

September 28, 2001

The Honorable Richard A. Meserve
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: ACNW COMMENTS ON NRC STAFF'S ISSUE RESOLUTION PROCESS FOR
RISK-INFORMING ITS SUFFICIENCY REVIEW OF DOE'S TECHNICAL BASIS
DOCUMENTS FOR THE YUCCA MOUNTAIN SITE RECOMMENDATION

The *Nuclear Waste Policy Act* (NWPA) requires the U. S. Department of Energy (DOE) to include in its site recommendation to the President preliminary comments from the NRC as to whether DOE's at-depth site characterization and waste form proposal for the proposed high-level waste (HLW) repository seem to be sufficient for inclusion in a possible license application. In this letter, we provide our observations and recommendations regarding the issue resolution process that the NRC staff used in its sufficiency review of DOE's technical basis documents pertaining to the site recommendation for the proposed Yucca Mountain, Nevada, HLW repository.

In summer of 2000 the Advisory Committee on Nuclear Waste (ACNW) initiated a vertical slice review of the NRC staff's issue resolution process and DOE's technical basis documents for the Yucca Mountain site recommendation. The purpose of our vertical slice review was to evaluate the NRC staff's tools, guidance, and technical capability for evaluating sufficiency and, if needed, an eventual license application. Primary objectives of our review were to evaluate: (1) whether the NRC's sufficiency review comments and issue resolution process are transparent, traceable, and defensible, and (2) whether the NRC's issue resolution agreements and information requested of DOE reflect a risk-informed and performance-based (RIPB) approach and are appropriate and realistic. In planning our vertical slice review, we selected four technical areas that correspond to one or more key technical issues (KTIs). The four areas were: (1) high-level waste chemistry, (2) saturated zone flow and transport, (3) thermal effects on flow, and (4) total system performance assessment and integration. Because we have not yet seen the staff's sufficiency comments, our observations are predicated solely on the issue-resolution process. The staff has informed the Committee that the information gleaned from technical exchange meetings and the agreements that stemmed from them formed the basis for the staff's sufficiency comments.

On the basis of our selected reviews, we make several observations and recommendations:

- The staff appears to be well equipped with analytical tools, technical capability, and guidance for conducting the sufficiency review and an eventual license application (LA) review, particularly in light of the staff's ongoing upgrades to the TPA code for analyzing

the waste package and source term. It is not obvious, however, whether or how the staff used information and performance assessment tools to focus its sufficiency review on the most risk-significant issues, and whether or how it used its TPA code to develop risk insights to support the sufficiency review.

- The NRC staff should continue to use its TPA code in conducting sensitivity analyses to explore important contributors to risk at the sub-issue level. We also encourage the staff to continue to enhance its use of the TPA code to allow for greater realism in its analyses and to conduct its own risk-informed assessments to quantify the uncertainties associated with the important risk contributors. We believe this will allow the staff to meet the Commission's intent of having a risk-informed analysis, refine its understanding of the potential risks associated with the proposed Yucca Mountain repository, focus its licensing review, and better justify its request for information and detailed analyses from the DOE.
- Through its issue resolution process, the staff appears to be addressing the issues that are likely to be important for conducting an LA review for the proposed Yucca Mountain repository.
- The technical exchange meetings have proven very valuable in resolving issues and establishing substantial and essential communication between NRC and DOE staffs.
- The NRC staff used the ongoing issue resolution process efficiently and effectively to conduct its review in a timely fashion.
- The staff seems to be doing an excellent job of tracking issue resolution as the emphasis shifts from KTIs to integrated sub-issues (ISIs). The ISI format appears to effectively capture and integrate material from the KTIs.
- In the areas where the Committee focused its vertical slice review, the staff's issue resolution process is logical, defensible, and well documented in the issue resolution status reports (IRSRs).
- DOE's inconsistent use of conservatism throughout the TSPA-SR models makes it difficult to identify issues that are important to risk, and precludes a risk-informed analyses of the proposed repository on the basis of the evidence.
- The NRC staff should clarify and publish in its YMRP how it will tailor its licensing review of the abstractions (ISIs) on the basis of their importance to safety. We are concerned that the staff's technical exchange agreements may be challenged if the staff does not document how it is focusing on the most risk-significant issues. The Committee believes that the staff is on its way toward making the YMRP an RIPB guidance document, but still faces a significant challenge in making its issue resolution process and possible LA review RIPB and documenting how this was achieved.
- The staff should clarify in the YMRP how to use "conservatism" appropriately to treat uncertainty, while providing a risk-informed analysis and understanding of the risks associated with the proposed repository.

- According to the staff, the issue resolution agreements that emerged from the technical exchange meetings formed the basis for the staff's sufficiency comments. However, the existing IRSRs do not reflect the most current information supporting the recent agreements. This discrepancy will make it difficult to trace the bases and criteria that the staff used to develop its sufficiency comments. We understand that the staff intends to update the IRSRs to reflect the most recent information and acceptance criteria in the integrated IRSR, but this document is still under development and may not become publically available for some time. The traceability, clarity, and transparency of the sufficiency comments will not be complete without this integrated IRSR. Therefore, we recommend that the staff release this document to the public as soon as feasible.

The ACNW developed a "template" containing a set of questions to guide its review toward achieving the desired objectives. Our answers to the template questions and additional background information for our review are provided in the attachment to this letter.

Sincerely,

/RA/

George M. Hornberger
Chairman

Attachment: Advisory Committee on Nuclear Waste's Vertical Slice Review Approach

Attachment

Advisory Committee on Nuclear Waste's Vertical Slice Review Approach

In Summer 2000, the Advisory Committee on Nuclear Waste (ACNW) initiated a vertical slice review of the NRC staff's sufficiency review of the technical basis documents prepared by the U.S. Department of Energy (DOE) for the site recommendation regarding the high-level waste (HLW) repository at Yucca Mountain, Nevada. The ACNW's approach for this review is one element of our larger strategy for evaluating the staff's overall licensing review capability. Other elements of the strategy include ongoing evaluation of the staff's key technical issue KTI resolution program, specific KTIs, the staff's performance assessment (PA) tools and capability, and the staff's overall regulatory framework for HLW. The Committee briefed the Commission on its overall strategy in March 2001.

Background

During its March 2000 meeting, the Committee heard a briefing from the NRC staff on its draft strategy to conduct the Yucca Mountain sufficiency review, and subsequently received a copy of the draft sufficiency review strategy in September 2000.

In a letter to the Commission dated June 29, 2000, the Committee conveyed that the staff's approach appeared to be well thought out, logical, and consistent with the risk-informed and performance-based (RIPB) strategy outlined in the proposed draft 10 CFR Part 63.

In July 2000, at the Commission's request, several Committee members informally provided feedback on the staff's draft proposed Yucca Mountain Review Plan (YMRP), which the staff developed for conducting an RIPB review of an eventual license application (LA). The staff also developed and provided to the ACNW a copy of the draft YMRP implementing guidance for conducting the sufficiency review. The Committee has not yet received a briefing on the draft YMRP or its implementing guidance and has not yet reviewed these documents in detail.

During its August 2001 meeting, the Committee heard a briefing from the NRC staff on its sufficiency review and DOE's supplemental science and performance analysis (SSPA). However, we have not reviewed the SSPA and have not considered it in our evaluation of the staff's sufficiency review. Finally, the Committee members also gained insights into the staff's issue resolution process over the past year by participating in informal interactions with the NRC staff and by attending DOE-NRC technical exchange meetings for resolving technical issues.

NRC Staff's Sufficiency Review

The purpose of the NRC staff's sufficiency review was to evaluate whether the DOE has enough data and conceptual understanding of the Yucca Mountain HLW repository system to develop a safety case for a potential license application. Consequently, the scope of the sufficiency review was narrower than it would be for an LA review. For example, the staff will not make estimated dose comparisons relative to 10 CFR Part 63, and it will not make findings regarding the correctness of the site recommendation in relation to DOE's siting guidelines in 10 CFR Part 963. Rather, the staff will provide preliminary comments on where data and analyses appear to be sufficient or insufficient, what additional data and analyses are needed and within what time frame, whether conceptual models are supported by sufficient data, and

the status of DOE's quality assurance (QA) efforts. The staff's sufficiency review will also document the status of the KTI issue resolution process, in addition to reporting on progress in the DOE's program. The staff informed us that the DOE-NRC KTI technical exchange meeting agreements formed the basis for its sufficiency review, and that it used the issue resolution process and IRSRs to risk-inform and document the basis for its sufficiency review.

Similar to the way the ACNW conducted its review of the DOE's viability assessment in its letter dated April 8, 1999, each Committee member informally met with the NRC staff one or more times to exchange ideas and information related to their technical area. The Committee used the staff's IRSRs and agreements from the ongoing NRC-DOE technical exchange meetings to focus its review on relevant portions of DOE's technical basis documents. Other source material for the review included DOE's process model reports (PMRs), analysis model reports (AMRs), science and engineering report, TSPA-SR, DOE's repository safety strategy (RSS), and (to a very limited extent) SSPA. The Committee provided a separate report on its vertical slice review of HLW chemistry in its letter dated August 13, 2001 and the TSPA-SR in its letter dated September 18, 2001.

The Template Questions

- 1, Are the NRC staff's tools, guidance, and capability sufficient to conduct a sufficiency review or LA review?

In general, the NRC staff appears to be well equipped to conduct a sufficiency review and an LA review. The staff has its own analytical tools [e.g., total-system performance assessment (TPA) code and more detailed codes] to use in reaching conclusions about DOE's ability to meet regulatory requirements for licensing.

The NRC staff and the staff of the Center for Nuclear Waste Regulatory Analyses (CNWRA) have impressive expertise in the areas that the ACNW evaluated, (i.e., repository chemistry, TSPA, saturated zone, and thermal effects on flow). The Committee also commented in its chemistry vertical slice review report that the NRC and CNWRA staff seem to be well positioned to deal with the impacts of evolutionary repository design changes.

However, as noted in the chemistry report, we believe that deficiencies may exist in some engineering areas and that the staff lacks the computing capability to run DOE's Goldsim TSPA code in a Monte-Carlo mode. We also noted in the chemistry report that DOE's and NRC's treatment of coupled chemical processes is inadequate as a result of their complexity and difficulty in incorporating them in the modeling. In addition, the Committee noted that the staff needs to more fully address in-package chemistry issues as it develops an integrated chemistry model to be implemented in the NRC's TPA code, and that it is essential to develop an appropriate source term model for the TPA code. We are pleased to note that the NRC and CNWRA staffs are in the process of updating the TPA code to address the above deficiencies and to allow for more realistic assessments of the waste package, source term, and coupled processes.

2. Is there sufficient evidence to support the results of DOE's TSPA, process model, or model abstraction?

On the basis of our collective reviews, more evidence may exist for treating the saturated zone in the TSPA model than for treating repository chemistry and thermal effects on flow. For the latter areas, we believe that DOE's understanding of system behavior may be derived more from modeling than from data. We also observed that neither the evidence supporting the TSPA-SR modeling assumptions, nor the importance of the assumptions to performance are made transparent. For example, DOE cites a variety of assumptions as "conservative." This is a concern because: (1) use of multiple "conservative" assumptions masks the risks posed by the repository and compromises the opportunity for a risk-informed analysis on the basis of the evidence, and (2) in many cases, assumptions are labeled as conservative without the supporting evidence. We also observed that verification and qualification of data and models are inconsistent and sometimes lacking.

3. Is the staff's approach adequate for using the TPA code to review the TSPA, process models, and/or model abstractions?

Although the staff's TPA code lacks the detail and sophistication of DOE's Goldsim TSPA code, we believe that the staff is well positioned and equipped with its own, independent code to review information contained in a possible LA. A possible advantage of the simpler TPA code (compared to DOE's Goldsim code) is that it should be conducive to more realistic, scenario-based approaches that may be useful for verifying DOE's analysis.

It is not obvious, however, whether or how the staff used information and performance assessment tools to focus its sufficiency review on the most risk-significant issues, and whether or how it used its TPA code to develop risk insights to support the sufficiency review.

4. Is the issue resolution process sufficient, given review of the integrated sub-issue (ISI)? Has integration between KTIs and ISIs been achieved?

The staff's public technical exchange meetings were organized around KTIs and their sub-issues, while the staff's sufficiency review is structured around the ISIs. The Committee believes that the ISI format effectively captures and integrates material from the KTIs, and appears to have enabled the staff to integrate technical information across various KTIs in conducting its sufficiency review. Overall, the staff seems to be doing an excellent job of tracking issue resolution as the emphasis shifts from KTIs to ISIs.

5. Is the relative risk of the sub-issue (ISI) known or understood by the NRC? By DOE? Is it a principal factor?

In the case of saturated zone flow, the staff recognizes the saturated zone as a geological barrier that is important to the safety case. The saturated zone flow regime itself is not a principal factor; however, because radionuclide transport relies on groundwater flow as input, the flow path ISI is seen to be important to both the NRC and

DOE. In the areas of repository chemistry and thermal effects on flow, the NRC's understanding of the relative risk is less apparent and was not documented in the corresponding IRSR.

We observed that DOE tends to use very "conservative" assumptions in some cases but not in others, and does not integrate the differing approaches in a consistent way. The inconsistent use of conservatism throughout the TSPA-SR models makes it difficult to identify issues that are important to risk and to ascertain if particular errors or problems are significant to overall performance. The complexity of the TSPA-SR model and code make it difficult to evaluate the individual contributors to risk. We discuss our review of the TSPA-SR in more detail in the September 18, 2001 letter.

6. Does NRC's YMRP/Guidance reflect an RIPB approach?

Although the Committee has not yet reviewed the draft YMRP, several Committee members perused the draft document last year at the Commission's request and offered comments to the staff on how to better meet the Commission's expectations for making the document RIPB. Until we are briefed on the YMRP, we cannot assess how the staff might use the YMRP to conduct an RIPB review by taking advantage of such factors as risk insights derived from previous PAs, results of the TPA code, and sensitivity analyses.

The Committee believes that the staff is on its way toward making the YMRP an RIPB guidance document, but still faces a significant challenge in making its issue resolution process and possible LA review RIPB and documenting how this was achieved.

7. Are the KTIs consistent with the issues that the PA identified as being important?

As part of the issue resolution process, the original 10 KTIs have now been subsumed into the 14 ISIs. It would appear that the KTIs remain important issues for determining repository performance. In addition, the staff effectively uses the KTIs to highlight important issues in interactions with DOE, and the KTI-IRSR process has proven to be a flexible framework for identifying significant technical issues.

8. Are the staff's IRSRs and agreements logical, defensible, and focused on the most risk-significant issues?

DOE and the NRC appear to have covered the important issues, but it is not obvious whether the NRC staff has made a concerted effort to focus on the most risk-significant issues. Although the staff appears to be in the process of identifying the most important issues, the discovery process is still underway. We are concerned that the defensibility of the staff's issue resolution process and technical exchange agreements may be challenged if the staff does not document how it is focusing on the most risk-significant issues. Although it was beyond the scope of our vertical slice review, a Committee member observed a technical exchange meeting on preclosure that caused him to question the defensibility of the NRC's agreements and request for information from the DOE. However, we believe that if the staff succeeds in making the YMRP an RIPB

document and uses it to guide its LA review, the conclusions reached should be logical, defensible, and focused on the most risk-significant issues.

9. Are the staff's agreements well documented, transparent, and traceable?

The Committee believes that the NRC staff's issue resolution process is well documented in the IRSRs. However, the existing IRSRs do not reflect the most current information supporting the recent agreements; this discrepancy will make it difficult to trace the bases and criteria that the staff used to develop its sufficiency comments.

10. How has uncertainty been evaluated? Are the issues treated with bounding assumptions, or are they realistically assessed?

In the chemistry area, DOE handles uncertainty with differing degrees of realism, largely depending on what information is available. In the area of thermal effects on flow, it appears that DOE uses bounding assumptions together with probability distributions, but uses more bounding assumptions (taken to be "conservative") than "best estimates" by about 10:1. We believe that sensitivity analyses that are founded on bounding values for parameters (rather than on best estimates) are of questionable value and are more likely to be misleading than informative.

A recurring theme in ACNW's review is that reliance on bounding analyses or "conservative" assumptions can obscure a true performance assessment. Although "sufficiency" relates only to the adequacy of the evidence (and not to performance per se), the staff must make a judgment about whether the philosophy behind the information-gathering process is adequate to support realistic performance for a license application. ACNW maintains that the use of conservatism upon conservatism makes a risk-informed approach impossible.