UNITED STATES
NUCLEAR REGULATORY COMMISSION
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AUG 18 1983

MEMORANDUM FOR: Malcom R. Knapp
High Level Waste Licensing
Management Branch

FROM: Robert A. Kornasiewicz, Leader
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Division of Health, Siting & Waste Management, RES

SUBJECT: REVIEW OF DOCUMENTS RELATED TO ESTIMATING PROBABILITIES OF OCCURRENCE OF FUTURE EVENTS AND PROCESSES

I have completed my review of the subject documents, including NUREG/CR-1667 as requested in your August 1, 1983 memo.

My comments are presented as responses to the three areas of concern as listed in this memo.

The question as to whether the method of choosing scenarios for consideration is technically appropriate can be answered in the affirmative only with significant qualifications. As presented in NUREG/CR-1667, the method was demonstrated to be appropriate for the hypothetical site. However, this hypothetical site was selected such that Surficial Phenomena and Processes were, by definition, eliminated as potential problems. Specifically, the site was selected to be a fully saturated one. How this methodology would be applied in an unsaturated site has not been demonstrated. Similarly, the site was selected as never having been glaciated and in a location that could not conceivably been affected by gross changes in sea levels. In summary, the method appears to work in a relatively simple case but whether and how the method would be applicable in more complex and uncertain situations has, in my opinion, not yet been demonstrated. The problem that appears to have been skirted is the admittedly very difficult one of assigning probabilities to the occurrence of the phenomena, particularly when such occurrences may not be independent events.

With regard to the methodology as related to climatic changes, the primary problems would be the available data and the complication resulting from the non-independence of several phenomenon associated with climatic changes. For example, NUREG/CR-1667 addressess glaciation, pluvial periods and sea level changes as independent events. In reality, all three could occur as a result of a climatic change.

The prediction of climatic changes is, in principle, possible. Recent studies have demonstrated a strong correlation between ice ages and the earth's orbital variations. Since the orbital variations are predictable, the timing of the onset and mitigation of glacial periods might also be predicted. Predicting the severity of, and thus the areas that might be affected by, such changes in climate are not so easily accomplished however. The problem here is in the current level of understanding as to the mechansim of the atmosphere's climate response to the orbital variations.

Another complication is the potential effects of anthropogenic action on the climate, which are unrelated to the effects of the orbital variations. An example is the growing concern over the effects of carbon dioxide (CO_2) concentration increases in the atmosphere. The predictability of the onset and extent of climatic changes which might occur as a result of human actions is dependent on the predictability of potential human activities in the future, as well as on the predictability of the atmosphere's response to the antropogenic impacts.

It may be possible to determine probability levels for the occurrence of the phenomena asssociated with climatic change such as glaciation, pluvial periods or sea level changes. However, the error bands associated with these probabilities may be unacceptably large in many areas. In most cases, the probability levels and error bands will be both site and phenomenon specific.

The understanding and prediction of climatic change is currently evolving fairly rapidly. The understanding of past climates is restricted by the lack of data and the time necessary to obtain these data. The National Science Foundation is currently sponsoring a major research effort in this area, and considerable progress is being made. Achieving the level of understanding that would be necessary to reduce the error bands associated with occurrence probabilities, particularly if these probabilities have relatively narrow go-no go limits, may not be possible before the end of the decade. Even then, any findings may be subject to considerable controversy because of unresolved issues related to the potential anthropogenic impacts on the climate.

The IAEA list of scenarios appears to be complete in my assigned review area. The main concern is that in some cases, these scenarios are interdependent and would have to be evaluated in that context. For example, climate change could include sea level change and hydrology change, as well as stream and glacial erosion processess. The flow of groundwater would also be affected, particularly in the unsaturated zone.

As stated above, at the present state of knowledge in the area of climatic change, probabilities could be determined for the occurrence of some of the events based on current information. However, due to the probable non-independence of the events and lack of sufficient supporting data, the error bands for such estimates would, in many cases, be so large as to compromise the usefulness of the probability estimates. Sufficient uncertainty exists in this area

that attempts to justify or support a numerical classification of scenarios related to climatic change as "reasonably forseeable" and "very unlikely" could very likely result in considerable, if not insurmountable, controversy when subjected to peer review.

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