State of California

Memorandum

To : Barbara Byron
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Date : MAR 29 1989

Jesse M. Diaz, Chief
Division of Water Quality
From : ~~STATE~~ WATER RESOURCES CONTROL BOARD

Subject : REVIEW OF SITE CHARACTERIZATION PLAN OVERVIEW FOR PROPOSED HIGH-LEVEL NUCLEAR WASTE REPOSITORY LOCATED AT YUCCA MOUNTAIN, NEVADA

We appreciate the opportunity to review the Overview of the Site Characterization Plan for the proposed high-level nuclear waste repository located near Yucca Mountain, Nevada. Staffs general comments on the proposed facility follows. (Note: Headings do not follow sections in Overview, but rather are general areas of concern.):

LOCATION

Not all figures show the repository location. Each figure should depict this location. Without this information, it is difficult to place the Repository in relation to the natural and man-made features which have been discussed throughout the Overview. Staff was not able to ascertain the relative location for the exploratory shafts to be dug in relation to the proposed Repository. It is difficult to determine if the location for this testing is close enough to the proposed Repository site to test the same depositional environment, but far enough to prevent creating a potential conduit for ground water into this same Repository. We would be happy to complete the evaluation when the figures are amended.

SEISMICITY

The Overview states "Measurements made since 1978 show that within about six miles from the proposed repository the release of seismic energy has been 100 or 1,000 times lower than that in the surrounding region". This statement is not clear as to its intent. It may be that the site is storing up energy (locked fault segment) which indicates increased probability of relatively large fault movement in the future.

The prediction of future seismicity has only been presented in general terms. The theory of eduction (Dixon, Farrar, 1979) should be discussed in terms of predicting future seismicity. This paper states that the upwelling and lateral flow of mantle material associated with the subducted East Pacific Rise produced the horizontal extension of the Basin and Range Province. This scenario may indeed describe the mechanism which created the Yucca Mountain area. In this case, the seismicity expected may be different than that proposed previously for Basin and Range geographic provinces.

VOLCANISM

Hydrothermal veining due to nearby volcanism may have been the cause for calcite-silica-sepiolite veining seen in the area. Thus, their presence may indicate the existence of a volcanic body at depth near this site. The potential for future volcanism and the associated ground water rise upwards through new veins needs to be defined in terms of their effect upon the Repository. The origin of these calcite-silica-sepiolite deposits should be examined.

LITHOLOGY

The Overview discusses the welded tuff, the rock type into which the Repository may be installed. However, much of the investigation to date, as well as future investigation of this lithologic bed, must rely upon the use of geophysics predominantly so as not to disturb the in-place material at the Repository site. However, it is difficult to characterize welded tuff deposits by the use of geophysics due to the fact that welled tuffs are dense and have no definitive structure and because of the complexity and heterogeneity of the site. Thus, the exploratory shafts will need to serve, by the use of direct sampling, to extrapolate and infer the distinguishing characteristics of the rock materials at the proposed Repository site. As discussed under LOCATION, staff has not been able to determine where these exploratory shafts will be dug, nor were they are able to find in the report the rationale as to why the exploratory shaft site is similar geologically to the proposed Repository site. It is not clear in the report if the investigators are planning to drill these exploratory shafts in the same lithologic bed as the proposed Repository. Since much data must be derived from these exploratory shafts to aid in the understanding of the rock material at the proposed Repository site, it is important that staff understands the rational for their placement. We would be happy to complete the evaluation when the information is submitted.

MINERAL RESOURCES

The report states that no high temperature geothermal resource exists in the area. The report considers 190 degrees Fahrenheit to be the minimum temperature for a high temperature resource, although the actual temperature at which electricity can be produced (albeit inefficiently) may be below this temperature. Because the report does not quantify the surrounding heat flow gradient anomalies, the potential for geothermal development in the future is unknown. Also, with the probable future advent of new technologies, as well as dwindling energy supplies, a fairly low heat flow gradient may be indicative of future energy reserves. Investigation of these reserves at a later date may result in future disturbance of the Repository site.

In the Overview, the designation "speculative, undiscovered" was applied to gold, silver, mercury, uranium, and base metals occurring in the area of the facility. These terms should be defined. No indication was given in the report as to whether further exploration for these minerals would be performed. If there is some potential for these minerals to exist at the proposed Repository site, then it should be determined whether they do indeed exist at the site.

HYDROLOGY

A full description of the ground water below the proposed Repository was not included in the Overview. This description should include water quality analyses (Chloride, Iron, Manganese, Sodium, Phenols, Sulfate, pH, specific conductance, total organic carbon, total organic halogens, gross alpha, gross beta, total gamma, radionucleides), yield, and storage coefficient.

No age dating information on the ground water has been supplied. The age of this water would give an approximation of surrounding lateral and vertical permeabilities as well as recharge and discharge rates and locations.

It is not clear as to whether the underlying aquifer is confined or unconfined, which would help to indicate potential flow paths and discharge points, such as the Furnace Creek area of Death Valley National Monument.

The estimates of rainfall infiltration given in the report are 0.3 percent. It is not clear if pan evaporation rates were used. If so, then slow, steady precipitation events should be factored into the calculations to determine actual infiltration.

It has not been described how flow direction was determined under the site nor whether further delineation of the flow regime will be performed during site investigation and

Repository construction. There must be a site-specific investigation undertaken to determine these flows, as regional studies alone do not yield enough information to determine this information accurately.

It is not clear as to why such a large discrepancy exists between the predicted migration rates (9,000 to 80,000 years) through the bedrock to the saturated zone given in the Overview document. All permeability values determined from below the level of the Repository should be determined relative to the suspected leachate that would be produced from the waste.

The investigation at the area of the exploratory shafts indicates that sampling of the unsaturated zone will be performed when possible. However, it is not stated how sampling will be performed. It would seem reasonable to install lysimeters to collect this water for continuous monitoring rather than or in addition to a one-time sampling.

The Overview document states that pump tests will be conducted in the saturated zone to determine hydrologic parameters. It is not clear which type of well pump tests will be performed nor how long these tests or the infiltration tests will be performed. Slug tests can be used in conjunction with pump tests in the saturated zone to give a larger number of data points. Packer tests should also be used in the unsaturated zone to determine subsurface permeabilities. No boreholes drilled for the determination of hydrologic parameters should have drilling fluids introduced downhole. In many cases, air can be used for the purpose of lifting the cuttings (and for cleaning blast holes). If fluids must be introduced, they should be kept at a minimum and the resultant mud cake scraped from the walls of the borehole.

No mention is made of water quality or quantity sampling of Ghost Dance fault nor of the imbricate faults identified on Figures 2 and 3. Test holes should be drilled, fluids sampled, and aquifer tests performed in these areas to further identify local hydraulic characteristics. These faulted areas would seem to be capable of carrying the most fluids subsurface.

The presence of much faulting in the area (32 faults of unknown activities within 6 km, Dudley, USGS, GEOTIMES, January 1989) increases the permeabilities and porosites of the natural geologic materials. This secondary permeability and porosity precludes the predictability of the variable porosities and permeabilities of the Repository site. The Overview states that investigators believe fracture flow to be a minor component of flow in the area. The rationale for believing that fracture flow is minor compared to matrix flow should be explained.

GEOENGINEERING

No mention is made in the report of the methodology for sealing boreholes, shafts, or ramps after abandonment. Normal methods of sealing (as used today in the drilling industry) are not suitable for long-term isolation. The water content of the seals (grouts) will lessen over time and the grout mixture will crack, especially with the added heat that radioactive decay within the Repository will produce. Unless a better method of sealing is agreed upon, it might be better to rely upon diversion instead of, or in conjunction with, sealing. This would require the placement of diversionary dams and/or checks at various subsurface locations to divert flow from these boreholes. They must be designed to compensate for an elevated water table if this area experiences a wetter climate in the future.

The surface expression of these boreholes would require the same types of devices to stop the introduction of fluids below grown. All of the openings sealed after closure of the site should also have a method of diversion designed accordingly.

Roof bolts, such as those proposed to be used to stablize the roof of the Repository, can not be expected to remain in-place for 10,000 years. The excavation of the Repository should make use of the surrounding consolidated tuff formation to insure long-term stability in the Repository gallery. By proper design and excavation of the gallery, it may be possible to distribute the loads upon existing, in-place bedrock, as either pillars or by utilizing the surrounding enclosure itself. This would be a more realistic alternative as the usefulness of roof bolts diminishes greatly over a relatively short period of time (depending on ambient conditions).

The Overview document states that waste-emplacement boreholes will be only partially lined and grouted in the effort to contain waste within the boreholes. All vertical and horizontal waste-emplacement boreholes should be fully lined and grouted to prevent, to the greatest possible extent, migration of fluids either into or out of the holes.

Air gaps between the waste-emplacement cylinders and the borehole walls have been designed to keep ground water away from the waste-emplacement cylinders. The air gaps will not have adequate capacity if ground water encroaches upon the facility. Thus, these air gaps should not be relied upon to demonstrate isolation of the wastes from saturated or unsaturated underground flow.

A number of drains are to be installed in the Repository (exact number is unknown). All drains are likely to clog over time. A procedure should be developed to test for clogging and a design implemented to allow for remediation should clogging occur.

The term "lithophysae" is used in conjunction with the thermal and mechanical response of rocks within the Repository . Staff have not been able to find a definition for "lithophysae" and are thus unable to determine the accuracy of the investigation of the breakout room.

It is not clear for what length of time this repository is designed to retard the flow of radionucleides. Staff assumes the report is referring to complete containment for 300 years and partial containment for 10,000 years. If this assumption is correct, partial containment should be defined.

As our concerns and questions are addressed, the State Water Resources Control Board would be happy to make further comments on the Site Characterization Plan. Thank you again for the opportunity to comment on the proposed nuclear waste repository. If you have any questions, please telephone Bill Levine, of my staff, at (916) 322-0203 (ATSS 492-0203).

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