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Subject: Solution Mining for Potash

Introduction and Summary

The 40 CFR Part 194 criteria require that performance assessments for the Waste Isolation Pilot Plant (WIPP) Compliance Certification Application (CCA) include an analysis of the effects on the disposal system of any activities that occur in the vicinity of the disposal system prior to disposal or are expected to occur in the vicinity of the disposal system soon after disposal. One activity of potential concern is solution mining of potash. This document provides an analysis of the likelihood and potential effects on the WIPP disposal system of potash solution mining operations in the Delaware Basin.

In summary, it is likely that the potash in the vicinity of the WIPP will continue to be extracted using conventional excavation methods, rather than solution mining. If solution mining is assumed to occur in the near future¹ near the WIPP Land Withdrawal Boundary, the assumptions made in the CCA concerning the treatment of mining-induced subsidence would still be appropriate. The potential effects of leakages to the Culebra resulting from solution mining in the near future would be of low consequence to the performance of the disposal system.

Consistent with 40 CFR §194.33(d) performance assessments need not analyze the effects of techniques used for resource recovery² subsequent to the drilling of a borehole in the future².

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- ¹ Near-future human activities are those activities that may be expected to occur based on existing plans and leases. The DOE assumes that all such activities will occur and will continue until their completion, potentially at some time after disposal.
 - ² Future human activities are those that occur within or outside the controlled area subsequent to repository closure, for which there are no existing plans and leases. Such activities are limited by 40 CFR §194.32(a) to drilling and mining.

Therefore, future solution mining within or outside the controlled area has been eliminated from performance assessment calculations on regulatory grounds.

Potash Mining in the Delaware Basin

Throughout the Carlsbad Potash District, commercial quantities of potassium salts are restricted to the middle portion of the Salado, locally called the McNutt. A total of 11 zones (of distinct ore layers) have been recognized in the McNutt. In the vicinity of the WIPP the 4th ore zone (langbeinite) and 10th ore zone (sylvite) contain economic reserves.

Potash can be extracted either by underground excavation mining or by solution mining. Solution mining involves the injection of water into a mineralized zone and the extraction of saturated brine which is recrystallized in evaporation ponds. Solution mining of langbeinite is not technically feasible because the evaporite minerals which surround the ore are more soluble than the ore itself. EPA (1996, p. 9-33) and Brausch et al. (1982, pp. 23-24) reported that past attempts to solution-mine sylvite in the Delaware Basin did not meet with success because of the characteristics of the ore body. Failure of solution mining was attributed to low ore grade, thinness of the ore beds, and problems with heating and pumping injection water. Currently, potash is recovered only by excavation mining in the Delaware Basin.

Likelihood of Solution Mining in the Vicinity of the WIPP

It is unlikely that potash mine operators in the vicinity of the WIPP will elect to use solution mining in the future, even once sylvite deposits are fully mined out by conventional excavation methods, because conditions are economically unfavorable, as noted by Heyn (1997), a potash mine operator within the Delaware Basin. Points raised by Heyn (1997) are summarized below:

- Solution mining requires heat to increase the ambient temperature of the injected water in order to increase the dissolved salt capacity of the brine. This is usually accomplished by taking advantage of geothermal heat found in deep wells or mines. Most solution mines are at depths in excess of 3000 feet (910 meters). The potash ore bodies in the vicinity of the WIPP are less than 1740 feet (530 meters) below the surface. Also, the cost of evaporation equipment to recover the potassium salts may be prohibitive.
- Solution mining of the sylvite ore bed in the vicinity of the WIPP would result in excessive solution of unwanted minerals and clays because the ore zone is too thin (less than 6 feet [1.8 meters]). Solution mining usually requires an ore bed thickness in excess of 10 feet (3 meters).
- Unavailability and cost of fresh water in the area would impede implementation of solution mining.

- Potash ore reserves in the vicinity of the WIPP are too low in potash grade and the life expectancy of the mines is too low to justify the cost of constructing a solution mining refinery.

Thus, it is likely that the potash-bearing ore zones in the vicinity of the WIPP will continue to be extracted using conventional room and pillar methods, rather than solution mining.

Effects of Solution Mining on the Performance of the WIPP

If solution mining for potash were undertaken in the vicinity of the WIPP it could result in subsidence. However, performance assessment calculations already assume that widespread subsidence will occur as a result of potash mining in the near future. The assumed extent of subsidence and its effects on the hydraulic conductivity of the Culebra are independent of the mining method used (underground excavation or solution mining).

Poor management of the solution mining operations could conceivably result in water losses to hydraulically conductive units above the Salado. Large water losses would result in low potash yields and most likely remedial actions would be taken by the operators. Undetected leakages to the Culebra would be no more severe than leakages that might be speculated to occur during secondary oil production operations (waterflooding) or brine disposal in the vicinity of the WIPP. The potential effects of such events have been analyzed by Stoelzel and O'Brien (1996) and have been shown to be of low consequence to the performance of the disposal system.

Note that, consistent with 40 CFR §194.33(d), performance assessments need not analyze the effects of techniques used for resource recovery subsequent to the drilling of a borehole in the future. Therefore, performance assessments need not analyze the effects of future solution mining within or outside the controlled area.

References

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