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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
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May 31, 1983

MEMORANDUM FOR: John G. Davis, Director
Office of Nuclear Material Safety
and Safeguards

FROM: R. F. Fraley, Executive Director, ACRS

SUBJECT: ACRS WASTE MANAGEMENT SUBCOMMITTEE COMMENTS ON THE DOE SITE CHARACTERIZATION REPORT (SCR) AND THE NRC DRAFT SITE CHARACTERIZATION ANALYSIS (SCA) FOR THE BASALT WASTE ISOLATION PROJECT AT HANFORD

During its 277th meeting, May 12-14, 1983, the Advisory Committee on Reactor Safeguards endorsed forwarding the subject comments for use by the NRC Staff in finalizing the SCA (Enclosure 1). A copy has also been provided to DOE. Please note that the Subcommittee comments have been developed based on discussions with and input from several of our consultants. Individual assignments on the SCR and draft SCA as well as the professional affiliations of the participating ACRS consultants, are listed in Enclosure 2.

Enclosures:
As stated

cc: H Miller, NMSS
M. Frei, DOE/Headquarters
D. Squires, DOE/Hanford
R. Morgan, DOE
D. W. Moeller, ACRS
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ENCLOSURE 1

Report of ACRS Waste Management Subcommittee Meeting
on the DOE Site Characterization Report (SCR)
and the NRC Draft Site Characterization Analysis (SCA)
for the Basalt Waste Isolation Project (BWIP)
April 21-23, 1983, Washington, D.C.

I. General Comments:

1. One of the most striking facts brought out by these meetings was the critical need for a full exchange of data and information among the several groups involved in preparing and reviewing the Site Characterization Report (SCR). Although representatives from both DOE and NRC acknowledged the need for communications and although the channels appear to be improving, more dialogue needs to occur on a regular basis. This was exemplified by the fact that some of the information presented at this meeting was apparently being heard by DOE and/or NRC personnel for the first time. It must be recognized that NRC's role is to require that the site be characterized to the extent necessary for licensing and that this characterization be supported by adequate data. It is DOE's responsibility to be responsive to NRC's requests to the extent practicable. As in the case of this meeting, the ACRS is pleased to foster the necessary exchanges and interactions, to the extent that it can. The Subcommittee plans to continue to interact with both groups and to offer advice as requested.

2. The limited resources available to both DOE and NRC make it necessary to structure the schedules for data acquisition and analysis very carefully. Both the NRC Staff and the DOE/Contractors should be urged to organize their requests for data and the plans for obtaining such data on the basis of the priorities required by the licensing process. The Subcommittee heard comments that such organization would be

desirable but little evidence was presented to show progress toward this objective. Since, in the final analysis, it is the overall performance of the repository that must meet the NRC criteria, certain tradeoffs among individual components of the system will undoubtedly be necessary. To the extent practical, the Staff should seek to define the tradeoff configurations that would be acceptable.

3. In identifying data needs, the Staff presented an overly-detailed list of topics. In many instances this list is of limited utility because of several factors, all of which must be rectified. The Staff should identify in specific terms those data needs that have arisen because of the inadequacy or incompleteness of the information forwarded to them by DOE/Contractors. The Staff should be particularly careful not to request specific but secondary data that contribute to an increase in general knowledge but may do little to increase confidence in site-specific information. The NRC Staff should be urged to follow the practice of specifying as exactly as possible the data needs, the acceptable levels of uncertainty (precision and accuracy) and, only where critical, the methodology. The DOE/Contractors should be free to obtain these data by any appropriate method, but must be prepared to rigorously defend their quality and be prepared to furnish a full range of information to the reviewing NRC Staff. The steps outlined by the Staff at the Subcommittee meeting for correcting these problems appear to be reasonable.

4. It is clear that information on data collection and treatment must be made readily and completely available to the Staff. The Subcommittee was disturbed to hear that some of the data presented by DOE/Contractors

to the NRC may not have been of the quality that it appeared to be. Closer and more effective interaction between the Staff and the DOE/Contractors is necessary to avoid such problems. The Subcommittee found inadequate evidence that the models used in estimating certain repository behavior and impacts were sufficiently verified by experimental data. As the process of repository selection and corresponding analyses proceeds, such model verification will become increasingly important.

The NRC Staff should be urged to provide information derived from sensitivity studies to guide its own research, and to communicate to DOE/Contractors the importance of selected data and requests for them. Through such an approach, the Staff may be able to define the levels of uncertainty that are called for under item 3 above.

5. The requirement that the retrievability option be maintained may negate prompt backfilling of the waste emplacement holes. This, in turn, could exacerbate the potentiality for water (and steam) interaction with the waste canisters and subsequent degradation due to corrosion.
Although the requirement for retrievability is incorporated into the EPA proposed environmental release standards, it is the Subcommittee's impression that this should apply primarily to correcting mistakes that might occur during waste emplacement, rather than facilitating removal of wastes from a repository which later proves to be unacceptable.
If unprocessed spent fuel is placed in the repository, retrievability should be maintained until it can be made certain that there is no need to recover the uranium and plutonium for future use.

6. Commentary:

Three additional items appear worthy of comment:

a. Both DOE and NRC Staff members now agree that obtaining the necessary site-specific data for BWIP may require additional drilling on site. Although care will have to be taken to assure proper selection of such drill holes, and proper plugging and sealing of them after the tests have been completed, this now does not appear to be a problem.

b. The work load placed upon the NRC Staff in reviewing the SCR for the proposed basalt repository has been demanding. Estimates are that this review has required about 12 person-years. With SCRs soon to be prepared for additional proposed repositories (i.e., in tuff, salt and perhaps granite), the question arises whether the NRC Staff will be able to meet the associated commitments. This matter needs to be carefully assessed and appropriate plans must be developed. Included in such planning should be a careful selection and grouping of the key items to be addressed. Time does not permit the direction of efforts to matters of minor importance.

c. To facilitate the review and understanding of the Site Characterization Analyses prepared by the NRC Staff, greater care needs to be directed to their format. The current draft appears to deal in so much detail that the overall concerns and interests of the NRC Staff could be missed. Critical issues and specific recommendations should be highlighted.

II. Technical Comments:

1. Overall, this review revealed a lack of certain detailed data about the candidate site. This was exemplified by many factors including the need for a better understanding of the Nancy lineament, the groundwater barrier that creates the large difference (approximately 400') in hydraulic head between confirmed aquifers of the proposed site and zones to the northwest. Data are also lacking on the basalt flow thicknesses and properties within the site, and permeable fracture zones within the site. No firm geological, hydrological and geophysical projections can be made for the necessary thousands of years into the future without site-specific information. The current acceptability of additional drilling onsite should expedite the acquisition of the required data.

2. Earthquakes within the site area may continue and may even originate within the repository. Data are needed on the seismic moment (and therefore fracture size) of known earthquakes in the area. Extensive experience beginning with the Denver earthquakes a few years ago shows that earthquakes can be turned on and off by pumping water into or out of the ground, respectively. This happens because the critical shear stress necessary for a fracture to slip is a function of the effective stress (the normal stress minus the fluid pore pressure). Thus, one would expect earthquakes to be suppressed by dewatering of the site and to be triggered by its subsequent re-flooding. This whole realm needs to be analyzed even though the earthquakes known to be induced are insignificantly small. Because in situ stresses have

been measured, there is a real opportunity to develop a range of failure models and thus to anticipate future problems.

3. Site Specific Data:

   a. Rock Permeability, Strength, and Stratigraphic and Structural Continuities

   Site-specific data are needed to support the feasibility of the conceptual repository design. Among these are: the strength, structure and stratigraphic continuity of the rock and the presence or absence of water and its flow. Additional core borings both vertical and inclined need to be drilled to determine the frequency, character and attitude of the vertical and steeply dipping joints within the limits of the repository as planned. Physical testing needs to be performed of the rock core at temperatures to be developed by the waste and at the existing water content. The strength and continuity of the rock mass at the level of the repository also needs to be determined. The permeability of the rock mass as well as the repository layer should be established by full-scale, well instrumented, long-duration pumping tests with observation wells drilled specifically for this purpose in the repository site beneath the Umtanum flow. Permeabilities of critical zones should be established.

   b. Geochemistry/Waste Package Design

   The Subcommittee observed that while the the nature of the geochemical interactions between the waste package components and the

geologic formations is complex, the DOE/Contractors' treatment appeared to avoid major issues that were subsequently and appropriately raised by the NRC Staff. Impressions gathered from the SCR were that some important conclusions were drawn on the basis of insufficient data or, in some cases, no data at all. The Subcommittee also noted that some aspects of the NRC Staff presentation concerning geochemistry appeared to be peripheral to the important questions. The Staff should be urged to focus sharply on the identified data needs that will directly address questions of radionuclide transport. The DOE/Contractors should be required to increase the visibility of their methodology and data significantly, and to demonstrate explicitly that certain potential effects (e.g., transport of actinides by dissolved organic groundwater components) can be neglected. The Subcommittee also recommends that the issues surrounding radiolysis be examined in a detailed manner. Prior to backfilling (and without massive ventilation) the canisters may be in an extremely corrosive environment, since radiolysis of air and water produces several potentially corrosive products. Even if the emplaced canisters are backfilled promptly, radiolysis can still produce corrosive products if water saturates the backfill. The impact of such reactions on the canister integrity requirement should be evaluated.

4. Repository Design

a. Selection of the Rock Horizon for the Repository

Neither the DOE Site Characterization Report nor the NRC Site Characterization Analysis deals with selection of the rock horizon for the repository. No detailed information on water bearing characteristics or on horizontal or gently dipping heterogeneities which may occur in either of the two candidate flows (the Cohasset above, or the Umtanum, below) has been provided. If such planes of weakness occur in these flows, then the roof of the repository should be so located that it is not affected. To permit ease of excavation and safer working conditions, the repository should be located in solid rock, if such is available. The repository horizon should be essentially dry.

The detailed description of the geological section of the rock layer in which the repository will be located is a fundamental necessity for its proper design. Therefore, extreme care needs to be shown in the logging of the core and description of the drilling of the borings penetrating the zone of the repository. The rock characteristics should be checked on a face-to-face basis in the exploratory shaft. The location of the repository should be established on the basis of detailed logging of the walls of the shaft so that the roof of the repository will be within a massive layer of basalt to provide a stable crown over the repository. This logging requires that the lining of the shaft in the repository zone be delayed until the logging of the walls of the shaft in the critical zones is complete.

b. Repository Depth and Orientation

The repository needs to be deep enough so that it is adequately safe from inadvertent penetration or unusual erosion. But it does not need to be deeper than this unless good rock is unavailable at shallower depths. Selection of a deeper than necessary horizon will increase the costs of access, hoisting, pumping and air conditioning. Orientation of the repository should be such that maintenance and operating conditions will be as simple as possible. To accomplish this goal, the placement rooms should be oriented parallel to the maximum principal horizontal stress on their walls. Such an orientation would place the canister holes parallel to the lesser principal horizontal stress.

c. Shaft Diameters and Roof Spans

Shafts of one design would reduce the cost of drilling machines and allow the use of common facilities. The high velocities of ventilation air, approaching 20 miles per hour, make the service shaft an undesirable personnel route. The underground openings (shown in Fig. 10-8 of the SCR) will provide intersections where the roof span may approach the limit which the basalt can support. Reduction of the radius of the intersections may be of value. The support system for the roof should be at or embedded in the roof, probably in the form of roof bolts. Several patterns of bolting should be examined before specifying final requirements.

d. Exploration and Testing

It would appear that exploration of certain aspects of the proposed repository design could be investigated within Gable Mountain. These include:

1) Canister hole drilling over a range of diameters, including back reaming;
2) Backfilling of waste holes after placement of canisters;
3) Retrievability of canisters from the waste holes;
4) Placement of proposed backfill material in repository rooms.

ENCLOSURE 2

ACRS consultants that participated in the April 28-30, 1983 Waste Management Subcommittee meeting and contributed to the Subcommittee report:

1. Dr. Richard Foster (retired from Battelle Pacific Northwest Laboratory) - reviewed and provided comments on Chapters 5 (Hydrogeology), 7 (Surface Hydrology), 12 (Performance Assessment), 16 (Performance Assessment Issues and Plans).
2. Dr. Donald Orth (du Pont - Savannah River Laboratory) - reviewed and provided comments on Chapters 8 (Climatology, Meteorology, and Air Quality), 9 (Environmental, Land-Use, and Socioeconomic Characteristics).
3. Dr. Shailer Philbrick (retired from Cornell University; private consultant in geology and seismology) - reviewed and provided comments on Chapters 4 (Geoengineering), 10 (Repository Design), 14 (Geoengineering and Repository Design Issues and Plans).
4. Dr. Martin Steindler (Argonne National Laboratory) - reviewed and provided comments on Chapters 6 (Geochemistry), 11 (Waste Package), 15 (Waste Package and Site Geochemistry Issues and Plans).
5. Dr. George Thompson (Professor in Geophysics, Stanford University) - reviewed and commented on Chapters 5 (Hydrogeology), 6 (Geochemistry), and 10 (Repository Design).