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November 12, 1999

Mr. George T. Basabilvazo, Compliance Team Leader
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US Department of Energy
Carlsbad Area Office
P.O. Box 3090
Carlsbad, NM 88220

Subject: Evaluation of Candidate MgO Materials for use as Backfill at WIPP

Dear Mr. Basabilvazo:

Sandia was requested by DOE/CAO to evaluate two candidate MgO materials for use as backfill at the WIPP. Sandia evaluated materials recommended and supplied by Martin Marietta Magnesia Specialties and by Premier Chemicals. Materials were evaluated on the basis of reactivity, particle size, chemical purity, and density. Material cost was also considered.

Both candidate materials are acceptable in terms of particle size, reactivity, and purity. The lower net density (MgO plus equivalent CaO) of the Premier Chemicals Gabbs MgO requires that an additional amount of about 2 percent would have to be added to meet the CCA requirement. Considering that significant money would be saved by using the Premier Chemical product, Sandia recommends that the DOE/CAO pursue acquiring approval from the US EPA to reduce the amount MgO emplaced. While that approval is being sought, Sandia recommends that the DOE/CAO use the Premier Chemical product, and adds the small additional amount required to meet the CCA specification.

If you have any questions, please contact Hans Papenguth of my staff at (505) 844-3819.

Sincerely,

Ned Z. Elkins

Enclosure

Sandia National Laboratories

Operated for the U.S. Department of Energy by
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date: November 12, 1999

to: Melvin G. Marietta, MS1395 (6821)

from: Hans W. Papenguth, MS0733 (6832)

subject: Evaluation of Candidate MgO Materials for use as Backfill at WIPP

Summary

Sandia was requested by DOE/CAO to evaluate two candidate MgO materials for use as backfill at the WIPP. The primary purpose of backfill at WIPP is to control chemical conditions, so that actinide solubilities are minimal. Sandia evaluated materials recommended and supplied by Martin Marietta Magnesia Specialties and by Premier Chemicals. Materials were evaluated on the basis of reactivity, particle size, chemical purity, and density. Material cost was also considered.

Both candidate materials are acceptable in terms of particle size, reactivity, and purity. The lower net density (MgO plus equivalent CaO) of the Premier Chemicals Gabbs MgO requires that an additional amount of about 2 percent would have to be added to meet the CCA requirement. Given that significant money would be saved by using the Premier Chemical product, Sandia recommends that the DOE/CAO pursue acquiring approval from the US EPA to reduce the amount MgO emplaced. While that approval is being sought, Sandia recommends that the DOE/CAO uses the Premier Chemical product, and adds the small additional amount required to meet the CCA specification.

Introduction

As described in the Compliance Certification Application (CCA; US DOE, 1996), magnesium oxide backfill has been selected as the most desirable backfill material for the Waste Isolation Pilot Plant (WIPP; Bynum et al., 1996, 1997, 1999). For WIPP, the primary attribute of MgO backfill is that it buffers aqueous chemical conditions in the repository, resulting in a significantly decreased actinide source term. MgO controls chemical conditions in two ways. MgO reacts with microbially generated carbon dioxide, which disassociates to form carbonate, which is a powerful actinide complexant. The formation of magnesium carbonate minerals virtually eliminates carbonate as an actinide solubility enhancing ligand. MgO also maintains pH in a slightly basic region, where actinide solubilities tend to be lowest.

Several constraints have been defined for the physical and chemical character of MgO backfill. The reactivity of the MgO with carbonate must be sufficiently high to ensure that the backfill reacts with carbonate as it is formed from microbial degradation of cellulose, plastic, and rubber waste materials. In contrast, the reactivity of the MgO with carbonate must be sufficiently low, or adequately protected, to ensure that the backfill does not react with atmospheric carbon dioxide present in ventilation air in the WIPP. Trace and minor constituents accompanying the MgO must not have a detrimental effect on actinide solubilities. Finally, bulk density and material purity must be sufficiently high so that sufficient MgO can be emplaced in the WIPP. Detailed discussions of the basis for these constraints are included in other documents (WID, 1997; Bynum et al., 1996, 1997, 1999; Krumhansl et al., 1997).

Most of the initial WIPP-specific evaluation of MgO was conducted with MgO samples obtained from National Refractory Materials (Moss Landing, California). The specific material used consisted of hard-burned MgO pellets referred to as MAG Plus 00HB 3/8xDown (i.e., 3/8-inch and smaller). Westinghouse Waste Isolation Division (WID) acquired a significant quantity of MAG Plus 00HB for use during the first few years of WIPP operation. However, National Refractory Materials is no longer able to supply MgO.

DOE/CAO has requested that Sandia evaluate candidate MgO materials supplied by two prospective suppliers (Basabilvazo, 1999). The remainder of this memorandum describes the candidate MgO materials and laboratory testing to evaluate materials. This work has been completed following standard WIPP Quality Assurance Procedures.

Materials Tested

A sample of proposed MgO material was requested from Premier Chemicals by e-mail and telephone on October 14, 1999. Mr. Tom Miller (909/594-4921, tmiller@premierchemicals.com) arranged for Sandia to receive a sample of MgO produced in Gabbs, Nevada, which arrived on October 21, 1999.

A sample of proposed MgO material was requested from Martin Marietta Magnesia Specialties by e-mail and telephone on October 14, 1999. Mr. David van Overschelde (913/897-1107, david.vanoverschelde@martinmarietta.com) arranged for Sandia to receive a sample of MagChem MC 10-20, which arrived on October 18, 1999.

For most of the tests conducted in the laboratory evaluation, we also included samples of the current MgO stock, produced by National Magnesia Chemicals (Moss Landing, California). This material, called MAG Plus 00HB 3/8xDown, was obtained by Dan Lucero (Sandia) from Advanced Metal Processing, Carlsbad, New Mexico, on March 4, 1999. In addition, we have included some results from previous tests conducted on MAG Plus 00HB 3/8xDown. The pellet size of the current material is noticeably coarser than the previously acquired material.

Manufacturer	Plant Location	Reference Name	Acquisition Date
National Magnesia Chemicals	Moss Landing, California	1997 MAG Plus 00HB 3/8xDown	10/17/96
National Magnesia Chemicals	Moss Landing, California	1999 MAG Plus 00HB 3/8xDown	3/4/99
Martin Marietta Magnesia Specialties	Manistee, Michigan	MagChem MC 10-20	10/18/99
Premier Chemicals	Gabbs, Nevada	Gabbs MgO	10/21/99

Particle Size

The production techniques used by each of the three manufacturers are different, but all three materials are categorized as hard-burned MgO.

National Magnesia Chemicals produced MgO by mixing calcined limestone (CaO) with seawater at their Moss Landing, California plant. The precipitate was then processed in rotary kiln. The resulting product appears macroscopically as pellets, but when viewed with scanning electron microscopy (SEM) actually consist of MgO crystallites on the order of several micrometers in size (Figure 1). The crystallites are fused together to form hard, well-indurated pellets with porosities of about 50 percent. As mentioned above, the 1999 MAG Plus 00HB 3/8xDown (i.e., 3/8 inch and smaller) has a pellet size that tends to be slightly larger than the 1997 MAG Plus 00HB 3/8xDown samples.

Martin Marietta Magnesia Specialties produces MgO in a similar way. Instead of seawater, however, the source of magnesium is from brine pumped from the subsurface at their Manistee, Michigan plant. Their product does not occur as pellets. In their letter to DOE/CAO, Martin Marietta Magnesia Specialites (1999) states that their material, MagChem MC 10-20, is a milled-grade product, with 96% passing a 20 mesh (850 micrometers, assuming that mesh size follows the U.S. Mesh standard), and a median particle size of 50 micrometers. Examination with SEM shows that the crystal sizes are about 10-20 micrometers (Figure 2).

Premier Chemicals produces MgO by calcining magnesite ore mined at their Gabbs, Nevada plant. This material is clearly not as pure as the other MgO materials, as it has a yellow color instead of white, due to minor iron. In their letter to DOE/CAO, Premier Chemicals (1999) states that their material is less than 12 mesh (1700 micrometers, assuming that mesh size follows the U.S. Mesh standard). Examination with SEM shows that the material is more massive compared to the other materials, but has topography on the micrometer scale, and lacks internal porosity within the grains (Figure 3).

Particle size actually serves only as an indirect indicator of the suitability of MgO for the WIPP. The surface area of the MgO is the primary control on reactivity with carbon dioxide. Mineral reactivity can also be affected by the degree of crystallinity of the mineral (and impurities included in the crystal lattice). However, considering that all candidate MgO materials are categorized as hard-burned MgO, the degree of crystallinity is not a factor. In fact, the narrow peak geometry on powder X-ray diffraction (XRD) spectra show that all MgO materials have a high-degree of crystallinity (Figure 4). Given that surface area increases as particle size decreases, the particle size of acceptable MgO backfill materials should be somewhat similar to the current material, but actual measurements of chemical reactivity are more important.

In summary, particle sizes of both candidate MgO materials are acceptable.

Reactivity

In an aqueous environment, MgO is believed to undergo a series of reactions preceding its reaction with the carbonate ion: (1) hydration of MgO to form $Mg(OH)_2$, or brucite; (2) dissolution of $Mg(OH)_2$; and (3) reaction of the dissolved Mg ions with carbonate ions. The reaction step that is most critical for the WIPP is the third step, the carbonation reaction. It would be most relevant to the WIPP to conduct a test based on the carbonation reaction to use as a reactivity criterion for WIPP MgO. However, as was learned from the experiments supporting the Conceptual Model Peer Review Panel (CMPRP; Papenguth et al., 1997), those tests are quite slow, requiring months rather than minutes. An alternative test is to measure the hydration reaction, which can be done much more quickly. To provide the most relevant test criterion for the WIPP requires that the hydration reaction must be the rate-limiting step. It is likely that the hydration reaction is the rate-limiting reaction because we did not observe a brucite layer forming at the surface of the MgO pellets in the CMPRP experiments. In any case, the carbonation reaction [i.e., the combination of $Mg^{2+}_{(aq)}$ and $CO_3^{2-}{}_{(aq)}$] is irrespective of the source of the $Mg^{2+}_{(aq)}$ or of the $CO_3^{2-}{}_{(aq)}$ ions, but is likely to be dependent on the concentration of the ions. Therefore, measuring the rate at which the reactant is supplied to the system is a reasonable acceptance test.

We followed the test procedure developed in late 1997 for the Westinghouse WID (Krumhansl et al., 1997; WID, 1997). Briefly, 300 mL of 20% concentrated phosphoric acid is mixed with 18 g of MgO pellets. The mixture is stirred using a magnetic stirrer and the temperature rise is noted over a 40-minute time period, or until the temperature begins to decrease. Triplicate tests were conducted with 1999 MAG Plus 00HB 3/8xDown, Gabbs MgO, and MagChem MC 10-20. For comparison, Figure 5 and Table 1 also include results of eight replicate tests conducted with 1997 MAG Plus 00HB 3/8xDown described in Krumhansl et al. (1997). Results are summarized in the following table.

Manufacturer	Material	Temperature Rise	Time to Maximum Temperature
National Magnesia Chemicals	1997 MAG Plus 00HB 3/8xDown	22.9 ± 0.5°C	34 ± 1.5 min
National Magnesia Chemicals	1999 MAG Plus 00HB 3/8xDown	18.8 ± 0.4°C	60 ± 2.6 min
Martin Marietta Magnesia Specialties	MagChem MC 10-20	34.7 ± 0.1°C	20 ± 0.6 min
Premier Chemicals	Gabbs MgO, as received	35.6 ± 0.4°C	16 ± 0.0 min
Premier Chemicals	Gabbs MgO, leached to remove CaO	35.6 ± 0.1°C	16 ± 0.0 min

The recommendation made in Krumhansl et al. (1997) was that for a candidate MgO material to be acceptable for the WIPP, the average maximum temperature rise observed in the three replicates must be at least 20°C. The candidate MgO materials from Martin Marietta Magnesia Specialties and from Premier Chemicals both meet the temperature rise specification with rises on the order of 35°C.

All three MgO materials contain a significant portion of CaO. According to the manufacturers statements, Gabbs MgO contains 2.11 percent (by weight) CaO (Premier Chemicals, 1999). MagChem MC 10 typically has 0.9 percent CaO, with a maximum of 1.0 percent (Martin Marietta Magnesia Specialties, 1991). For comparison, MAG Plus 00HB 3/8xDown typically has 0.5 percent CaO, with a maximum of 1.0 percent (National Magnesia Chemicals, 1995). CaO is significantly more reactive than MgO, and potentially could affect the temperature rise tests. To evaluate that potential artifact, we repeatedly leached about 110 g of Gabbs MgO in 2-L aliquots of deionized water for 20 to 40 minutes per treatment. The pH of the supernatant was measured at the end of each leaching, and the supernatant poured off. Initially, pH was about 12, consistent with a system buffered by portlandite [$Ca(OH)_2$]. After 10 leaches, the pH decreased to about 10.6, which indicates that much of the accessible CaO had been removed. As shown in Table 1 and Figure 5, and summarized in the Table above, the presence of 2.11 percent CaO does not influence the temperature-rise test.

As stated above, it would be most relevant to the WIPP to conduct a test based on the carbonation reaction to use as a reactivity criterion for WIPP MgO, rather than a acid reaction test, but the times required for such tests are long. A comparatively fast evaluation was made, however, by reacting small samples of the current and candidate MgO materials in sealed vessels with a $NaHCO_3$ solution for one week at 90°C to enhance reaction kinetics. The hypothesis tested is that the MgO materials should react with carbonate ion to form hydromagnesite, since at that elevated temperature, nesquehonite is not the favored metastable hydrated magnesium carbonate mineral. SEM photomicrographs of the reacted materials show that the two candidate materials and the current MgO materials all react to form hydromagnesite, identifiable by its typical platy habit, and brucite, identifiable by its typical hexagonal-shaped tablets with trigonal terminations (Figures 6, 7, and 8).

The reactivities of the MgO must also not be great enough that the backfill reacts with atmospheric carbon dioxide from WIPP ventilation air. The reactivities of the two candidate MgO materials are significantly faster than the current MgO material. All materials, however, are hard-burned, which makes them much more inert than light-burned MgO. In addition, the plastic bags used to contain MgO for emplacement in WIPP provide a permeability barrier for diffusion of carbon dioxide into the MgO mass. This is aided by the fact that the gradient for diffusion of CO_2 into MgO is not large, since the partial pressure of CO_2 in air is only about $10^{-3.5}$ atmospheres. A thorough analysis demonstrating the lack of importance of MgO reaction during the WIPP disposal phase has been done to support the CCA (USDOE, 1996).

In summary, the reactivities of both candidate materials are acceptable.

Material Purity

Both candidate MgO materials and the current MgO material contain minor (0.001 to several weight percent) concentrations of CaO, SiO_2, Fe_2O_3, Al_2O_3, and SO_3 (Martin Marietta Magnesia Specialties, 1991; National Magnesia Chemicals, 1995; Premier Chemicals, 1999). The Gabbs MgO also contains minor Na_2O, K_2O, TiO_2, and P_2O_5 (Premier Chemicals, 1999).

Both candidate products, as well as the current MgO, contain significant concentrations of calcium oxide. CaO is important at WIPP, because, under some brine influx conditions, it has the potential to shift pH to higher values, where actinides may become more soluble. The concentrations of CaO in the MgO materials are less than or equal to 1.0 percent or less (by weight) for MagChem MC 10-20 and MAG Plus 00HB 3/8xDown and 2.11 percent for Gabbs MgO.

The impact of CaO on WIPP performance was demonstrated to be insignificant in arguments made for the CCA (USDOE, 1996, Appendix SOTERM). In addition, the concentrations of CaO introduced with backfill represent only about a one to four-fold increase over the amount CaO [or $Ca(OH)_2$] introduced as a waste constituent (about 8 million moles, Appendix SOTERM). However, in light of post-CCA advances in the actinide solubility model and data base, it would useful to confirm the assessment made in the CCA.

In summary, the material purities of both candidate MgO materials appear to be acceptable.

Density

Bulk densities of the candidate and current MgO materials were measured using materials as received and are compared to the bulk densities stated in the manufacturers' specification sheets in the following table. Measured bulk densities were consistent with manufacturers' specifications. The net bulk density of MgO in the each backfill material was calculated using the manufacturers' information.

MgO Material	Bulk Density, Measured	Bulk Density, Stated	Fraction of MgO, Stated	MgO Density, Calculated
MAG Plus 00HB 3/8xDown	93.4 lb/ft^3	90 lbs/ft^3	98.5% typical 97.5% min.	88.7 lb/ft^3 typical 87.8 lb/ft^3 min.
MagChem MC 10	93.2 lb/ft^3	90 lb/ft^3	98.2% typical 97.0% spec.	88.4 lb/ft^3 typical 87.3 lb/ft^3 spec.
Gabbs MgO	88.8 lb/ft^3	87 lb/ft^3	93.41%	81.3 lb/ft^3

For reaction with carbonate, the CaO concentrations in the backfill materials can be included as well, since CaO will hydrate to form $Ca(OH)_2$, which will react with CO_2 to form calcite, $CaCO_3$. Including CaO provides the following:

MgO Material	Bulk Density, Measured	Bulk Density, Stated	Fraction of MgO and CaO, Stated*	MgO plus CaO Density, Calculated
MAG Plus 00HB 3/8xDown	93.4 lb/ft^3	90 lb/ft^3	98.9% typical	89.0 lb/ft^3 typical
MagChem MC 10	93.2 lb/ft^3	90 lb/ft^3	98.9% typical	89.0 lb/ft^3 typical
Gabbs MgO	88.8 lb/ft^3	87 lb/ft^3	94.9%	82.6 lb/ft^3

*Note: CaO weight percent was converted to equivalent MgO weight percent by dividing by 1.392, obtained from gram-molecular weights of CaO and MgO.

The specifications for MgO backfill bulk density and purity are stated in WID (1997), "The backfill material which is used to fill super sacks and mini sacks shall have a minimum loose bulk density of 90 lb/ft^3." and "Backfill material shall have a minimum 95% of magnesium oxide (MgO)." The bulk density for the material specification is actually 88.89 lb/ft^3, which was then rounded up to 90 lb/ft^3 (WID, 1997; ECP # 1-WH97-044, page 6, paragraph 4). The 88.89 lb/ft^3 material specification together with the 95% purity requirement means that the MgO in the backfill must have a net density of 84.5 lb/ft^3. MagChem MC 10-20 meets that requirement. The Premier Chemicals Gabbs MgO is close, particularly when CaO is included. A small increase in Gabbs MgO would have to be added (about 2 percent) or an agreement would have to be obtained from the US EPA to reduce the total mass of backfill by a small amount.

The two candidate MgO materials meet or are slightly less dense than the specification. The lower net density (MgO plus equivalent CaO) of the Premier Chemicals Gabbs MgO means that an additional amount of about 2 percent would have to be added to meet the CCA requirement, or approval for reducing the MgO backfill mass would have to be obtained from the US EPA.

Cost

The Premier Chemicals material is significantly less expensive the material from Martin Marietta Magnesia Specialties product.

Recommendation

Both candidate materials are acceptable in terms of particle size, reactivity, and purity. The lower net density (MgO plus equivalent CaO) of the Premier Chemicals Gabbs MgO means that an additional amount of about 2 percent would have to be added to meet the CCA requirement. Given that significant money would be saved by using the Premier Chemical product, Sandia recommends that the DOE/CAO pursue acquiring approval from the US EPA to reduce the amount MgO emplaced. While that approval is being sought, Sandia recommends that the DOE/CAO uses the Premier Chemical product, and adds the small additional amount required to meet the CCA specification.

References

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Distribution

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SWCF-A:1.1.01.2.7:DPRP:NF:MgO Research Technical Studies (WPO#49064)

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MS-0750	J. L. Krumhansl, 6118
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DOE	G. Basabilvazo
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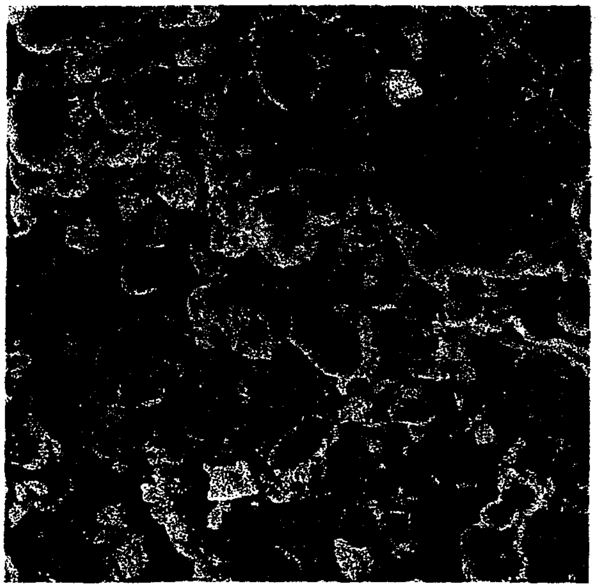


Figure 1.-National Magnesia Chemicals MAG Plus 00HB 3/8xDown, as received from manufacturer. Scanning electron microscopy (SEM) photomicrograph. Bottom of photomicrograph is 65 micrometers in length.

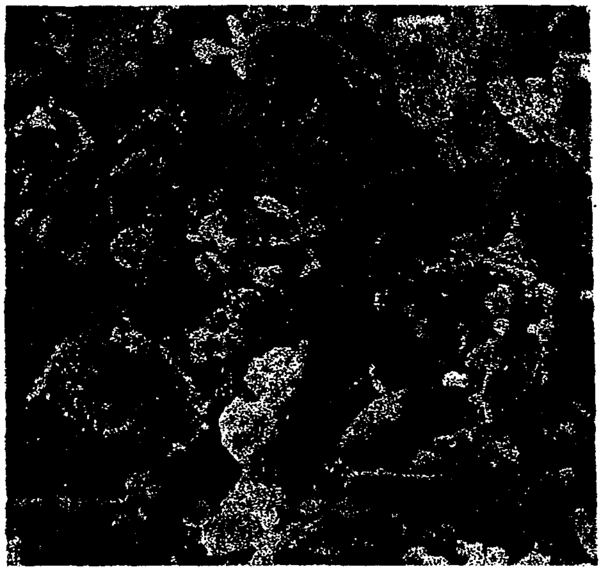


Figure 2.-Martin Marietta Magnesia Specialties MagChem MC 10-20, as received from manufacturer. SEM photomicrograph. Bottom of photomicrograph is 65 micrometers in length.

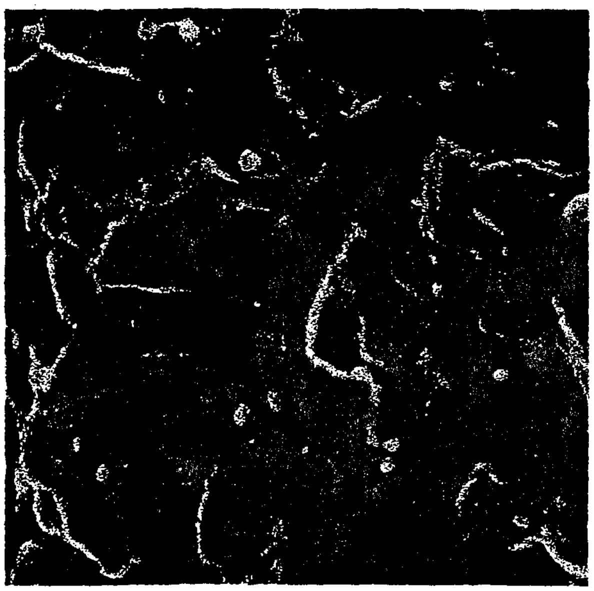


Figure 3.-Premier Chemicals MgO produced at Gabbs Nevada, as received from manufacturer. SEM photomicrograph. Bottom of photomicrograph is 65 micrometers in length.

Figure 4.-Powder X-ray diffraction spectra of two candidate MgO materials and the current material. Material from Premier Chemicals has discernable peaks for CaO. Detection limits for powder XRD are typically on the order of 1 weight percent. For the material from Martin Marietta Magnesia Specialties and the current MgO material from National Magnesia Chemicals, no minerals other than MgO are observed.

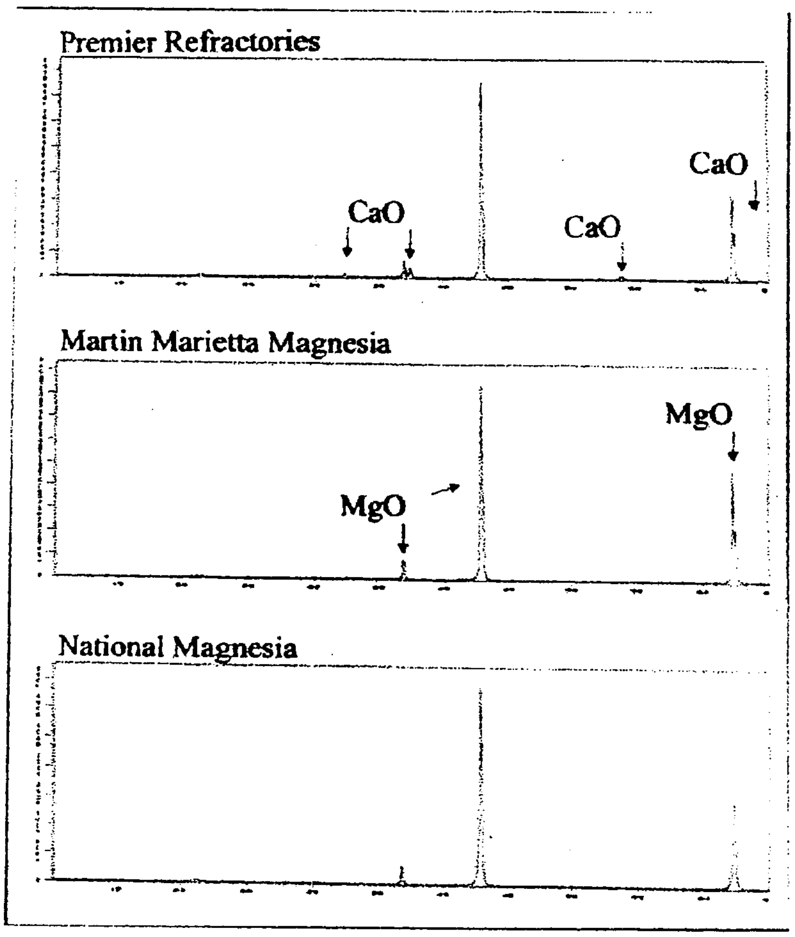
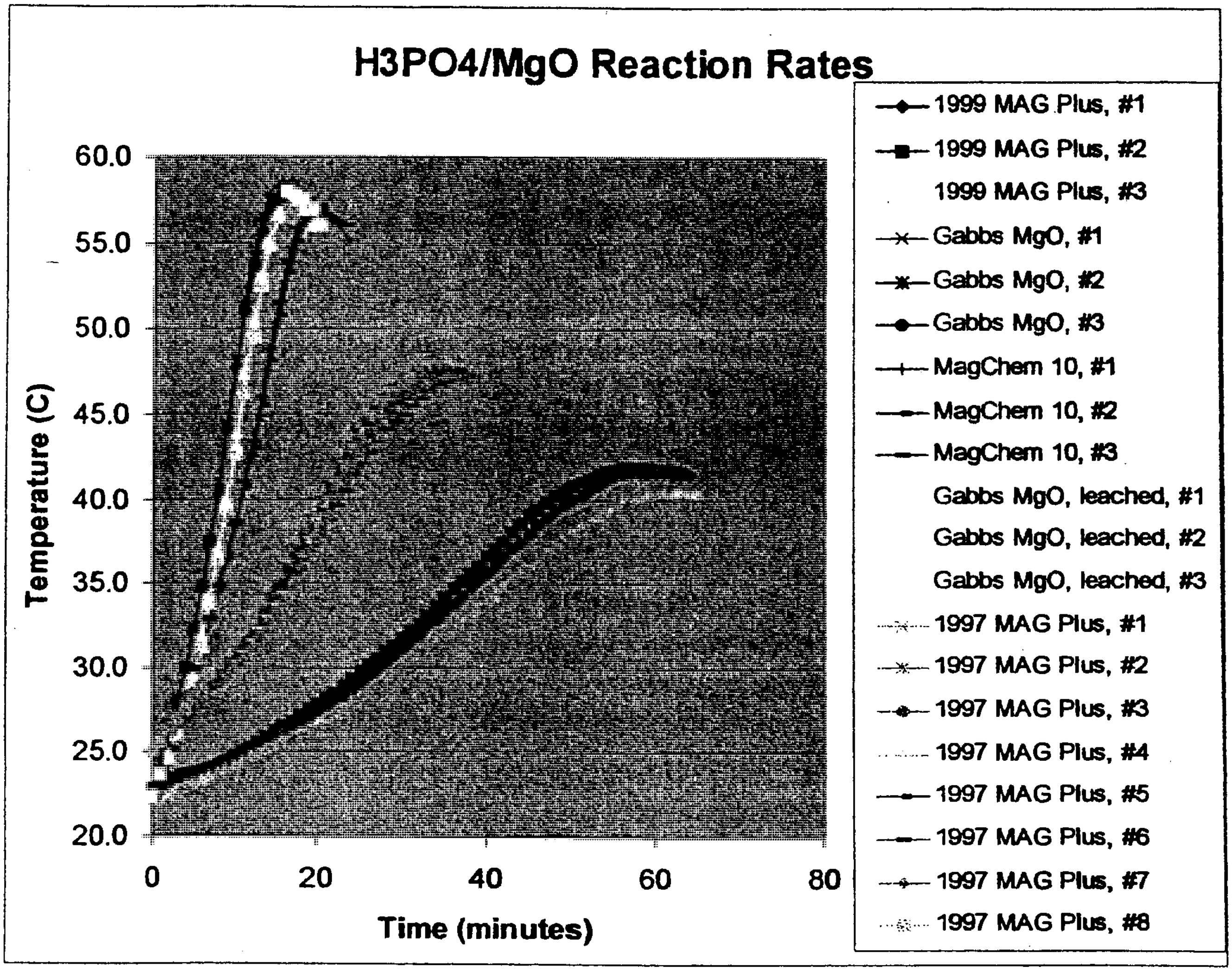


Figure 5.-Temperature rise results from the phosphoric acid test.



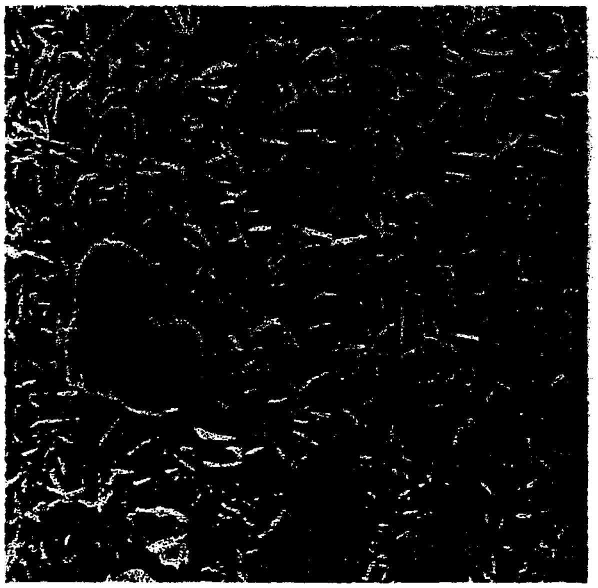


Figure 6.-National Magnesia Chemicals MAG Plus 00HB 3/8xDown. MgO reacted in sealed vessel with $NaHCO_3$ at 90°C for one week. Scanning electron microscopy (SEM) photomicrograph. Bottom of photomicrograph is 115 micrometers in length.

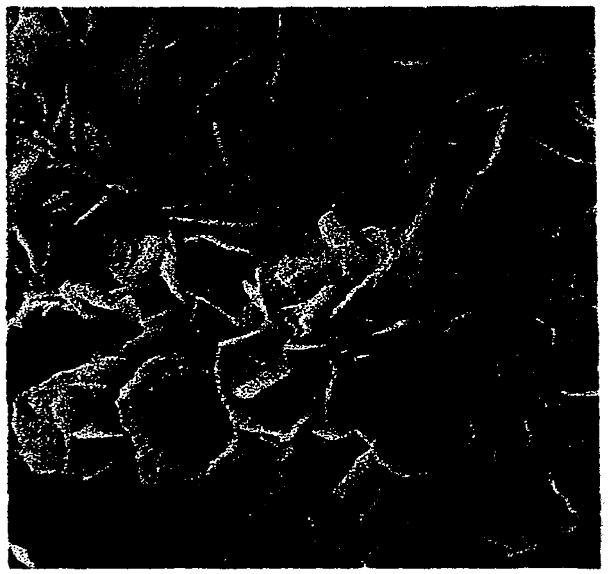


Figure 7.-Martin Marietta Magnesia Specialties MagChem MC 10-20. MgO reacted in sealed vessel with $NaHCO_3$ at 90°C for one week. SEM photomicrograph. Bottom of photomicrograph is 115 micrometers in length.

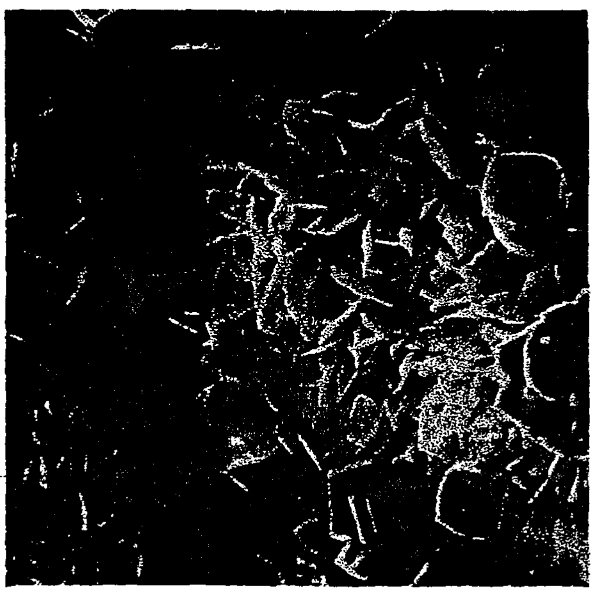


Figure 8.-Premier Chemicals MgO produced at Gabbs Nevada. SEM photomicrograph. MgO reacted in sealed vessel with $NaHCO_3$ at 90°C for one week. Bottom of photomicrograph is 115 micrometers in length.

Attachment 1 - Engineering Change Proposal

1. ECP #____	2. REC'D DATE ____	3. SYSTEM # WH02
4. TITLE: Revise Specification for Prepackaged MgO Backfill		
5. CLASS: ☒ 1 ☐ 2	6. COSTS: FY: 00 $ -0-	7. WORK ORDER #: N/A

8. DESCRIPTION: (use ECP continuation sheet if required)

Make changes to the MgO Backfill Specifcation, D-0101, to accomplish the following:

- Reduce the minimum bulk density requirement from 90 lb per cubic foot to 87 lb per cubic foot
- Increase the height of the supersacks from 24.5 inches to 25.5 inches.
- Increase the required assembled weight of the super sack from 4,100 lbs. to 4,200 lbs. tolerance of +/- 50 lbs. is unchanged.

See attached Rev. 2 of Specification D-0101.

9. INTERFACING SYSTEM (S)	AFFECTED CE: SIGNATURE & DATE:	INTERFACING SYSTEM (S)	AFFECTED CE: SIGNATURE & DATE:
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

10. ATTACHMENTS:

- ☒ SDD (Sections 1.0, 2.0, or 3.3)
- ☐ NEPA
- ☐ ALARA

DRAWING IMPACTS:

- ☐ RCRA DRAWING #'s None
- ☐ ENG. DRAWING #' s None

RCRA Permit Screening Results:

- ☐ No modification to RCRA Permit (screening sheet(s) attached)
- ☐ RCRA Permit modification (screening sheet A and B, and Permit Change Request attached)

RCRA Screening Performed by: ____ Date ____

USQ Determination Section:

- ☒ USQ Safety Evaluation Attached
- ☐ Existing USQ #_________ Applies.
- ☐ USQ Safety Evaluation Not Applicable.

USQ Screening Performed by: ____ Date ____

11. CRITICAL IMPACT IF ECP IS NOT APPROVED: (use ECP continuation sheet if required)

MgO material meeting the existing specification is no longer available. MgO backfill is required to meet the Engineered Barrier requirement of the EPA CCA.

12. COGNIZANT ENGINEER: J. L. Jackson (PRINT) — 8142 (EXT #)

SIGNATURE ____ DATE ____ Engineering (DEPT)

13. COGNIZANT MANAGER: A. E. Strait (PRINT) — 8636 (EXT #)

SIGNATURE ____ DATE ____ Engineering (DEPT)

Attachment 1 - Engineering Change Proposal

NOTE: Page two of the ECP Form is to be completed by the CMB

Date:	ECP No:		RECOMMENDATION			
ORGANIZATION	CMB REPRESENTATIVE PRINT NAME	SIGN NAME	CONCUR AS WRITTEN	CONCUR WITH ACTION	DEFER WITH ACTION	DISAPPROVED
Engineering						
E S & H						
NEPA						
ALARA						
RCRA Permit Compliance						
Operations						
Maintenance						
Quality Assurance						
Sandia National Lab						
Other						
Other						
CM (Secretary						

Action Item(s): (use separate sheet if necessary): Action assigned to: ____________

Action Completed By: ______________________________ Signature ____________ Date

CMB CLASS 1 DISPOSITION ☐ Concur ☐ Disapprove CLASS 2 AUTHORIZATION ☐ Approve ☐ Disapprove	Comments: ______________________________ ____________ Signature Chairman Date
DOE CLASS 1 AUTHORIZATION ☐ Approved ☐ Disapproved	Comments: ______________________________ ____________ Signature DOE Date

Cancellation Justification:

Submitted By: ______________________________ Proposer/CE ____________ Date

Approved: ______________________________ CMB Chairman or Secretary ____________ Date

ECP #: ____________
Page: ____________

Attachment 2 - Environmental Review

DOCUMENT NAME: Engineering Change Proposal
(Test Plan, Engineering Document, Etc.)

DOCUMENT No. ____________
(If available)

DESCRIPTION: (Identify the type of work or action required, location, schedule, justification. Use separate attachment if necessary)

Revise Specification for Prepackaged MgO Backfill

ENVIRONMENTAL CONCERNS: Will the project/activity, either during construction or operations result in changes and/or disturbances in the following areas? Check "YES" of the proposed project/activity represents a commitment to a course of actions that would ultimately require a positive response to one or more of the questions below. Provide explanations for "YES" responses using the guidelines for completion of the Environmental Review Form contained in Attachment 3.

	YES	NO
1. Air emissions	☐	☒
2. Liquid effluents	☐	☒
3. Solid waste	☐	☒
4. Hazardous constituents	☐	☒
5. Radioactive waste	☐	☒
6. Mixed waste (red. & haz.)	☐	☒
7. Chemical storage/use	☐	☒
8. Petroleum use/storage	☐	☒
9. Asbestos materials	☐	☒
10. Utility system	☐	☒
11. Clearing or excavation	☐	☒
12. Outside property protection area	☐	☒
13. Archaeological/cultural resources	☐	☒
14. Noticeable increase in noise	☐	☒
15. Radiation/toxic chemical exposures	☐	☒
16. Pesticide/herbicide use	☐	☒
17. High energy source/explosives	☐	☒
18. Transportation issues	☐	☒
19. Special status species/environment	☐	☒
20. Environment restoration site	☐	☒
21. Other (specify)	☐	☒

No.	Explanation and qualification of specific "YES" responses. Use a separate attachment if necessary to explain responses.

Are any waste minimization measures planned for this action? If "YES", provide brief description of the measures planned.

J. L. Jackson

CI Printed Name	Signature	Date
WID NEPA Coordinator	Signature	Date
Land Use Coordinator Printed Name (Required only if items 12, 13, and/or 20 are checked "YES")	Signature	Date

Attachment 1 - RCRA Permit Screening Sheet

ECP #: ______
Page: ______

Page 1 of ___

Proposed Activity Number ______
(e.g., document number with PCN number/Rev. number, ECP number, etc.)

Proposed Activity Title Revise Specification for Prepackaged MgO Backfill

(e.g., change title, ECP title, etc.):

SECTION A

		YES	NO
1.	Are facilities, equipment, systems or components described in the RCRA Permit proposed to be changed? If YES, indicate the facility, equipment, system or component number(s), then **GO TO** Section B: MgO Backfill	(YES) circled	NO
2.	Are processes described in the RCRA Permit proposed to be changed? If YES, briefly describe the processes, then **GO TO** Section B:	YES	(NO) circled
3.	Are procedures, PMs or controlled documents contained in the RCRA Permit or that implement activities described in the RCRA Permit proposed to be changed? If YES, indicate procedure, PM, or controlled document number(s) and title(s), then **GO TO** Section B:	YES	(NO) circled
4.	Is a Training Program described in the RCRA Permit proposed to be changed? If YES, indicate the RCRA Permit Training Program(s) and section(s), then **GO TO** Section B:	YES	(NO) circled
5.	Is a direct change to the RCRA Permit proposed? If YES, indicate the Permit section(s) and affected page(s), then **GO TO** Section B:	YES	(NO) circled

Section A Completion
(If any answers above are YES, skip and complete Section B)

The proposed change will NOT result in a RCRA Permit Modification.

RCRA Permit Screener: See Section B

Printed Name Signature Date

Cognizant Manager: See Section B
(of the change proposal)

Printed Name Signature Date

Attachment 1 - RCRA Permit Screening Sheet (Continued) ECP #: ________
ANSWER ALL QUESTIONS 1 THROUGH 5 Page: ________

SECTION B

Page 2 of 2

		YES	NO
1.	Will the description of facilities, equipment, systems or components in the permit change? If YES, indicate the RCRA Permit section(s), page number(s), drawing or figure number(s) and Title(s): Permit Attachment M2, Pages M2-3, M2-4 and M2-14	(YES) circled	NO
2.	Will the description of any processes in the permit change? If YES, indicate the RCRA Permit section(s), page number(s):	YES	(NO) circled
3.a	Will any procedures, PMs, or other controlled documents that are contained in the RCRA Permit be changed? If YES, indicate the RCRA Permit section(s), page number(s):	YES	(NO) circled
3.b	Will any procedures, PMs, or other controlled documents that implement RCRA Permit requirements change such that the requirement must change? If YES, indicate the RCRA Permit section(s), page number(s):	YES	(NO) circled
4.	Will Training Programs described inthe RCRA Permit change <u>such that the description in the permit must change</u>? If YES, indicate the RCRA Permit Training Program(s) and section(s):	YES	(NO) circled
5.	Does the change affect a Permit requirement? If YES, indicate the RCRA Permit section(s), page number(s):	YES	(NO) circled

Section B Completion

	YES	NO
Will the proposed change result in a RCRA Permit Modification? If NO, skip Permit Modification and obtain approvals below.		

Permit Modification	Class 1	Class 1*	Class 2	Class 3	Other

Modification Name: Modification Code:

RCRA Permit Screener: J. L. Jackson
Printed Name Signature Date

Cognizant Manager: A. E. Strait
(of the change proposal) Printed Name Signature Date

RCRA Permitting: ________
Printed Name Signature Date

Attachment 3 - RCRA Permit Change Request Sheet

RCRA PERMIT CHANGE REQUEST

Doc No. ______ Rev./Chg. No. ______

(NOTE: The Draft RCRA Permit is considered the Final RCRA Permit until it has been issued.)

Section A: To be completed by RCRA Permit Screener:

1. Section/Appendix/Attachment: Page: Line:

2. Permit Change Description (attach permit mark-up, or attach additional pages if necessary):
SEE ATTACHED MARK-UP

3. Does the proposed change to the permit affect any other part of the permit? ☐ Yes ☒ No
If yes, identify other locations within the permit to be changed (Section/Appendix/attachment, **Page, and Line**):

4. Why is the change needed? (Include references to other documents that define the change - ECO, PCN, etc.)
ECP # ______ REVISE SPECIFICATION FOR PREPACKAGED MgO

5. Impact if the change is not approved:
BACKFILL EMPLACED TO MEET EPA CERTIFICATION WILL NOT BE PROPERLY DESCRIBED IN THE RCRA PERMIT

6. Screener: J. L. JACKSON [signature]
Printed Name / Signature / Date / Dept. / Phone No.

7. Cognizant Manager: ______
Printed Name / Signature / Date

Section B To be completed by RCRA Permitting & DOE/CAO:

1. Enter Tracking Number:

2. Designation Not Requiring NMED Approval:

Modification Class 1 ☐

20 NMAC 4.1, Subpart IX § 270.42, App. I

Reference ______

3. Designation Requiring NMED Approval Prior to Change:

Modification Class Determination Required ☐
(Attach correspondence of determination)
Modification Class 1* (requiring NMED approval) ☐
Modification Class 2 ☐
Modification Class 3 ☐

20 NMAC 4.1, Subpart IX § 270.42, App. I
Reference ______

4. Recommended for permit modification? Yes ☐ No ☐

By: ______
Printed Name / Signature / Date

5. Basis for recommendation:

6. Recommendation Approval:

Manager, RCRA Permitting (Printed Name) / Signature / Date

7. DOE/CAO: Approved ☐ Denied ☐

By: ______
Printed Name / Signature / Date

M2-2a(1) CH TRU Mixed Waste Handling Equipment

The following are the major pieces of equipment used to manage CH TRU waste in the geologic repository. A summary of equipment capacities, as required by 20 NMAC 4.1.500 is included in Table M2-1.

Facility Pallets

The facility pallet is a fabricated steel unit designed to support 7-packs of drums, SWBs, ten-drum overpacks (**TDOPs**), or groups of overpack drums, and has a rated load of 25,000 pounds (lbs.) (11,430 kilograms (kg)). The facility pallet will accommodate up to four 7-packs of drums or four SWBs (in two stacks of two units), two TDOPs, or two groups of overpack drums (maximum of four drums per group). Loads are secured to the facility pallet during transport to the emplacement area. Facility pallets are shown in Figure M2-3. Fork pockets in the side of the pallet allow the facility pallet to be lifted and transferred by forklift to prevent direct contact between TRU mixed waste containers and forklift tines. This arrangement reduces the potential for puncture accidents. WIPP facility operational documents define the operational load of the facility pallet as the contents of two Transuranic Package Transporter, Type IIs (**TRUPACT-IIs**). Since the maximum TRUPACT-II load is 7,265 lbs (3,300 kg), the maximum weight of a loaded facility pallet is less than 19,000 lbs (8,630 kg), including the pallet weight.

Backfill

Magnesium oxide (**MgO**) will be used as a backfill in order to provide chemical control over the solubility of radionuclides in order to comply with the requirements of 40 CFR §191.13. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill.

The MgO backfill will be purchased and received in two different containers: 1) a supersack holding 4,000 lbs (1,814 kg); and 2) a mini sack holding 25 lbs (11.3 kg). Quality assurance requirements, such as material quality and quantity, will be addressed by using current quality assurance procedures in the procurement process and receipt inspection. The filled containers will be shipped by road or rail and will be delivered underground using current shaft and material handling procedures and processes.

The mini sack will be 34 inches (in.) (86.4 centimeters (cm)) long, 6 in. (15 cm) in diameter and will be fabricated of a single layer of polyethylene or other suitable material. It will have an integral handle/hook attached into the sack closure. Six sacks will be manually placed in the external voids of each 7-pack unit just before the 7-pack is positioned on the waste stack. The mini sack will be lifted up behind the shrink wrap around the top of the 7-pack, slid into place, and held there by the four inch hole in the lower slip sheet. See Figure M2-4. Once the sacks are in place, the 7-pack will be positioned on the waste stack in the normal manner. No new equipment or training of operators is necessary.

A similar process will be used for SWBs except that the sacks will be hung from the lift clips on these units. See Figure M2-4. Again, no new equipment or training is necessary.

Super sacks will be handled and placed using the slip sheet/BRUDI technique used for normal waste handling operations. Hence, no new equipment, procedures, or training are required. Once each row of waste units is in place, a layer of 6 super sacks will be placed on top of them. See Figure M2-5. The super sack will be ~~5 ft (1.5 m) wide by 6 ft (1.8 m) deep by 1.5 ft (0.45 m~~) ~~high~~ and will be of multi-wall construction with a vapor/moisture barrier. The super sack will have an integral slip sheet or base attachment so that it can be handled and placed in a manner that is identical to how waste units are emplaced, using a BRUDI-like attachment on a lift truck.

HEXAGON 61" ACROSS FLATS, 25.5" TALL.

Finally, mini sacks will be manually stacked on the floor in the space between the waste stack and ribside. These sacks can be placed horizontally or vertically as may be convenient and loading rates up to 100 lbs per linear foot (148.8 kg per linear meter) can be achieved.

Quality control will be provided within waste handling operating procedure to record that the correct number of sacks are placed and that the condition of the sacks is acceptable.

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner.

<u>The Waste Hoist Conveyance</u>

The hoist systems in the shafts and all shaft furnishings are designed to resist the dynamic forces of the hoisting system and to withstand a design-basis earthquake of 0.1 g. Appendix D2 of the WIPP RCRA Part B Permit Application (DOE, 1997) provided engineering design-basis earthquake report which provides the basis for seismic design of WIPP facility structures. The waste hoist is equipped with a control system that will detect malfunctions or abnormal operations of the hoist system (such as overtravel, overspeed, power loss, circuitry failure, or starting in a wrong direction) and will trigger an alarm that automatically shuts down the hoist.

The waste hoist operates in the Waste Shaft and is a multirope, friction-type hoist. A counterweight is used to balance the waste hoist conveyance. The waste hoist conveyance (outside dimensions) is 30 ft (9 m) high by 10 ft (3 m) wide by 15 ft (4.5 m) deep and can carry a payload of 45 tons (40,824 kg). During loading and unloading operations, it is steadied by fixed guides. The hoist's maximum rope speed is 500 ft (152.4 m) per min.

The Waste Shaft hoist system has two sets of brakes, with two units per set, plus a motor that is normally used to stop the hoist. The brakes are designed so that either set, acting alone, can stop a fully loaded conveyance under all emergency conditions.

Once a waste panel is mined and any initial ground control established, flow regulators will be constructed to assure adequate control over ventilation during waste emplacement activities. The first room to be filled with waste will be Room 7, which is the one that is farthest from the main access ways. A ventilation control point will be established for Room 7 just outside the exhaust side of Room 6. This ventilation control point will consist of a bulkhead with a ventilation regulator. Stacking of CH waste will begin at the ventilation control point and proceed down the access drift, through the room and up the intake access drift until the entrance of Room 6 is reached. At that point, a brattice cloth and chain link barricade will be emplaced. This process will be repeated for Room 6, and so on until Room 1 is filled. At that point, the panel closure system will be constructed.

Because the emplacement of CH TRU mixed waste into the HWDUs will typically be in the order received and unloaded from the TRUPACT-IIs, 7-packs of drums, SWBs, TDOPs, and 85-gal (321-L) overpack containers will be emplaced as they arrive (except that 85-gal (321-L) overpacks will only be placed on the top row in the repository). There is no specification for the amount of space to be maintained between the waste containers themselves, or between the waste containers and the walls. Containers will be stacked in the best manner to provide stability for the stack (which is up to three containers high) and to make best use of available space. It is anticipated that the space between the wall and the container could be from 8 to 18 in. (20 to 46 cm). This space is a function of disposal room wall irregularities, container type, and sequence of emplacement. Bags of backfill will occupy some of this space. Space is required to be maintained over the stacks of containers to assure adequate ventilation for waste handling operations. A minimum of 16 in. (41 cm) was specified in the Final Design Validation Report (Appendix D1, Chapter 12 of the WIPP RCRA Part B Permit Application (DOE, 1997)) to maintain air flow. Typically, the space above a stack of containers will be 36 to 48 in. (90 to 122 cm). However 18 in. (0.45 m) will contain backfill material consisting of bags of Magnesium Oxide (MgO). Figure M2-8 shows a typical container configuration, although this figure does not mix containers on any row. Such mixing, while inefficient, will be allowed to assure timely movement of waste into the underground. No aisle space will be maintained for personnel access to emplaced waste containers. No roof maintenance behind stacks of waste is planned.

The anticipated schedule for the filling of each of the Underground HWDUs known as Panels 1 through 3 is as follows. The following assumptions are made in estimating the time to fill each HWMU:

- Throughput for CH waste is 784 drums per week (7 pallets per day, 4 days per week, 28 drums per pallet)

- The capacity of a panel is 81,000 drums

Under these assumptions, a minimum of 104 weeks is needed to emplace the waste. Allowing a 25 percent contingency for maintenance delays and time to transition from one room to another, it is estimated that a panel will be filled 2.5 years after emplacement is initiated. Panel closure in accordance with the Closure Plan in Permit Attachment I and Permit Attachment I1 is estimated to require an additional 150 days.

Figure M2-12 is a flow diagram of the CH TRU mixed waste handling process.

Plans call for bolt systems installed in the future to equal or exceed the bearing characteristics of the bolts used in the primary pattern in Panel 1. The configuration of Panel 2 through 8 will be similar to Panel 1, therefore; the performance of these rooms should be similar to those in Panel 1. Supplementary support systems will further extend the effective life of the rooms, should they be required. A detailed discussion of initial and supplementary support systems is included in Section 4.3.5.

The support system will be subjected to longitudinal and lateral loading due to the rock deformation. The anchorage components may undergo lateral deformation due to offsetting along clay seams or fractures and increasing tensile loading. Rigid, non-yielding support systems are not designed to accommodate salt creep; however, they do respond to creep and continue to provide support during ductile behavior. Yielding support systems are currently being evaluated in the WIPP underground. These systems are designed to yield at predetermined loads, and provide support over their prescribed yield interval without maintenance. Preliminary data indicate that the design and performance of some of these systems are clearly superior to rigid systems in their ability to respond to salt creep while maintaining adequate ground support.

Because the disposal area access drifts must remain open and operational for a much longer period than any panel, they will require additional consideration from time to time. They are subject to regular and systematic inspection and evaluation, and appropriate ground control measures will be implemented whenever necessary.

The DOE will ensure that any room in which waste will be placed will be sufficiently supported to assure compliance with all laws and regulations. Creep and rock failure in WIPP excavations progress slowly. As a result, many years pass before any operationally significant instability could occur. This long period allows more than sufficient time for whatever actions are appropriate, such as additional monitoring, installing supplementary support, or taking other managerial and operational actions. Support is installed to the requirements of 30 CFR 57, Subpart B. Random checks are conducted by Quality Assurance/Quality Control personnel as each system is installed. Geotechnical monitoring, design, analysis, and planning are performed in addition to regulatory inspections, maintenance, and construction, as discussed in detail in Section 4.3.5.

The underground facilities ventilation system will provide a safe and suitable environment for underground operations during normal WIPP facility operations. The underground system is designed to provide control of potential airborne contaminants in the event of an accidental release or an underground fire.

The main underground ventilation system is divided into four separate flows (Figure 4.2-21a): one flow serving the mining areas, one serving the northern areas, one serving the disposal areas, and one serving the Waste Shaft and station area. The four main airflows are recombined near the bottom of the Exhaust Shaft, which serves as a common exhaust route from the underground level to the surface. The underground confinement/ventilation system is discussed in detail in Section 4.4.

4.2.3.3 Backfill

Magnesium oxide (MgO) will be used as a backfill in order to provide chemical control over the solubility of radionuclides. The MgO backfill will be purchased prepackaged in the proper containers for emplacement in the underground. Purchasing prepackaged backfill eliminates handling and placement problems associated with bulk materials, such as dust creation. In addition, prepackaged materials will be easier to emplace, thus reducing potential worker exposure to radiation. Should a backfill container be breached, MgO is benign and cleanup is simple. No hazardous waste would result from a spill of backfill.

The MgO backfill will be purchased and received typically in two different containers: 1) a super sack ~~typically holding 4,100 ± 50 lb (1859 ± 22.7 kg),~~ and 2) a mini sack ~~holding 26 ± 1 lb (11.8 ± 0.45 kg).~~ Quality assurance requirements, such as material quality and quantity, will be addressed by using current quality assurance procedures in the procurement process and receipt inspection. The filled containers will be shipped by road or rail, and will be delivered underground using current shaft and material handling procedures and processes.

The mini sack will be a conical container ~~with a nominal base diameter of 5.75 in. (14.6 cm), a nominal overall length of 33 in. (83.8 cm), and a nominal top diameter of 3 in. (7.6 cm).~~ The mini sack shall be constructed of woven polypropylene material, coated or uncoated (alternate materials are acceptable subject to approval by WID Engineering prior to shipment). Poly Vinyl Chloride (PVC) material is not acceptable. It will have an integral handle/hook attached into the sack closure. ~~Six~~ sacks will be manually placed in the external voids of each seven-pack unit just before the seven-pack is positioned on the waste stack. ~~The mini sack will be lifted up behind the shrink wrap around the top of the seven-pack, slid into place, and held there by the four inch (10.2 cm) hole in the lower slip sheet.~~ See Figure 4.2-23. Once the sacks are in place, the seven-pack will be positioned on the waste stack in the normal manner.

A similar process will be used for standard waste boxes (SWB)~~, except that the sacks will be hung from the lift clips on these units~~. See Figure 4.2-23.

Super sacks will be handled and placed using the slip sheet/BRUDI technique used for normal waste handling operations. Hence, no new procedures or training are required. Once each row of waste units is in place, a layer of super sacks will be placed on top of them. See Figure 4.2-24. ~~The assembled (empty) dimensions of the super sack shall be a hexagon which is nominally 61 in. (155 cm) across the flats by 24.5 in. (62.2 cm) high.~~ The super sack shall be constructed such that it retains its shape well enough to not deform beyond a 65 in. (165 cm) hexagon ~~with 12 in. (30.5 cm) radius corners after filling and shipping.~~ The super sack shall be constructed of woven polypropylene material~~, with a minimum weight of 8.0 ounces per square yard~~, coated or uncoated (alternate materials are acceptable subject to approval by WID Engineering prior to shipment). Poly Vinyl Chloride (PVC) material is not acceptable. The filled super sack must be able to retain it's contents for a period of two years after emplacement without rupturing from it's own weight. The super sack will have an integral slip sheet or base attachment so that it can be handled and placed in a manner that is identical to emplacement of waste units, using a BRUDI-like attachment (a low-headroom push-pull device from Loron, Inc.) on a lift truck.

Finally, mini sacks will be manually stacked on the floor in the space between the waste stack and rib side. These sacks can be placed horizontally or vertically as may be convenient, and loading rates up to 100 lb per linear ft (148.8 kg per linear m) can be achieved.

~~Quality control will be provided within waste handling operating procedures to record that the correct number of sacks (six) are placed.~~

Backfill placed in this manner is protected until exposed when sacks are broken during creep closure of the room and compaction of the backfill and waste. Backfill in sacks utilizes existing techniques and equipment and eliminates operational problems such as dust creation and introducing additional equipment and operations into waste handling areas. There are no mine operational considerations (e.g. ventilation flow and control) when backfill is placed in this manner.

breaking or a loss of contents.

3.1.2 The vendor shall provide an MSDS for each MgO material.

3.1.3 The vendor shall provide an MSDS and flame spread, smoke generation, and decomposition product information for all materials used in the super sacks and mini sacks.

3.2 Functional Requirements

3.2.1 Supplier filled super sacks will be handled during transportation to the WIPP, at receipt and during material handling operations on support sheets. Refer to Figure 3.1 for the emplaced position of the super sack.

3.2.2 Supplier filled super sacks are to be placed on a vendor furnished support sheet which will be suitable for the application when placed on the waste stack.

3.2.3 A filled "Super Sack" and its support sheet will be placed on top of one of four waste containers; Standard Waste Box (SWB), 7-pack of 55 gallon drums (Figure 3.3), Ten Drum OverPack (TDOP), or a 4-pack of 85 gallon overpack drums (Figure 3.4). The filled super sack must be able to retain its contents for a period of two years after emplacement without rupturing from its own weight.

3.3 Material Requirements

3.3.1 Backfill Material Requirements

3.3.1.1 Backfill material shall have a minimum 95% of magnesium oxide (MgO). The remainder of the material shall not contain any items considered hazardous to people or the environment.

3.3.1.2 Backfill material shall be of a dry granular form, which shall contain less than 0.5% particles which would be retained on a Tyler 3/8 inch sieve, and 95% of which will be retained on a Tyler 10 mesh screen.

3.3.1.3 All backfill material be tested for reactivity as outlined in Attachment 1, and shall meet the temperature rise listed in the test procedure.

3.3.1.4 The backfill material which is used to fill super sacks and mini sacks shall have a minimum loose bulk density of 87~~90~~ lb/ft^3. |

3.3.2 Backfill super sack Material Requirements

3.3.2.1 The super sack shall be constructed of woven polypropylene material, with a minimum weight of 8.0 ounces per square yard, coated or uncoated. Assembly shall be by normal bag fabrication methods; i.e. sewing, gluing, etc. Alternate materials and/or fabrication methods are acceptable subject to approval by WID Engineering prior to shipment. Poly Vinyl Chloride (PVC) material is not acceptable.

3.3.2.2 The assembled (empty) dimensions of the super sack shall be a hexagon which is nominally 61 inches across the flats (a 61 inch inscribed circle) by ~~24~~25.50 inches high (~~45.7~~47.6 ft^3). The super sack shall be constructed such that it retains its shape well enough to not deform beyond a 65 inch hexagon with 12 inch radius corners after filling and shipping.

3.3.2.3 The assembled super sack shall have the capacity to transport a minimum of ~~4,100~~4,200 pounds of a material with a loose bulk density as specified in Section 3.3.1.4. The super sack shall be designed to comply with the requirements of the Flexible Intermediate Bulk Container Association (FIBCA), including a safety factor of five to one (5:1) on the working load.

3.3.2.4 Any fill opening shall be closed to prevent leakage of material during shipping and handling. No discharge opening is required.

3.3.2.5 The super sack shall provide a barrier to atmospheric moisture and carbon dioxide (CO_2) which is equivalent to or better than that provided by a standard commercial cement bag. If required, an independent liner may be added. The liner may be a separate part or attached to the super sack at the manufacturer's option.

3.3.3 Backfill mini sack Material Requirements

3.3.3.1 The mini sack shall be constructed of woven polypropylene material, coated or uncoated. Assembly shall be by normal bag fabrication methods; i.e. sewing, gluing, etc. Alternate materials and/or fabrication methods are acceptable subject to approval by WID Engineering prior to shipment. Poly Vinyl Chloride (PVC) material is not acceptable

3.3.3.2 The empty mini sack shall have the shape of a frustum of a cone, with a nominal bottom diameter of 5.75 inches, a nominal overall length of 33 inches, and a nominal top diameter of 3 inches (0.30 ft^3 volume).

~~3.3.3.4~~ 3.3.3.3 The assembled mini sack shall have the capacity to transport a minimum of 27 pounds of MgO with a loose bulk density as specified in Section 3.3.1.5.

3.3.3.4 An integrally connected hook which is suitable to support the weight of the filled mini sack, i.e. a commercial steel "S" hook, shall be provided on each bag. The hook shall be of a size to fit over the lifting clip on the SWB (See Figures 3.2 and 3.3). The hook and its connection shall be positioned on the outer diameter of the mini sack such that the bottom of a filled sack is not more than 35.50" below the top of the SWB lift clip.

~~3.3.3.4~~ 3.3.3.5 Any fill opening shall be closed to prevent leakage of material during shipping and handling. No discharge opening is required.

~~3.3.3.5~~ 3.3.3.6 The mini sack shall provide a barrier to atmospheric moisture and carbon dioxide (CO_2) which is at least comparable to that provided by a standard commercial cement bag. If required, an independent form-fitted liner may be added. The liner may be a separate part or attached to the mini sack at the manufacturer's option.

3.4 Fabrication Requirements

3.4.1 The supplier shall provide backfill containers which comply with the requirements for super sacks as outlined in Sections 3.3.2 above. The super sack shall be filled with ~~4,100~~4,200 ± 50 pounds of backfill material as specified in Section 3.3.1.5 above.

3.4.2 The supplier shall provide backfill containers which comply with the requirements for mini sacks as outlined in Sections 3.3.3 above. The mini sack shall be filled with 26 ± 1.0 pounds of backfill material as specified in Section 3.3.1.6 above.

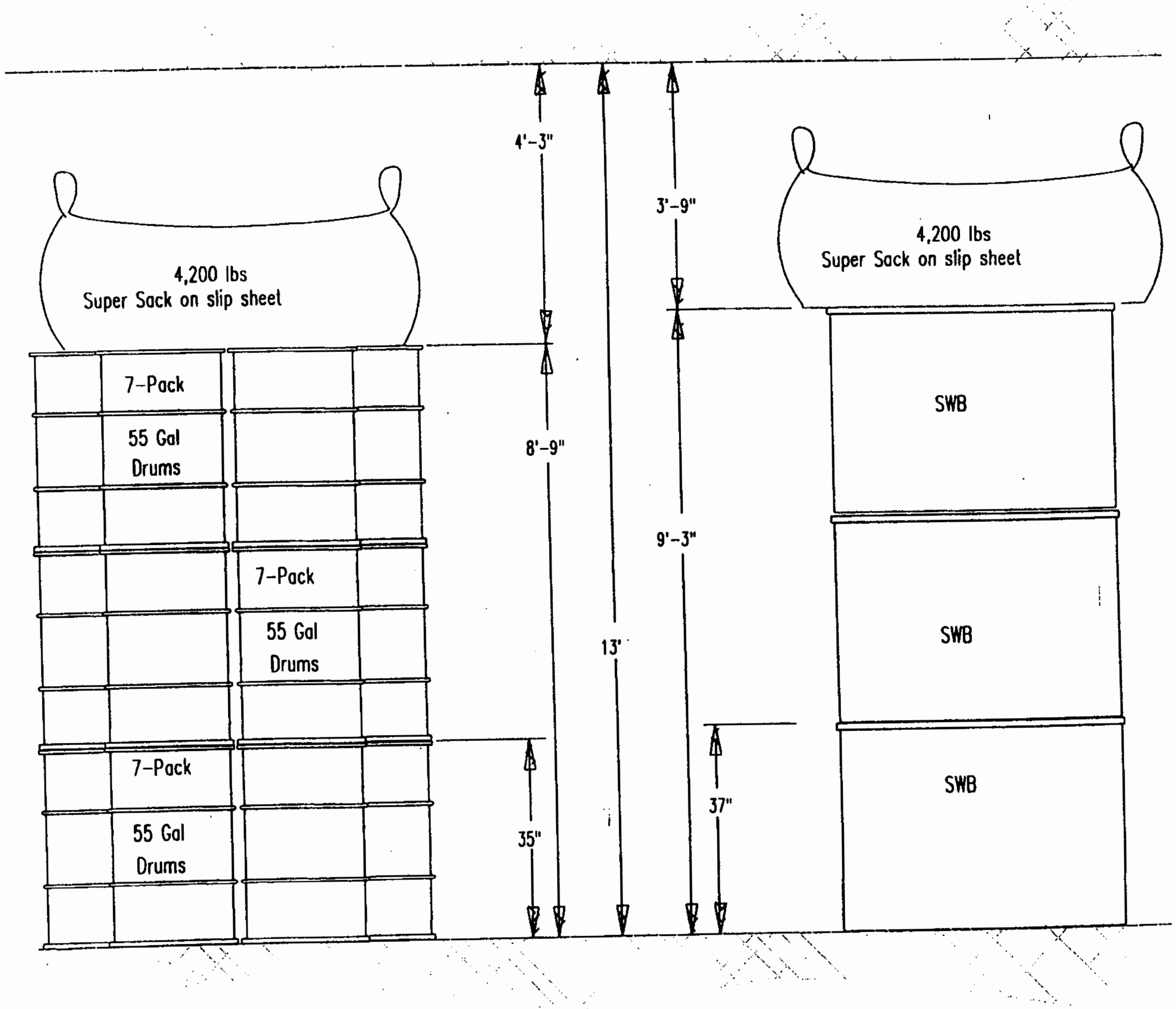
3.5 Packaging and Shipping Requirements

3.5.1 Filled backfill containers shall be delivered to the WIPP site by commercial carrier.

3.5.2 All items shall be packaged as required to provide protection from damage during shipping and handling.

3.5.3 Each individual backfill container shall be clearly labeled with the following information:

Figure 3.1



4,200 lbs
Super Sack on slip sheet
7-Pack
55 Gal Drums
7-Pack
55 Gal Drums
7-Pack
55 Gal Drums
4'-3"
8'-9"
35"
13'
3'-9"
9'-3"
37"
4,200 lbs
Super Sack on slip sheet
SWB
SWB
SWB

- o A 6 ton overhead bridge crane to remove the OCA and ICV lids of the TRUPACT-II shipping packages and remove the waste containers.

- o Support stands for holding a TRUPACT-II in a pocket of the TRUDOCK.

- o Ventilation hoods, exhaust systems, vacuum systems, radiological survey systems (RM04), and tools needed to open the TRUPACT-IIs (WH01) in a safe manner. Industrial grade HEPA type, pre filters to mitigate any release of radioactive contamination. Both the exhaust and vacuum systems shall be directly connected to discharge to the CH Bay HEPA filter exhaust system of HV00.

- o Provision for storing the short and long legs of the Adjustable Center of Gravity Lift Fixture (ACGLF).

2.2.2.5 Facility pallets shall be provided to support the contents of two TRUPACT-IIs (two sets of two-high seven-packs of waste containers, two sets of two-high SWBs or two ten drum overpacks). The facility pallets are used to move waste containers within the WHB and to the cage loading room (provided by system CF00) using the 13 ton battery powered forklifts.

2.2.2.6 A conveyance loading car shall be provided to transport a loaded facility pallet from the cage loading room onto the waste hoist equipment platform.

2.2.2.7 A general purpose 3 ton battery powered utility forklift shall be provided to lift and move components, stands, and other miscellaneous items.

2.2.3 WH02 Underground Requirements

2.2.3.1 Underground transporters (diesel-powered articulated tractor trailers) shall be provided. The transporters are used to remove a loaded facility pallet from the waste hoist and transport the pallet to an underground storage room or to the facility pallet platform. The transporters shall be provided with fire suppression systems, rupture resistant fuel tanks, and reinforced fuel lines to minimize the potential for a fire involving the fuel system.

2.2.3.2 The WH02 subsystem shall provide the facilities and equipment to emplace prepackaged backfill material as described in the applicable regulatory documents.

2.2.3.3 Magnesium oxide (MgO) will be used as backfill, and will be provided in mini sacks and in super sacks, which are shown in Figure WH I-II-9, and are defined in specification D-0101. As a general description, the mini sack will be a conical item approximately 33 inches long, with about a six inch diameter base and a three inch diameter top. The super sack will be a hexagonal container which is nominally 61 inches across the flats and 24.5 inches high.

25.5

DOE F-1325.8

United States Government

Department of Energy

memorandum

Carlsbad Area Office
Carlsbad, New Mexico 88221

DATE: November 17, 1999

REPLY TO ATTN OF: CAO:ORC:DDM:GS:99-1091:UFC 5822.00

SUBJECT: Evaluation of Candidate MgO Materials for use as Backfill at WIPP

TO: D.H. Haar, Deputy Manager, Engineering, Westinghouse Waste Isolation Division

As requested in your letter of September 28, 1999, Sandia National Laboratories has evaluated the alternative MgO products available from two potential suppliers of backfill material for WIPP. As seen in the attached information from Sandia, both candidate materials are acceptable to replace the current MgO product. The Martin Marietta Magnesia Specialties MgO product meets the current requirements as is, while emplacement of an additional two percent of the Premier Materials Gabbs material would be required to meet the CCA specifications.

If you have any questions regarding this review, please call Daryl Mercer at (505) 234-7452. His fax number is (505) 234-7008.

Harold Johnson for
Cynthia A. Zvonar
Acting Compliance Team Leader
Office of Regulatory Compliance

Attachment

cc w/attachment:
L.B. Lilly, CAO
G. Basabilvazo, CAO
H.R. Trumble, CAO
D. Mercer, CAO
M.G. Marietta, SNL
H.W. Papenguth, SNL
J. L. Jackson, WID

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November 12, 1999

Mr. George T. Basabilvazo, Compliance Team Leader
Office of Regulatory Compliance & Assurance
US Department of Energy
Carlsbad Area Office
P.O. Box 3090
Carlsbad, NM 88220

Subject: Evaluation of Candidate MgO Materials for use as Backfill at WIPP

Dear Mr. Basabilvazo:

Sandia was requested by DOE/CAO to evaluate two candidate MgO materials for use as backfill at the WIPP. Sandia evaluated materials recommended and supplied by Martin Marietta Magnesia Specialties and by Premier Chemicals. Materials were evaluated on the basis of reactivity, particle size, chemical purity, and density. Material cost was also considered.

Both candidate materials are acceptable in terms of particle size, reactivity, and purity. The lower net density (MgO plus equivalent CaO) of the Premier Chemicals Gabbs MgO requires that an additional amount of about 2 percent would have to be added to meet the CCA requirement. Considering that significant money would be saved by using the Premier Chemical product, Sandia recommends that the DOE/CAO pursue acquiring approval from the US EPA to reduce the amount MgO emplaced. While that approval is being sought, Sandia recommends that the DOE/CAO use the Premier Chemical product, and adds the small additional amount required to meet the CCA specification.

If you have any questions, please contact Hans Papenguth of my staff at (505) 844-3819.

Sincerely,

Ned Z. Elkins

Enclosure

Copy to: (with enclosure)

MS-0733	H. W. Papenguth, 6832
MS-0771	M. S. Y. Chu, 6800
MS-0779	K. W. Larson, 6848
MS-1395	B. A. Howard, 6821
MS-1395	M. K. Knowles, 6121
MS-1395	Y. Wang, 6821
MS-1395	M. G. Marietta, 6821
MS-1395	N. Z. Elkins, 6810
DOE/CAO	D. Mercer