UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
AIR AND RADIATION

R. Paul Detwiler, Acting Director
Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, New Mexico 88221-3090

Dear Dr. Detwiler:

We have been reviewing information regarding the Department of Energy's (DOE) request to dispose of supercompacted waste from the Idaho National Environmental and Engineering Laboratory's (INEEL) Advanced Mixed Waste Treatment Facility (AMWTF). Over the course of our review, as a result of DOE's written responses and staff-level technical discussions, most of our questions have been resolved or will be resolved with additional information already requested by my office and expected from DOE. Our two main remaining issues involve: 1) the documentation and implementation of the SANTOS computer code for modeling the creep closure of the waste area and subsequent transfer of these results into the performance assessment (PA) computer code BRAGFLO, and 2) the justification for the assumption that the process of methanogenesis will occur in the repository and be the dominant gas generating process, thereby decreasing the impact of carbon dioxide gas generation on releases.

Use of SANTOS and Related Computer Codes

The computer code SANTOS is used to calculate room porosity as a function of time, halite properties, disposal room and waste properties. SANTOS calculations are run separately from the mainline performance assessment calculations, on a different computer system that does not appear to fall under the general computer configuration management system used for most performance assessment codes. The results from SANTOS are used, via intermediate calculations, in a lookup table (also known as a "porosity surface") that provides room porosity values for different times and repository gas pressures. This information is then used in BRAGFLO, the main computer code used for calculating repository conditions, including pressure. The porosity information is important because, all other things equal, low porosity in the repository waste area is generally associated with higher releases.

Our examination of how the Department modeled the behavior of supercompacted waste in the repository and the creep closure process has raised concerns about how the SANTOS and related calculations were conducted. We believe that SANTOS or its associated computer codes may overestimate the porosity in the room. This concern may arise partly because you have not provided the necessary and required detailed information to support the calculations, including justification for parameters and information on secondary computer codes (e.g., NUMBERS) – items crucial for understanding how room volumes, and thus porosity, get calculated in the creep closure computational grid. Based on our detailed review, it appears that there may be errors in the calculations; however, without appropriate documentation and testing we cannot make a determination on this aspect of the modeling. Also disturbing is that the SANTOS computer code calculations from the original Certification Compliance Application cannot be retrieved, thus limiting comparison to past results. At the technical exchange held January 21-23, 2003, your staff committed to producing a document that describes fully the modeling parameters and assumptions used in the advanced mixed waste (AMW) performance assessment (PA), with a focus on those related to the SANTOS computer code and the supercompacted waste. We expect that this document will address many of our questions, but issues still remain with the modeling.

With these issues in mind, the Agency believes it is appropriate to evaluate the performance of the repository with modifications to the SANTOS process. A bounding performance assessment with constant porosity (i.e., eliminating the porosity surface) would provide key information about the impact of AMW waste on system performance and eliminates the reliance on SANTOS calculations that have been problematic in our view. Thus, in order to address our outstanding concerns regarding porosity calculations, DOE must conduct an additional set of AMW PA calculations. For these calculations, instead of the porosity surface, BRAGFLO is to use a constant porosity for the waste area assuming a panel of supercompacted waste. The rest of the repository can, but is not required to, have a separate constant porosity for the standard waste. The waste porosities are to be determined analytically and/or geometrically, not with the SANTOS computer code. We expect that the final calculated porosity for the supercompacted waste would account for the compacted puck void space, the interstitial void space, and the potentially compressible space in the 100-gallon drums. Due to uncertainties in the process, such as the amount of halite that could fill void space, it is reasonable to use a uniform range of porosities, identified and documented by DOE for review by the Agency, from which a constant porosity could be selected for each realization as other parameters are sampled. DOE must also ensure that appropriate changes are made to other relevant parameters – such as waste permeability or those related to methanogenesis or gas generation (see below) – to ensure that these bounding computations are appropriately implemented. These bounding calculations will remove the SANTOS and porosity surface concerns for the AMWTF waste and verify continued compliance with our regulations under rather extreme conditions.

Methanogenesis

Microbial gas generation is a major contributor to the gas pressure in the waste area of the disposal system for the one-half of the realizations for which it is presumed to occur. Microbes are assumed to consume cellulosic material, plastic and rubber (CPR). Supercompacted AMWTF waste contains ten times as much CPR as average amounts across the entire waste inventory. For this reason, additional gas from microbial processes can be generated, potentially increasing the pressure in the repository and increasing related radionuclide releases via spallings and transport in brine. The process for calculating microbial gas generation used until now has assumed that carbon dioxide will be the primary gas produced through the processes of de-nitrification and sulfate reduction. The magnesium oxide (MgO) engineered barrier is meant to buffer the pH of the brines in the repository to maintain consistent chemical conditions for actinide solubility and to sequester the carbon dioxide produced in the system.

In the AMW PA calculations, DOE assumes that methanogenesis will be the primary microbial gas generation process based on recent experimental results, so that methane will replace some of the carbon dioxide. In our December 9, 2003, letter we raised concerns about the use of methanogenesis because of the potential for excess sulfate in the disposal system to maintain sulfate reduction as the primary microbial gas generation system. The Department's response of December 24, 2003, and the presentation on the subject at the January 2004 technical exchange do not adequately support your contention that methanogenesis will dominate. We cannot accept the methanogenesis-with-excess-sulfate assumption with the current information (essentially the handout from the technical exchange) that we have. Your analysis must provide a defendable bounding estimate of sulfates and their effect. Specifically, DOE must provide a document on sulfate/methanogenesis that:

- addresses the effects of gas generation on a panel in addition to the repository,
- uses different inventory assumptions on the distribution of the supercompacted waste within the repository (e.g., homogeneous or concentrated supercompacted waste emplacement and an intermediate case),
- addresses parameter uncertainty (e.g., concentrations), assumptions and sources of information,
- identifies and discusses potential alternative sulfate sources/flowpaths,
- addresses the MgO safety factor as part of the analysis,
- provides other relevant information/context.

Currently, the MgO safety factor (i.e., the ratio of MgO emplaced in the disposal system to the amount of MgO estimated as necessary to maintain the expected chemical conditions) is 1.67. During the initial certification, this safety factor was a key element for EPA in accepting the use of MgO as an engineered barrier and in providing additional confidence in the performance of the disposal system. For these reasons, we believe it is important to maintain such a safety factor in the same range. We will examine your analysis to ensure that the safety factor is maintained.

I appreciate the constructive technical discussions and information exchange that have already occurred on this topic. These exchanges have been very helpful in clarifying important technical issues. The enclosure to this letter describes some additional minor modifications and information to be addressed in your response. Once DOE provides the information requested above and in the enclosure, we will evaluate it to determine whether the disposal of supercompacted waste can be approved for the WIPP. Until you are notified of a decision, supercompacted wastes processed at the AMWTP are not approved for disposal at WIPP. If you have any questions, please contact Tom Peake at (202) 343-9765.

Sincerely,

Bonnie C. Gitlin for

Frank Marcinowski, Director
Radiation Protection Division

Enclosure

cc: Russ Patterson, DOE/CBFO
Steve Casey, DOE/CBFO
Matthew Silva, EEG
Larry Allen, EEG
Steve Zappe, NMED
EPA Docket

Enclosure: Additional Issues Related to AMW Performance Assessment

1. The AMW performance assessment calculation did not appropriately account for the additional iron surface area associated with the AMWTF supercompacted waste. This affects the rate at which anoxic corrosion generates gas. During the January 21-23, 2004, technical exchange we were shown the results of an analysis using a surface area factor ten times higher than that of the expected inventory. The results indicated that the extra iron consumes the brine and reduces gas pressure produced from microbial processes. Our analysis indicates that for the supercompacted waste, the extra surface area would be a factor of 2.2. (The relative increase in iron surface area when a seven-pack of 55-gallon drums is replaced by a three-pack of AMWTF supercompacted waste is $(30.6\ m^2 \times 3)/(6\ m^2 \times 7) = 2.19$ where the estimated surface area per 100-gallon drum of supercompacted waste is 30.6 m^2 versus 6 m^2 for the 55 gallon drums.) Please repeat the analysis of increased anoxic corrosion rate using a factor of 2.2 instead of 10 for the increase in the surface area of iron and provided the documentation for the calculations.

2. Additional justification is needed to support SNL's qualitative assessment of parameter values for supercompacted AMW waste as compared with standard waste. For example, additional justification is needed to support SNL's contention that supercompacted waste has higher tensile and shear strengths and lower porosity and permeability than standard waste. As stated in the body of this letter, DOE staff have already made a commitment to do this and that should be sufficient to address this concern.

3. Please provide more detailed technical information (i.e., citable documentation) to support the handouts provided to EPA at the January 21-23 technical exchange.

4. Regarding the December 9, 2003, letter from Dr. Triay, we raised the issue of the accuracy of inventory calculation given the discrepancy between the emplacement assumptions used for the ten-drum overpack in the inventory calculations and the actual emplacement. In the presentation during the January 21-23 technical exchange, your staff acknowledged that the incorrect inventory was used in the AMW performance assessment and that the discrepancies could even affect the MgO safety factor. The inventory needs to be updated for the next AMW performance assessment calculations.