



UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON NUCLEAR WASTE
WASHINGTON, D.C. 20555

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July 27, 1988

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Mr. Victor Stello, Jr.
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Stello:

SUBJECT: RESPONSE TO QUESTIONS ON PROPOSED YUCCA MOUNTAIN HIGH LEVEL WASTE REPOSITORY

Last summer, the members and consultants of the ACRS Waste Management Subcommittee visited the Yucca Mountain Site for the proposed high level radioactive waste repository. During that visit, the members provided to the U.S. Department of Energy (DOE) personnel a list of questions that they wished to have addressed. Subsequently, DOE submitted responses to these questions, and the Subcommittee Chairman, in turn, requested that each of the consultants who made the Yucca Mountain visit review and comment on the DOE responses.

As of this date, comments have been received from Drs. Konrad B. Krauskopf, Carson Mark and Mihailo D. Trifunac. A review of these consultants' comments by the ACNW Chairman indicates that, in general, the DOE responses are adequate. There are several areas, however, on which members of the ACNW would like to comment, not in the sense of requesting additional responses from DOE, but to assure that DOE is aware of these outstanding questions. These areas include the following:

1. Dr. Krauskopf has asked whether enough attention is being given to the nature of the sorbing surfaces relative to the retardation in the movement of radionuclides. The primary point he wants to emphasize is that when rock is crushed or broken for use in sorption experiments, the freshly exposed surfaces may be quite different from the weathered rock. He has asked also whether there are any plans to try to validate the laboratory results with in-situ experiments.
2. Both Dr. Mark and Dr. Trifunac addressed the matter of the potential impacts of underground nuclear explosions at the Nevada Test Site on the level of the groundwater in the vicinity of the proposed repository. Dr. Mark emphasized the necessity of monitoring the water level to determine if it is affected; he suggested also that if a change in plans called for the testing of larger devices, DOE should be required to demonstrate that the tests would not result in unacceptable effects. Dr. Trifunac called for an examination of why the area, about two miles northwest of the proposed site,

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July 27, 1988

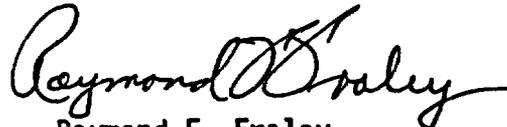
rises so suddenly. He called also for an examination of what causes a sudden drop in the water table as one approaches the repository site, and how natural causes, as well as underground nuclear explosions, could change the present equilibrium.

3. Dr. Mark encouraged DOE to examine more carefully the existing data on the migration of radionuclides from the underground explosion cavities at the Nevada Test Site. He believes that such an examination would provide additional insight on the movement of radionuclides within the tuff medium.
4. Dr. Trifunac suggested that the current work might be expanded to correlate more specifically the relationships between the observed stress patterns and the inferred geological displacements. This might provide guidance on how one could extrapolate for possible movements of the geological blocks in the area. This, in turn, would help identify the 10,000 year seismic risk and provide constraints on estimates of the risks from volcanism.

Copies of the letters from each of these three consultants are enclosed.

These comments are being relayed to you for informational purposes only, and the ACNW believes this brings the matter to a conclusion. No response to the ACNW on the part of the NRC staff is necessary.

Sincerely,



Raymond F. Fraley
Executive Director

Enclosures:

1. Letter from Konrad B. Krauskopf, ACRS Consultant, dated February 12, 1988
2. Letter from Carson Mark, ACRS Consultant, dated February 20, 1988
3. Letter from M. D. Trifunac, ACRS Consultant, dated February 29, 1988

cc: Robert Bernero, NMSS
Robert Browning, NMSS

STANFORD



UNIVERSITY

DEPARTMENT OF GEOLOGY
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12 February 1988
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U.S. NUCLEAR REG. COMM
ADVISORY COMMITTEE ON
REACTOR SAFEGUARDS

Mr. C.S. Merrill
Senior Staff Engineer, ACRS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Owen:

Here are the comments you requested in your memo of 28 January, on DOE responses to eight questions we posed during our meeting with DOE in Las Vegas last July.

1. Seems to me this answer is satisfactory. I like the intended use of several conceptual models and different mathematical techniques to describe the models. Also I like the emphasis on getting professional judgment about predictions from the models, from parties both within and outside of the Commission. For my taste there should have been more emphasis on the item labeled (4), "calibration of model predictions with data obtained at the site", and I would hope that the calibration will include in-situ experiments, perhaps in G-tunnel. The response would have pleased me more if a concrete example had been given of the use of some particular model, to illustrate the many generalizations, but I expect this is asking too much.

2. I have no expertise in formal probabilistic analysis, so my comments are probably not relevant. The use of both probability and bounding-value analyses as a basis for "reasonable assurance" seems eminently sensible, but it's almost a truism -- what other possibilities are there? The danger of getting preposterous results by the use of boundary values alone is properly emphasized. Here again a concrete example would have helped me.

3. The response seems adequate in that existing data are described, but I'm amazed that the existing data are apparently so meager. I'll look forward to the report that is promised for "early next year."

4. Stress fields and their measurement are beyond my expertise. From a layman's viewpoint, the response appears to be a good description of the state of present knowledge. My only complaint would be that the requested details of the calculations are not given.

5. The original ACRS question is not given, but I imagine it involved more than a mere listing of references. I suppose the three named enclosures describe current thinking about volcanic activity and ground motion; without seeing them I can't comment.

6. This was my question, and the oral answer given at the Las Vegas meeting was so sketchy that I had real concern about the geochemical part of DOE's program. From the written response here, I see that my worry was completely unfounded. The work under way at Los Alamos sounds excellent; all the major geochemical questions pertinent to Yucca Mountain are under aggressive attack. I like especially the use of several different methods to measure retardation coefficients, the careful efforts to simulate ground-water composition accurately, the work completed and planned on colloid formation, and the planned work on basic actinide chemistry to make possible identification of species and complexes in solution at very low concentrations. A couple of queries: Is enough attention being given to the nature of the sorbing surfaces? When rock is crushed or broken

Enclosure 1



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for use in sorption experiments, the fresh exposed surfaces may be quite different from the weathered, altered, or coated surfaces that solutions will encounter as they move through rock in place. Then is thought being given to the capacity of rock for sorption, as well as the distribution coefficient? A rock might show a high coefficient in experiments with small amounts of solution, but still might not be able to sorb an appreciable quantity because the area of exchange sites was limited or because the sites were already occupied by other strongly sorbed ions. I wonder also if there are any plans to try to validate laboratory results with in-situ experiments? Such experiments are difficult, but I think might be worth trying. I look forward to the promised SCP and the report on colloid stability and characterization.

7. This response seems entirely adequate. The work already done on migration of radionuclides from underground explosion sites is impressive, and additional work is planned. I'm glad to note the intended emphasis on plutonium.

8. I haven't given this much thought, but offhand it seems to me that for the unsaturated zone the flux of ground water may indeed be a more important parameter than travel time. The response seems to me satisfactory in that the question is evidently under serious consideration.

In general I think DOE did a good job in its handling of our questions.

With best regards,

A handwritten signature in cursive script that reads "Konrad".

Konrad B. Krauskopf

J. CARSON MARK
4900 SANDIA DRIVE
LOS ALAMOS, NEW MEXICO 87544

Feb. 20, 1988

Owen Merrill,
Senior Staff Engineer
ACRS.

Dear Owen:

In your letter of Jan 28 you asked for comments on the DOE responses to questions posed during our meeting in Las Vegas in July 1987.

Enclosed are my comments. If, after reading them, you think it worthwhile, you might have them typed out for transmittal to Dale Moller or whoever else might find them useful.

I don't have regular access to a secretary here; but I have tried to make these hand-written notes reasonably legible. Should you have any trouble deciphering any part of them, give me a call -- I am keeping a copy for a while.

Regards & best wishes --

Carson Mark

Query # 1.) Here -- as also in some other instances -- there would appear to be a disconnect between the question (as attributed to the ACRS) and the surrogate question posed and addressed by DOE. Apparently the ACRS had an interest in the "performance allocations" among the components of the repository. (Just why it was concerned with the "procedures for determining" these, rather than in the allocations themselves, isn't completely obvious.) In any case, the DOE comments seem not to address this matter at all. After introducing the notion of "accuracy" -- which they proceed (properly) to dismiss as not relevant -- they go on to discuss an impressively redundant program of numerics, which, as they then point out, will not serve to establish anything.

In the last two paragraphs they do make some quite relevant comments concerning the need of establishing credibility for their expected conclusion of "reasonable assurance" of adequacy, and the steps by which they hope to achieve this.

2.) It is not easy to see just how ACRS query #1 could lead to the need of discussing the evident difficulties of performing a PRA for the repository; but perhaps it is felt that a PRA is de rigueur these days. It would be good if they could remain

II.

themselves from having a PRA performed on the repository since here, where so few of the constituent probabilities have any basis other than mere guesses, the results of a PRA would be even more meaningless than usual.

3.) Presumably the ACRS was interested in any changes in the water table in the neighborhood of Yucca Mountain which might have been induced by nuclear explosions. DOE does not seem to have any data on that, nor even any indication that such changes are likely to have occurred. They did, of course, provide information on the quite violent effects on the water table that explosions have produced in their near neighborhood. The cue here, then, is to maintain a careful monitoring of water level at Yucca Mountain as affected -- if at all -- by such explosions as may be conducted in the normal course of events at NTS. Certainly the cue is not to start trying to figure out what might happen at Yucca Mountain should someone start a series of larger explosions than are now in fashion, at locations closer than any yet conducted. That approach, however, appears to have been part of the response to the question (DOE formulation of ACRS query #5) concerning ground motions which underground explosions

III

might induce at Yucca Mountain. Obviously, the necessary and sufficient response would be to ascertain whether or not the present testing regime causes any appreciable effects. In the event that it does not, and assuming Yucca Mountain should be chosen as the site for a repository, it would be appropriate that anyone who should propose a more threatening testing pattern should be assigned the responsibility of demonstrating that the proposed pattern would not result in unacceptable effects. There can be no doubt that explosions and locations can be hypothesized which would have unacceptable effects on any repository -- whether at Yucca Mountain, Deaf Smith County, or wherever. But that fact has absolutely nothing to do with the inherent suitability of the site as a potential repository.

#4, and #5). In DOE's formulation these are similar to #3), but concerning stress fields and ground motion rather than water table.

A considerable amount of information on those points has been gathered, but what is available is spot incomplete and subject to various possible interpretations which can be resolved only by the

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results of further work -- which is in progress.

The comments already offered concerning the effects of nuclear explosions apply equally -- or even more equally -- here. In particular, with respect to possible explosion-induced ground motion, Blume and Associates have prepared an analysis of the ground motions which might result from the testing of a series of 700 kT explosions (1.5 times the present maximum yield limit being observed under the Threshold Test Ban Treaty), at locations only half as far from Yucca Mountain as any yet used, and at a ~~rate~~ testing rate reminiscent of the good old days before budget limitations had much effect on such activities. Other than being ridiculous, the fact that DOE seems able and inclined to pay for such fanciful ~~test~~ exercises may not lead to much additional harm so long as absolutely zero attention is given to the results in formulating any significant conclusions concerning the repository.

Of course, the above is not to say that attention should not be given to relevant aspects of the effects of the present testing program, including the effects -- if any -- on the physical

V

features applying at Yucca Mountain, and also any useful data that might be available on such matters as the extent of effects on water tables, stress fields, signal transmission characteristics, and so forth.

#6.) This query concerned the work on geochemistry -- one of my fields of ignorance. From the extensive response provided it seems clear that at least some further work is necessary.

#7.) This DOE-generated query concerns information potentially available from studies of radionuclide migration from underground explosion sites. The response calls attention to some of the differences between an explosion and a repository setting in their source and near-source characteristics. However, once away from the source and the zone of crushed rock, and embodied in ground water, the transport of the various radionuclides will depend, not on the source, but on the characteristics of the medium through which they are moving. These will not be the same as those applying at Yucca Mountain; but it would appear that more information on this transport phase may be available than has yet been pulled together, and this would seem

#8.) This query concerned the emphasis to be placed on ground water travel time as compared to radionuclide travel time. In the response it is proposed, instead, that the ground water flux should be the governing parameter.

Though average flux is undoubtedly an important term, which could be argued to apply equally to both saturated and unsaturated media, such features as geochemistry, travel time -- both for water and radionuclides -- must also retain important roles, and may, even, be governing. Some ~~far~~ further elaboration or qualification would be useful here.

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U.S. NUCLEAR REG. COMM
ADVISORY COMMITTEE ON
REACTOR SAFEGUARDS

Dr. D.W. Moeller
Chairman
ACRS Subcommittee on Waste Management
U.S.N.R.C.
Washington, D.C. 20555

Dear Dr. Moeller,

This is in response to the memorandum from O.S. Merrill, dated Jan 28, 1988, in which he indicates that you requested to have the comments on the answers to the questions which were generated during the July 29, 1987 meeting of the ACRS Subcommittee on Waste Management. My comments regarding some of these questions are as follows:

Regarding Questions 1 and 2: I see little semantic relationship between the Question 1 as stated in the DOE letter by Maxwell B. Blanchard and the ACRS statement of this question. The ACRS statement is clear ... "procedures for determining performance ... should be carefully documented". We are all aware of the uncertainties associated with the selection of various parameters for the HLW repository and that there will be different proposed methods for their selection. But, one can evaluate the proposed procedures only if those are carefully documented. The ACRS statement (of this question) clearly asks for documentation, and the DOE response could have been simply that it will be provided?

Regarding Question 3: I suggest that this question be extended to examine also why the water table, about two miles north-west of the proposed repository site, rises so suddenly. One should examine (1) what causes such sudden drop in the level of the water table as one approaches the repository site and (2) how the natural causes (and UNE) can change the present equilibrium, i.e. raise the water table elevation at the proposed site. In this respect I see the studies of the fluctuations of the water table elevation, induced by UNE, as a useful vehicle to understand the physics of the problem, but I consider the natural forces, not the UNE to be the key mechanisms for changing the current state.

Regarding Questions 4: Perhaps the current work could be expanded to correlate more specifically the relationships of the observed current stress patterns (from measurements and from the fault plane solutions) and the inferred geological displacements, to suggest how one could extrapolate for possible movements of the geological blocks in the area. This in turn would help (1) identify the 10,000 year seismic risk and (2) provide constraints on the estimates of the risk from volcanism.

Enclosure 3

February 29, 1988
Dr. Moeller/page 2

I will be happy to provide more detailed comments if the above is not clear.

Sincerely,

M.D. Trifunac

M.D. Trifunac
Professor

MDT/jn