drilling rate increases on WIPP repository performance. This work was performed in response to questions raised by stakeholder

performed under Analysis Plan AP-112: Analysis Plan for CRA Response Activities Kirkes and Wagner (2004).

The EPA has defined two types of drilling in 40 CFR §194.2 (U.S. EPA 1996): deep drilling is defined as drilling events in the Delaware Basin that reach or exceed a depth of 2150 ft below the surface relative to where such drilling occurred, and shallow drilling is defined as drilling events in the Delaware Basin that do not reach a depth of 2150 ft below the surface relative to where such drilling occurred. However, the effects of future shallow drilling have been eliminated from WIPP PA calculations on the basis of low consequence to the performance of the disposal system (U.S. DOE 2004, Appendix PA, Attachment SCR). Thus, all further references to drilling in this document should be taken to mean deep drilling events.

EPA regulations set out several requirements for the consideration of drilling events in WIPP PA. Among these are: 1) drilling events are assumed to occur in the Delaware Basin at random intervals in time and space during the regulatory time frame; 2) the frequency of deep drilling should be determined by identifying the deep drilling that has occurred in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared.

Modeling the Drilling Rate and Potential Drilling Rate Increases

As described in the 2004 CRA (U.S. DOE 2004, Section 6.3.2), drilling intrusions are assumed to occur randomly in time and space (i.e., assumed to follow a Poisson process). The drilling rate, λ_d, is used by the CCDFGF code to generate the times at which drilling intrusions occur.

For the 2004 CRA, the drilling rate considered within the controlled area is reported in Appendix DATA, Attachment A, Section DATA-A-4.0. Based upon the number of deep boreholes drilled within the Delaware Basin (12,139) during the 100 year period from 1903 to September 2002, and the Delaware Basin surface area (23,102.1 km^2), the drilling rate was calculated as 5.25×10^{-3} km^{-2} yr^{-1}, an increase of approximately 12% over the rate of 4.68×10^{-3} km^{-2} yr^{-1} used in the CCA. Due to the 100-year window used to calculate the drilling rate, it is expected to increase for several years before it begins to drop. Because the first deep borehole was drilled in 1911, it will be 2011 before any boreholes are dropped from the borehole count. At the same time, new boreholes will be added to the count as oil and gas activity within the basin continues.

The expected increase in the drilling rate has prompted questions by some stakeholder groups about its potential impact. In particular, there have been requests that DOE calculate releases based upon an estimated drilling rate at the time of closure (2033). Although there is no regulatory basis for this approach, DOE has requested SNL to examine the impact of potential increases in the drilling rate on WIPP PA results.

SNL has obtained the most current available drilling data for deep boreholes in the Delaware Basin (Kouba 2004). This data is collected as part of the Delaware Basin Drilling Surveillance Program (DBDSP) and is current through December 6, 2004. Based upon this information, SNL uses a 100-year window (1934 through 2033) to calculate the average drilling rate. For the interval in which there is no

drilling activity data (2005 through 2033), we assume that the total number of deep boreholes during the period is equal to that observed in the previous 29 years (1976 through 2004).

$$\lambda_d = \frac{N_{1934-2004} + N_{1976-2004}}{A_{DB} \cdot 100\text{yr}}$$

$$= \frac{12381+6790}{23102.1\ \text{km}^2 \cdot 100\text{yr}}$$

$$= 8.30\text{x}10^{-3}\,\text{km}^{-2}\text{yr}^{-1}$$

The advantages of this approach are: 1) it maintains consistency with the 100-year window mandated by the regulations; 2) it includes the overall peak of drilling activity that occurred from the late 1950's to the mid 1960's; and 3) using 1976-2004 to fill in the missing data also does a good job of capturing smaller peaks in drilling activity that occurred during the mid 1970's to early 1980's and during the mid to late 1990's.

The approach outlined above results in a drilling rate of approximately 192 boreholes/year or 8.30 x 10^{-3} km^{-2} yr^{-1}. This is about a 1.6 factor increase over that used for the 2004 CRA.

Impact of Modeled Drilling Rate Increases

The impact of increased drilling rates was examined by running the CCDFGF code (Version 5.02) with modified drilling rates (the drilling rate is specified in the input data file supplied to CCDFGF). All other information in the input file is the same as that used for the corrected CRA results reported in Vugrin (2004b, 2004a).

Two drilling rates were considered: 1) 8.30 x 10^{-3} km^{-2} yr^{-1} (the projected 2033 drilling rate described above); and 2) 1.05 x 10^{-2} km^{-2} yr^{-1} (twice the rate used in the 2004 CRA). The latter rate was included because it is the rate proposed by stakeholders.

The CCDFGF input and output files used for these calculations are shown in Table 1. These files are stored on the WIPP Alpha Cluster, in CMS library LIBCRA1V_CCGF, in the class DRILL.

Table 1. CCDFGF input and output files used in the drilling rate impact study.

Drilling Rate (km^{-2} yr^{-1})	CCDFGF Input Files	CCDFGF Output File
8.30 x 10^{-3}	CCGF_CONTROL_TEST4.INP CCGF_RELTAB_TEST4.OUT	CCGF_QB0502_TEST4.OUT
1.05 x 10^{-2}	CCGF_CRA1_CONTROL.INP DOUBLEDRILLINGRATE.DAT	CCGF_CRA1V_2XDRILLRATE.OUT

Figure 1 shows the mean total release CCDF for the 2004 CRA drilling rate, the projected 2033 drilling rate, and double the 2004 CRA drilling rate. At the 0.1 probability level, one observes a nearly linear relationship between the drilling rate increase and the increase in total releases. Doubling the drilling

rate approximately doubles the total release. At the 0.001 probability level, the impact is more modest. Here doubling the drilling rate increases total releases by a factor of approximately 1.8. The nearly linear behavior is to be expected since the most significant contribution to total releases comes from drill cuttings ejected at the surface, and the total cuttings volume is a linear function of the number of drilling intrusions.

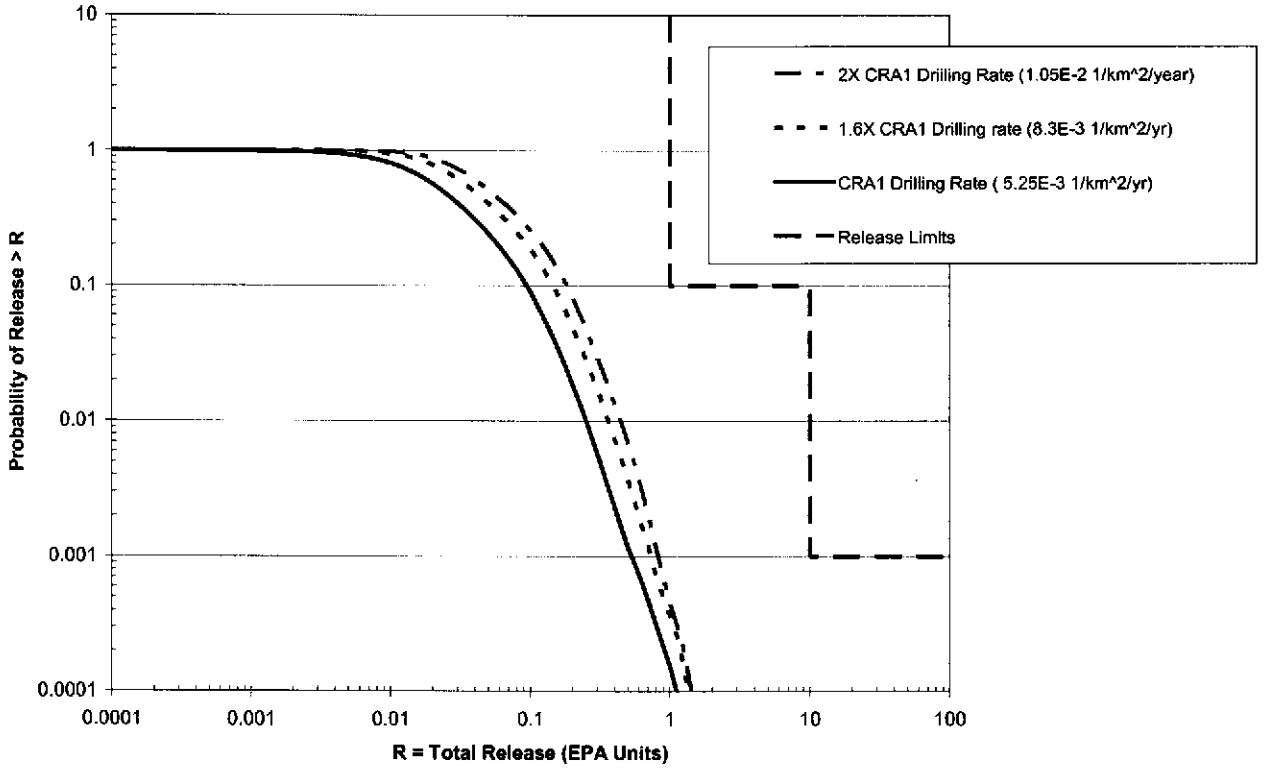

Figure 1. Impact of drilling rate increases on mean total releases.

Conclusions

SNL has analyzed the impact of increases in modeled drilling rates on repository performance. Our analysis shows that even if the drilling rate were doubled relative to that used for the 2004 CRA, the disposal system performance would be well within the release limits set forward in EPA regulations.

It is important to note that the projected increase for the drilling rate used in WIPP PA is a feature of the 100-year window used in the calculations. Examination of the drilling data collected by the DBDSP shows that although there are peaks and dips in drilling activity over time, there has been a consistent overall decreasing trend since the late 1950's, with each major peak smaller than the one that preceded it. This indicates that the projected 2003 drilling rate is very likely to be quite conservative and doubling the 2004 CRA rate is even more conservative.

References

Kirkes, R., and S. Wagner. 2004. Analysis Plan for CRA Response Activities, AP-112, Revision 0. Analysis Plan ERMS 534690, Sandia National Laboratories, Carlsbad, NM.

Kouba, S. C. 2004. Drilling Rates. Letter to David S. Kessel ERMS 538228, Washington Regulatory and Environmental Services, Carlsbad, NM.

U.S. DOE. 2004. Title 40 CFR Part 191 Compliance Recertification Application for the Waste Isolation Pilot. DOE/WIPP 2004-3231, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad Field Office, Carlsbad, NM.

U.S. EPA. 1996. 40 CFR 194. Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's

Compliance with the 40 CFR Part 191 Disposal Regulations. U.S. Environmental Protection Agency, Washington, DC.

Vugrin, E. D. 2004a. Corrected CRA Figures. Technical Memorandum ERMS 538260, Sandia National Laboratories, Carlsbad, NM.

Vugrin, E. D. 2004b. Run Control for Correction of Releases for the CRA. Technical Memorandum ERMS 537987, Sandia National Laboratories, Carlsbad, NM.