Application of Magnesium Oxide as an Engineered Barrier at Waste Isolation Pilot Plant

Report of the Expert Panel

Closeout Meeting

February 21, 2006

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 1

Is the assumption that *cellulosic* materials could be consumed by microbes, under conditions prevailing at WIPP, consistent with scientific and engineering principles, standards, and practices?

DISCUSSION OF FINDINGS

Biodegradation of cellulosic materials is well-documented and is a real possibility under the conditions in WIPP. However, it is not going to covert 100% of the cellulosic materials to carbon dioxide.

Two committees of the National Research Council (NRC 1996; NRC 2001) came to the conclusion that:

1. The biodegradation of cellulosic materials is expected to be minimal; but

2. For that portion that does undergo biodegradation, the rate is expected to be maximum during the pre-closure period.

The Expert Panel (EP) agrees with those conclusions. However, the EP made no attempt to independently quantify the extent and rate of biodegradation of *cellulosic* materials.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 2

Is the assumption that *plastic* materials anticipated to be present in TRU waste could be consumed by microbes, under conditions prevailing at WIPP, consistent with scientific and engineering principles, standards, and practices?

DISCUSSSION OF FINDINGS

Some plastics may be subject to biodegradation under WIPP conditions but many common plastics will not biodegrade to carbon dioxide.

It is of particular interest to note that, in its regulations, EPA (2005a; 2005b) defined the following polymers as nonbiodegradable:

- polyethylene,
- high density polyethylene (HDPE),
- polypropylene, polystyrene,
- polyurethane,
- polyacrylate,
- polynorborene,
- polyisobutylene,
- ground synthetic rubber,
- cross-linked allylstyrene
- tertiary butyl copolymers.

SUMMARY OF THE EXPERT PANEL'S FINDINGS
Continued

In recent years there has been an increasing recognition of a need to develop polymers that would be biodegradable. In addition, any biodegradable polymers that may have been present in the initial TRU waste should have been biodegraded by the time it was disposed at WIPP.

On the basis of the information that was provided, the EP concluded that the fraction of plastics that is expected to be biodegraded under the conditions existing within the WIPP is small. This conclusion is consistent with the assessment of the NRC (2001) and the regulatory decisions of the EPA. However, the EP made no attempt to independently quantify the extent and the rate of biodegradation of *plastic* materials.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 3

Is the assumption that *rubber* materials will be consumed by microbes, under the conditions prevailing at WIPP, consistent with scientific and engineering principles, standards, and practices?

DISCUSSION OF FINDINGS

Rubber materials are not subject to biodegradation under WIPP conditions.

On the basis of the information that was provided, the EP concluded that the fraction of rubber that is expected to be biodegraded under the conditions existing within the WIPP is small. This conclusion is consistent with the assessment of the NRC (2001) and the regulatory decisions of the EPA. However, the level and the rate of biodegradation of *rubber* materials, as small as they may be, were not independently quantified by the EP.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 4

Under conditions prevailing at WIPP, is the assumption that all the MgO, as presently emplaced, will be available to react with CO_2 consistent with scientific and engineering principles, standards, and practices?

SUMMARY OF FINDINGS

Under conditions prevailing at WIPP, the EP has concluded that not 100% of the MgO will be available to react with CO_2. However most of the MgO will be available for reaction.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 5

Assuming that only cellulosic materials are consumed by microbes, is it consistent with scientific and engineering principles, standards, and practices to conclude that, in the absence of MgO, the solubility of actinides will be such that releases to the accessible environment will still be below the EPA limits?

SUMMARY OF FINDINGS

On the basis of the information received by the EP, it is likely that releases to the accessible environment will be below the EPA regulatory limits. However, the evidence received by the EP is not sufficient to definitely support this conclusion.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 6

Assuming that all cellulosic, plastic and rubber (CPR) materials are consumed by microbes, is it consistent with scientific and engineering principles, standards, and practices to conclude that, in the absence of MgO, the solubility of the actinides will be such that releases to the accessible environment will still be below the EPA limits?

FINDING 6

On the basis of the information received by the EP, it is likely that releases to the accessible environment will be below the EPA regulatory limits.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 7

Is the application of Acceptable Knowledge reasonable and consistent with scientific and engineering principles, standards, and practices?

SUMMARY OF FINDINGS

Considering the costs and human health risks associated with measuring the amounts of cellulosic, plastic, and rubber (CPR) materials in each waste container, the EP concluded that the application of Acceptable Knowledge is reasonable and consistent with scientific and engineering principles, standards, and practices.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION 8

Is the requirement to emplace a 67% MgO excess consistent with ALARA, scientific and engineering principles, standards and practices? Is the associated increased and real risk to the affected workers and the general public imposed by this requirement offset by the potentially reduced risk to future generations?

SUMMARY OF FINDINGS

In reference to Finding 4, the EP has concluded that most of the MgO will be available for chemical reaction. In reference to Findings 1-3, the EP has concluded that only a small fraction of the CPR materials is likely to be biodegraded to produce CO_2. In reference to Findings 5-6, the EP believed that it is likely that the EPA release standards would be met, even if the MgO amount is less than the quantity required to consume all the CO_2 produced. Therefore, the EP concludes that 67% MgO excess (i.e., 67% in excess of the stoichiometric quantity required assuming complete biodegradation of CPR materials to CO_2) is not necessary.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION RELATED TO THE FORMATION OF AN EXPERT ELICITATION PANEL

CRITERION 9

Given the apparent uncertainties in consumption of CPR materials and the resulting quantities CO_2, is it reasonable to convene an Expert Elicitation Panel to reach a consensus on the potential extent of consumption of various components of CPR materials? If such a panel is convened, what other items should be considered?

FINDING 9

Present estimates of the mobilities of the actinides were performed under scenarios that included highly conservative values for many of the input factors. In order to develop realistic evaluations, it will be necessary to address the following issues:

1. What fraction of the cellulosic materials is likely to degrade from microbial activity in the expected repository environment?

2. What fraction of the plastic materials is likely to degrade from microbial activity in the expected repository environment?

3. What fraction of the rubber-based materials is likely to degrade from microbial activity in the expected repository environments?

SUMMARY OF THE EXPERT PANEL'S FINDINGS

CRITERION RELATED TO THE FORMATION OF AN EXPERT ELICITATION PANEL
Continued

4. What fraction of the emplaced MgO is likely to be available to react with CO_2?

5. What would be the performance consequences of a partial or complete shortfall in MgO buffering capacity?

The objective of this effort will be to assess release scenarios, using more realistic values for the required input factors, and considering their associated uncertainties. This being the case, it is reasonable and appropriate to convene an Expert Elicitation Panel to provide the necessary input and support.

SUMMARY OF THE EXPERT PANEL'S FINDINGS

RECOMMENDATIONS OF THE EXPERT PANEL

Based on a careful assessment of the information presented to the EP and the findings developed in response to the review criteria, the EP provides the following recommendations:

1. The DOE should consider convening an Expert Elicitation Panel to provide a more realistic and accurate estimate of the potential extent of biodegradation of various components of the CPR materials likely to be emplaced in the WIPP.

2. The DOE should consider performing a single-room realistic analysis of the complex processes involved, including gas generation, chemical reactions, biodegradation, and mechanical creep.