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12 October 2001

Mr. Lake H. Barrett
Acting Director
Office of Civilian Radioactive Waste Management (OCRWM)
U. S. Department of Energy
1000 Independence Ave.
RW-2/5A-085
Washington, DC 20585

Dear Mr. Barrett:

Thank you for your letter requesting comments pursuant to Federal Register notice 66FR 43850, published August 21, 2001. We have reviewed the *Preliminary Site Suitability Evaluation* (PSSE) for Yucca Mountain and the various support documents, as you suggested.

It is our finding that the *Preliminary Site Suitability Evaluation* is grossly inadequate in several key areas, discussed below. It uses neither the most conservative nor the best available information to arrive at its conclusions. Your letter of August 27, 2001, states that the DoE has spent 20 years and over \$6.7 billion studying various means to fulfill the Federal responsibility. It is reasonable, therefore, to expect the resulting description of the proposed engineered workings of the site to be scientifically rigorous and accurate, and the supporting baseline studies of existing conditions to be at least adequate. Unfortunately, neither is the case.

Time and money spent are not adequate justification for the Secretary of Energy to recommend to the President that Yucca Mountain be developed as the first high-level nuclear waste repository for the United States. Your letter seems to imply that since a great deal of time and funding have been expended already on this project, the DoE automatically must know what it needs to know about the site. Sadly, this is far from true. A significant number of technical issues remain open and require additional site characterization activities before they can be settled with the NRC. Further, the *Waste Package Material Performance Peer Review Panel Interim Report* of September 4, 2001 stresses that significant technical issues are unresolved regarding the performance of waste package materials with respect to corrosion processes, the service environment, and other degradation modes and issues.

In response to a greatly flawed *Draft Environmental Assessment* (DEA) and to a stipulation under the *Nuclear Waste Policy Act* of 1982 as amended NWPA, Public Law 97-425, the DoE has focused its efforts solely on Yucca Mountain, ignoring much scientific opinion and professional criticism. This political decision has proved misguided. It is now public knowledge that fracture flow conditions at Yucca Mountain, evidenced by chlorine-36 isotopic studies, provide a “fast path” from the proposed emplacement location in the Topopah Spring Tuff to the saturated zone and the accessible environment. The conceptual “dry and benign” Yucca Mountain environment portrayed by the DEA does not exist. Yucca Mountain is now considered by Department personnel to be an “adequate site,” a less than enthusiastic endorsement that raises serious questions about both the decision-making process in the Department and the ability of the site to function as required by the Nuclear Waste Policy Act. The multi-barrier (natural environment + engineered barrier systems) approach conceptualized and specified in the Nuclear Waste Policy Act is today almost completely dependent on an engineered barrier system (EBS). The Yucca Mountain site itself, originally the proposed natural barrier, is now viewed by most as a paper bag. The Department’s current efforts seem focused primarily on shoring up this “paper bag” with conceptual arguments, including radionuclide retardation by diffusion in fractured terrain, significant dispersion of radionuclides in the saturated zone, and retardation of radionuclides in the alluvium downstream of the proposed repository. These arguments are overstated and, in our opinion, not license-defensible.

The EBS currently represents some 95% of the DoE containment strategy for high-level nuclear waste at Yucca Mountain. Yet the keystone of this EBS, the C-22 alloy used in the waste containers, is poorly studied at best. For the purpose envisioned by the Department, its behavior is all but unknown. Further, the hydrogeochemistry of the aqueous vadose zone environment has never been characterized. Sufficient nuclear industry literature presently exists regarding the behavior of metal alloys similar to C-22 to indicate that there is a strong possibility C-22 will not behave as the Department claims. The State of Nevada studies also suggest that the Department has completed neither an adequate study of the natural environment nor of C-22 itself. In short, the performance of alloy C-22 has been grossly oversold by the DoE, apparently to compensate for the almost total failure of Yucca Mountain as a natural barrier site.

It has become ever more obvious that Yucca Mountain was chosen for characterization on the basis of its political rather than scientific merits. A proliferating series of rigorous scientific studies has made it increasingly clear that Yucca Mountain was a poor choice for a variety of reasons, including:

1. The proposed natural barrier is in reality a fast path to the accessible environment because of the fracture flow conditions that exist in Yucca Mountain.

2. There is sufficient water in the vadose system to provide radionuclide transport from the near-field to the accessible environment within the proposed containment time frame.
3. Radionuclide retardation is insignificant within the transport pathways for key radionuclides such as the actinides.
4. The proposed EBS has been oversold to compensate for poor judgment in the natural site selection. Scientific evaluation of the EBS components is drastically insufficient, as attested by the following:
 - a. It is highly unlikely that the drip shield will perform as predicted. Titanium–grade 7 alloy can be expected to fail during the containment period, due to the presence in the near-field aqueous system of dissolved fluoride and chloride ions, which are present in waters with low sulfate content and other waters (Greene, et al., Center for Nuclear Waste Regulatory Analysis, Southwest Research Institute; A. Pulvirenti, Department of Chemistry, Catholic University of America, for the State of Nevada; Gerald Gordon, Bechtel SAIC Company, September 25, 2001 presentation to Waste Package Materials Performance Peer Review; SCC failure of Ti-7; John Beavers, Peer Review Panel, presentation on SCC, September 25, 2001 meeting).
 - b. It is highly unlikely that alloy C-22 will perform as claimed. Alloy C-22 is subject to significant pitting corrosion under low concentrations of lead, mercury and other deleterious substances, all of which are present in available, active and transferable states in the natural rock and aqueous system of Yucca Mountain (State of Nevada research). Human contributions of deleterious substances such as lead and mercury will only exacerbate the situation; indeed, such introduced components are likely in many cases to result in rapid failure of the C-22 alloy. The potential for introduction of large quantities of some elements, such as lead, from drip shield failures and other sources of anthropogenic debris is actually quite frightening, given their close proximity to the waste packages.
 - c. The EBS clearly requires significant revision in light of the current painfully limited understanding of the potential behaviors of Ti-7 and C-22 alloys in their proposed service environments. Astonishingly, the original EBS, without any revisions whatsoever, remains the dominant barrier design offered by the DoE for high-level radioactive waste containment at the Yucca Mountain site.

5. The near-field vadose zone aqueous system has never been characterized adequately by the DoE. The limited water chemistry analyses that were performed by the Department completely ignored trace elements, until the State of Nevada recently publicized the importance of these data and their total absence from the Department's studies. Moreover, almost no hydrogeochemical data currently are available on natural, saturated zone or vadose zone water compositions at Yucca Mountain. Present analytical efforts by the Department, unfortunately, are far from comprehensive. As a consequence of all this, the understanding of the near-field repository is grossly insufficient both for characterization and for understanding the potential corrosion behavior of the metals so vital to the performance of the EBS and the site itself.
6. Both low and high heat conceptual repository designs permit transportation of the radionuclide source-term-inventory out of the near-field (Center for Nuclear Waste Regulatory Analysis, Southwest Research Institute).

In sum, the present state of the DoE's scientific evaluation of Yucca Mountain is hopelessly deficient for any finding that the site is suitable for the development of a repository. By itself, without a functioning EBS, the site cannot meet the applicable radiation protection standards required by the EPA and the NRC. The critical components that comprise the EBS have not been adequately studied by the Department, and will likely not be adequately studied by the Department within the next several years. Sadly, it appears that only a tiny fraction of the \$6.7 billion spent to date on the repository has been devoted to evaluating the scientific performance of the EBS in its pivotal role as the major barrier to radionuclide escape under Yucca Mountain service conditions!

For all of the above compelling reasons we find that the *Preliminary Site Suitability Evaluation* for Yucca Mountain is woefully inadequate. The proposed descriptions of the workings of the existing Yucca Mountain Site, and of the site as it might function under the proposed environmental repository conditions, are both overly reliant on predictive formulations that have poor to nonexistent site-specific scientific foundations. The DoE must assess, minimally, the behavior of alloy C-22 within the full range of service conditions. This absolutely includes experimentation at temperatures above 90 degrees centigrade—since the Department itself reports that the expected conditions for alloy C-22 can be as high as 160 degrees centigrade (presentations by the Department to NWTRB, September 10-12, 2001)! Although such experimentation should certainly be one of the "forward" items being proposed, the lack of these data *now* brings into serious question the conclusions drawn by the Department that the EBS will function perfectly for greater than 10,000 years.

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A crucial lack of vital information currently exists concerning the basic behavior of the EBS materials that comprise the major barrier claimed for radionuclide escape from the site. This fundamental deficiency obviously precludes the rendering of any decision at this time on site suitability. We strongly urge the Secretary to determine that the scientific evaluation of the site is still incomplete, and to charge the DoE (OCRWM) with the task of investigating adequately--and on an empirically-driven, site-specific basis--the role of the EBS materials in the repository.

Sincerely,

Maury E. Morgenstein, Ph.D.

Don L. Shettel, Ph.D.

Geosciences Management Institute, Inc.

Cc:

The Honorable Harry Reid, United States Senator, Nevada, % Dr. Jack Hess, Legislative Fellow, 528 Hart Senate Office Building, Washington, DC 20510

The Honorable John Ensign, United States Senator, Nevada, 364 Russell Senate Office Building, Washington, DC 20510

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