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NUCLEAR ENERGY INSTITUTE

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Director,
Spent Nuclear Fuel
Management

November 23, 1999

Central Docket Section (6102)
ATTN: Docket A-95-12
U.S. Environmental Protection Agency
401 M Street, SW, Washington DC 20460-0001

SUBJECT: Nuclear Energy Institute (NEI) Comments on Proposed 40 CFR Part 197

The Nuclear Energy Institute (NEI),¹ on behalf of the nuclear energy industry, is pleased to submit these comments to the Environmental Protection Agency (EPA) on the proposed 40 CFR Part 197 rulemaking, *Environmental Radiation Protection Standards for Yucca Mountain, Nevada*, (64 Fed. Reg. 46,976 - August 27, 1999).

The establishment of an appropriate radiation protection standard, in accordance with the Energy Policy Act of 1992 (EnPA), is an important piece of the regulatory framework that is needed for the nation to safely and responsibly dispose of used nuclear fuel and high level radioactive waste. However, EPA's proposal for separate groundwater protection limits, on top of an "all-pathways" individual dose limit, actually provides a result less protective of public health and safety as compared to the individual limit alone. With this knowledge, and backed by the overwhelming consensus of the scientific community, Congress specifically and exclusively called for an individual dose standard in the EnPA. EPA's separate groundwater limits directly violate the EnPA's instructions to establish an individual dose standard as the sole instrument of public health and safety protection.

There is considerable evidence, most recently documented in the Department of Energy's Draft Environmental Impact Statement, that separate groundwater protection limits will lead to a less protective result while introducing unnecessary complications and costs into the repository program. In contrast, EPA has provided no analysis showing any benefit to public health and safety from the proposed groundwater limits.

EPA has also included in this proposal a number of provisions that duplicate and conflict with NRC's statutory authority to specify how the radiation protection standard is implemented. For example, EPA's proposals for modeling the exposed population (the

¹ NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, nuclear material licensees, and other organizations and individuals involved in the nuclear energy industry.

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Reasonably Maximally Exposed Individual or RMEI) and potential human intrusion would be more appropriately dealt with in NRC's implementing regulation.

The industry endorses EPA's proposal for a compliance period of 10,000 years, and a limit on mean individual dose instead of a limit on level of risk. NEI recommends a 25 mrem dose limit instead of the proposed 15 mrem dose limit. There is no practical difference in health effects between 25 mrem and 15 mrem, but there would be substantial costs incurred to meet the lower limit. We note that both limits are significantly more protective than the 100 mrem Nevada standard applied to industrial, research and medical users of nuclear material in that state.

Our detailed comments are enclosed. These comments are in three parts:

1. Answers to the "Specific Questions for Public Comment" posed in Section IV of the proposal;
2. Views on the alternatives provided in the proposal (§197.25 and §197.37); and
3. Specific comments on the language of the proposed rule.

The Nuclear Energy Institute would like to establish a dialogue with the EPA on our significant concerns with the Part 197 rulemaking, and we would be pleased to address any questions the agency may have on our response. If you have any questions or wish to discuss this matter, please do not hesitate to contact me.

Sincerely,


Steven P. Kraft

Enclosure

cc: The Honorable Carol Browner, Administrator, EPA
The Honorable Robert Perciasepe, Asst. Administrator for Air and Radiation, EPA
Mr. Stephen Page, Director, Office of Radiation and Indoor Air, EPA

The Honorable Jacob Lew, Director, OMB

The Honorable Richard A. Meserve, Chairman, NRC
The Honorable Greta J. Dicus, Commissioner, NRC
The Honorable Nils J. Diaz, Commissioner, NRC
The Honorable Edward McGaffigan Jr., Commissioner, NRC
The Honorable Jeffrey S. Merrifield, Commissioner, NRC
Dr. William Travers, Executive Director for Operations, NRC
Dr. Carl Papariello, Deputy Executive Director of Materials, Research and State Programs, NRC

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Mr. William Kane, Director, Nuclear Material Safety and Safeguards, NRC
Mr. John Greeves, Director of the Division of Waste Management, NRC

The Honorable Jared Cohen, Chairman, NWTRB
Dr. William Barnard, Executive Director, NWTRB

Dr. John Garrick, Chairman, ACNW
Mr. Richard Major, Chief, Nuclear Waste Branch, ACNW

The Honorable Ivan Itkin, Director, OCRWM, DOE
Mr. Lake H. Barrett, Deputy Director, OCRWM, DOE

ENCLOSURE

NUCLEAR ENERGY INSTITUTE (NEI)
COMMENTS ON PROPOSED 40 CFR PART 197

Environmental Radiation Protection Standards for Yucca Mountain, Nevada

I. NEI response to EPA's "Specific Questions for Public Comment" posed in the notice

1. *The NAS recommended that we base the individual-protection standard upon risk. Consistent with this recommendation and the statutory language of the EnPA, we are proposing a standard in terms of annual CEDE incurred by individuals. Is our rationale for this aspect of our proposal reasonable?*

NEI response: A risk-based individual dose standard represents an appropriate implementation of the NAS recommendation that a limit on risk to individuals should be established. This is consistent with the statutory language of the Energy Policy Act of 1992 (EnPA), which directed EPA to "prescribe the maximum annual effective dose equivalent". Although this approach stops short of expressing the limit in terms of the probability of an adverse health effect, as recommended by NAS, there exist sound and established public policy reasons for applying dose as a proxy for risk. The dose proxy approach is more likely to be understood by the public and is consistent with the existing approaches for limiting radiological risk from nuclear activities. Furthermore, NAS itself noted the currently accepted direct link between individual dose and health risk in their report to EPA. Demonstration of compliance with the proposed dose limit through a probabilistic performance assessment will provide reasonable assurance that the overall health risk objective is met via this approach.

2. *We are proposing an annual limit of 150 μ Sv (15 mrem) CEDE to protect the RMEI and the general public from releases from waste disposed of in the Yucca Mountain disposal system. Is our proposed standard reasonable to protect both individuals and the general public?*

NEI response: No. 25 mrem would represent a more appropriate level at which to set the radiation limit for individual members of the public for the following reasons:

- A 25 mrem annual limit represents a conservative measure to assure that "above background" annual radiation exposures to the public in the vicinity of Yucca Mountain are maintained below the internationally accepted radiation protection threshold of 100 mrem.
- It is consistent with existing regulations covering spent fuel storage (10 CFR Part 72) and low-level radioactive waste disposal (10 CFR Part 61)

- It represents a level of protection 4 times more restrictive than what the State of Nevada affords its own citizens from other manmade source of radiation (Nevada has adopted a 100 mrem safety standard for industrial, research, and medical users of nuclear materials in that state).
- Given that 25 mrem is already a conservative fraction of an already conservative overall objective (100 mrem is well below both background and levels at which adverse health effects have been observed), any incremental benefit obtained by a further reduction of 10 mrem would be negligible. EPA has not provided any cost benefit analysis to support further reduction of the annual limit below 25 mrem.

We also note that, in directing EPA to prescribe an individual-protection standard, Congress asked NAS if such a standard would also be protective of the general public. The NAS responded in the affirmative stating that "a health-based individual standard will provide a reasonable standard for protection of the general public". ⁽¹⁾

3. *To define who should be protected by the proposed individual-protection standard, we are proposing to use an RMEI as the representative of the rural-residential CG. Is our approach reasonable? Would it be more useful to have DOE calculate the average dose occurring within the rural-residential CG rather than the RMEI dose?*

NEI response: The average member of the CG approach as proposed by the NRC in 10 CFR Part 63 would be more appropriate. This approach avoids conflicts in interpretation that may occur between what is "reasonable" and what is "maximal." It also represents a more balanced concept that will lead to more effective regulation. The vast majority of the scientific community supports NRC's proposal in this regard. The NRC proposal is also more consistent with the NAS recommendation. Accordingly, while EPA does need to address the question of who should be protected in specifying an individual protection standard, the details of how to do this (in terms of defining RMEI or, more preferably the CG characteristics) should be left to the NRC. Implementation of EPA's radiation protection standard is a role that has been assigned to the NRC by Congress.

4. *Is it reasonable to use RMEI parameter values based upon characteristics of the population currently located in proximity to Yucca Mountain? Should we promulgate specific parameter values in addition to specifying the exposure scenarios?*

NEI response: While we do not endorse the RMEI concept (see our response to question 3), we agree with the use of current population characteristics as the basis for evaluating radiation exposure scenarios. It would not be appropriate to require speculation about future populations as a basis for any repository licensing decision, as such characteristics can not be known with

any reliable degree of certainty. Specification of parameter values by EPA would be counterproductive to this purpose. Such prescription would remove the flexibility necessary to assure that current characteristics are interpreted and applied in the most appropriate manner. NRC, in its proposed rule (10 CFR Part 63) has taken appropriate steps to bound speculation

5. *Is it reasonable to consider, select, and hold constant today's known and assumed attributes of the biosphere for use in projecting radiation-related effects upon the public of releases from the Yucca Mountain disposal system?*

NEI response: Yes, there exists considerable support for this approach. The risks to future human generations due to disposal of radioactive waste should be limited to levels tolerated by present-day human society ⁽²⁾. It is only possible to determine if this general limit has been attained by making the assumption in the performance assessment that future individuals have the same behavior as those today ⁽³⁾. Finally, using present-day behavior similar to people currently living in the vicinity of the proposed repository has the advantage of providing additional confidence to the local community⁽⁴⁾.

6. *In determining the location of the RMEI, we considered three geographic sub-areas and their associated characteristics. Are there other reasonable methods or factors which we could use to change the conclusion we reached regarding the location of the RMEI? For example, should we require an assumption that for thousands of years into the future people will live only in the same locations that people do today? Please include your rationale for your suggestions.*

NEI response: This approach will support a fair and informed regulatory decision-making process while also providing for adequate protection of future generations (see our response to question 11 regarding protecting future generations). It is the goal of repository performance assessment to define models, based on today's knowledge, that can be applied to reasonably and conservatively protect future generations based on carefully selected assumptions, not to predict the lifestyles of future generations. The EPA's conclusion on the location of the target population does represent a reasonable and conservative assumption, and further supports specifying that future populations be assumed to live in the same locations as those living in the Yucca Mountain vicinity today. To do otherwise invites endless speculation that will not serve to enhance public health and safety.

7. *The NAS suggested using an NIR level to dismiss from consideration extremely low, incremental levels of dose to individuals when considering protection of the general public. For somewhat different reasons, we are proposing to rely upon the individual-protection standard to address protection of the general population. Is this approach reasonable in the case of Yucca Mountain? If not, what is an alternative, implementable method to address collective dose and the protection of the general population?*

NEI response: This question seems to indicate that EPA is misunderstanding the direction given to the agency by Congress. The EnPA directed EPA to prescribe an individual standard to protect the general public. The NAS subsequently confirmed that an individual standard would, indeed, protect the general population. The real issue is whether a population dose should be used for regulatory insight in the application of the proposed individual protection standard. Only if there is to be a population dose standard would one need to consider the NIR issue. While, this is not the case here, where an individual protection standard should be the sole quantitative standard to be applied, it is important to note that the specifics of the candidate facility at Yucca Mountain may warrant some qualitative or semi-quantitative (at most) consideration of local population dose or risk outside the context of this standard.

One of the original reasons why DOE, and subsequently Congress, selected the Yucca Mountain site for consideration was because it is in an arid region where the connection of the groundwater beneath Yucca Mountain to global scale water bodies is thought to be non-existent. Thus, the population that could theoretically be exposed to radionuclides released via groundwater at the candidate Yucca Mountain site is relatively limited. While we do not advocate a return to the use of release limits - as promulgated by EPA in 40 CFR Part 191 - as health effects to the general population,⁽⁵⁾ it seems appropriate that some qualitative 'indicator' be used to shed light on the effectiveness of Yucca Mountain in limiting population dose/risk. Such an approach is also supported by the general guidance in at least one set of national regulations on solid waste disposal.⁽⁶⁾ It is therefore useful to reflect on how the assumptions adopted as a basis for quantitative calculations for individual dose relate to such a distribution.

As a general rule, it can be anticipated that there will be a relatively small group who, because of their location in the immediate vicinity of the discharge and/or their habits, would receive greater exposures from any postulated future releases than the rest of the population. There may also be a somewhat larger group of people in the locality who would receive larger individual doses than those living farther away. Finally, the vast majority of the hypothetical population shall be expected to receive very little or no exposure.

Consideration of exposure groups other than just a 'critical' group (or RMEI as proposed by EPA) as a matter of regulatory insight is important for the Yucca Mountain system, because the likelihood of even a handful of individuals having all of the characteristics of the proposed group/individual is very small. The full combination of hypothetical assumptions that make these numbers very small are:

- The group/individual is located at the closest reasonable distance to the repository;
- The group/individual is located directly over the contaminant plume;
- The group/individual withdraws water from the highest concentration within that plume;
- The group/individual uses the contaminated water for all of their nutritional

- needs (i.e., irrigating crops and watering livestock, and using it for all drinking, cooking, and bathing); and
- The group/individual breathes the dust from the soil irrigated with the contaminated water.

With regard to the second bullet above, in the case of Yucca Mountain, contaminant plumes are likely to be rather confined with relatively little amount of spreading leading to dilution. Given the general probabilistic nature of the proposed regulation for Yucca Mountain, some consideration should be given to not only the critical group/RMEI dose, but also the likelihood that the critical group/RMEI represents even a handful of individuals.

Therefore, we recommend an approach that makes use of information on the local population dose distribution⁽⁷⁾. Such an approach not only provides information about the critical group/RMEI dose, but also puts such a dose in context by indicating the relative number of people receiving such a dose compared to doses received by the majority of the hypothetical local population. Such additional information would provide useful regulatory insight. By limiting the analysis only to the local population, the spirit of the NIR concept is preserved since it is not necessary to have to calculate minuscule theoretical doses to members of the global population living far away from Yucca Mountain. This also avoids having to specify a quantitative NIR value.

8. *Is our rationale for the period of compliance reasonable in light of the NAS recommendations?*

NEI response: Yes, on Page 56 of their report "Technical Bases for Yucca Mountain Standards" the NAS specifically stated that, "although the selection of a time period of applicability has scientific elements, it also has policy aspects that we have not addressed." Establishing sufficient regulatory certainty in order for a workable licensing process to proceed is an important policy issue. It is, in this case, necessary to limit the period of compliance to 10,000 years on policy grounds, in order to create an effective and implementable regulation.

The intent of the NAS recommendation can still be met by requiring DOE to evaluate repository performance beyond 10,000 years for the purpose of regulatory insight, as has been done by the NRC. While the longer term numbers (e.g. to peak dose) may not be meaningful from a strict, numerical compliance standpoint, they will still be useful in informing decision-makers. That is, to give decision makers confidence that a positive licensing decision based on a 10,000 year compliance period will not lead to unacceptable effects in the more distant future. However, it is important that the high level of uncertainty associated with such long range forecasting be balanced with even greater care in assuring the reasonableness of any assumptions made. The cumulative effect of even small amounts of excess liberalism or conservatism over such long time periods would be disproportionately large compared to the actual risks being evaluated. If not done carefully, a beyond 10,000 year analysis would merely serve as an exercise in speculative hyperbole,

not as useful information to regulators.

9. *Does our requirement that DOE and NRC determine compliance with § 197.20 based upon the mean of the distribution of the highest doses resulting from the performance assessment adequately address uncertainties associated with performance assessments?*

NEI response: Yes, however this is an implementation issue that is appropriately addressed by the NRC. In this context there may be additional criteria that can be specified that would bolster confidence in this approach, given the uncertainties involved. Accordingly, NEI has recommended to NRC that the performance objective in the proposed 10 CFR Part 63 should be restated to require that expected annual dose shall not exceed 25 mrem **and** the 95th percentile of the distribution shall not exceed 100 mrem⁽⁸⁾. This would provide additional confidence (beyond that gained by simply setting a conservatively lower limit on the mean) that the fundamental radiation protection objective (no more than 100 mrem above background) would be met.

The International Commission on Radiological Protection (ICRP),⁽⁹⁾ also suggests a constraint on health risk in a form such that successively higher estimated health risks are acceptable only if the probabilities of obtaining those higher health risks are successively lower. Our proposed revision to 10 CFR Part 63 was consistent with this philosophy. The recommendation made here is similar in approach to the risk-based approach in 40 CFR Part 191 and ICRP 46. However, we do not recommend the use of a complimentary cumulative distribution function (CCDF) to describe the complete uncertainty distribution of cumulative releases, as was done in 40 CFR Part 191, because uncertainties would be adequately addressed through limits on the mean and the 95th percentile of the distribution.

10. *Is the single-borehole scenario a reasonable approach to judge the resilience of the Yucca Mountain disposal system following human intrusion? Are there other reasonable scenarios which we should consider, for example, using the probability of drilling through a waste package based upon the area of the package versus the area of the repository footprint or drilling through an emplacement drift but not through a waste package? Why would your suggested scenario(s) be a better measure of the resilience of the Yucca Mountain disposal system than the proposed scenario?*

NEI response: Specifying potential scenarios for human intrusion is an implementation issue that falls completely within the NRC's authority. We recommend that EPA not make any requirements regarding what scenario(s) should be analyzed.

11. *Is it reasonable to expect that the risks to future generations be no greater than the risks judged acceptable today?*

NEI response: Yes, and a 25mrem all pathways standard without separate groundwater limits provides such assurances. This limit is conservatively low by today's standards and, by requiring that compliance be demonstrated far into the future, we are actually providing future generations with even greater protection. The reason for this is that numerous additional conservatisms will be built into the compliance analysis to compensate for future uncertainties. Therefore, the real risks to future generations are likely to be considerably less than what we expect and require them to be today.

12. *What approach is appropriate for modeling the ground water flow system down-gradient from Yucca Mountain at the scale (many kilometers to tens of kilometers) necessary for dose assessments given the inherent limitations of characterizing the area? Is it reasonable to assume that there will be some degree of mixing with uncontaminated ground water along the radionuclide travel paths from the repository?*

NEI response: In response to the first question, specifying requirements on how groundwater should be modeled represents an inappropriate level of subsystem detail to specify by standard. This would be counterproductive to repository safety (see our response to question 15). The choice of approach for modeling groundwater in repository performance assessment should be left up to DOE to decide, subject to NRC review and approval.

In response to the second question posed above and in the context of an all pathways standard, it is reasonable to assume there will be some degree of mixing along the travel paths.^{(10) (11)} However, this is again a matter that should be addressed by DOE and NRC in performance assessment and not be specified in this standard.

13. *Which approach for protecting ground water in the vicinity of Yucca Mountain is the most reasonable? Is there another approach which would be preferable and reasonably implementable? If so, please explain the approach, why it is preferable, and how it could be implemented.*

NEI response: As stated in response to question 15, an all pathways individual dose standard that includes the contribution to total dose from groundwater is the most reasonable approach for protecting groundwater as a pathway to protect people. If the people who drink, swim in, bathe in, wash their clothes in, and farm with the untreated groundwater can do all of these things without receiving an unacceptably high radiation dose, then it is safe to say that the groundwater as a resource for human use is protected.

14. Is the 10,000-year compliance period for protecting the RMEI and ground water reasonable or should we extend the period to the time of peak dose? If we extend it, how could NRC reasonably implement the standards while recognizing the nature of the uncertainties involved in projecting the performance of the disposal system over potentially extremely long periods?

NEI response: Yes, as far as EPA's individual protection standard is concerned*, 10,000 years strikes an appropriate balance between long term coverage and implementability. We believe that this length of time is at the outer limit for which reasonably meaningful quantitative estimates of future impact can be made. Longer term calculations should be conducted in order to responsibly address the hypothetical impacts on future generations even further out. However, the results of these calculations will carry too much uncertainty and should be used for regulatory insight only. Our position on this issue, with respect to the NAS recommendations, is further discussed in response to question 8.*

15. As noted by NAS, some countries have individual-protection limits higher than we have proposed. In addition, other Federal authorities have suggested higher individual-dose limits with no separate protection of ground water. Therefore, we request comment upon the use of an annual CEDE of 250 μ Sv (25 mrem) with no separate ground water protection, including the consistency of such a limit with our ground water protection policy.

NEI response: For the reasons explained above in our answer to question 2, a 25 mrem "all-pathways" individual annual dose limit is as effective at protecting public health and safety as a 15 mrem limit. Either limit would be more protective when applied in a single "all-pathways" standard than when combined with separate groundwater limits. Congress understood this when it directed EPA to promulgate an individual standards and only an individual standard in the 1992 EnPA. Separate groundwater protection limits, if promulgated, will have unintended adverse effects on the degree of public health and safety protection provided by this standard, while at the same time unnecessarily complicating DOE's compliance efforts. Such limits are in violation of the 1992 Energy Policy Act and contrary to the recommendations of the National Academy of Sciences. EPA must comply with the law and heed the overwhelming consensus of the scientific community by removing the unnecessary, counterproductive, and illegal groundwater provisions (§197.35 – §197.37) from the proposed standard.

A separate groundwater standard represents an improper application of public health and safety policy. The Energy Policy Act was enacted following nearly two decades of scientific research. Recognizing what science had already learned about geologic repositories and total systems performance assessment, Section 801 of the Act specifically directed EPA to:

* We oppose the promulgation of a separate groundwater standard noted in our response to Question 15.

“...promulgate, by rule, public health and safety standards for protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site. Such standards shall prescribe the maximum annual effective dose equivalent to individual members of the public from releases to the accessible environment...”

Congress further stipulated, in Section 801, that EPA’s individual dose limits, “shall be the only such standards applicable to the Yucca Mountain Site,” thereby specifically excluding from consideration groundwater contamination limits or any standard other than a dose standard. Additionally, Section 801 specified that the EPA standards shall be “based upon and consistent with the findings and recommendations of the National Academy of Sciences” (NAS). The NAS subsequently considered the possibility of a groundwater standard and chose to make “no such recommendation”⁽¹²⁾. The NAS also specifically cautioned against the use of subsystem performance requirements ⁽¹³⁾.

Even aside from the fact that Section 801 of the Energy Policy Act precludes it, there is no legal basis for application of the Safe Drinking Water Act (SDWA) in this instance. EPA admitted as much in 1993 when it declined to find the SDWA legally applicable to a “repository, either at the WIPP or elsewhere” ⁽¹⁴⁾.

EPA explains its decision to protect separately groundwater as a matter of groundwater protection policy without showing any additional benefit to public health and safety and without providing any cost benefit analysis. The agency has ignored the result of 3 decades of scientific inquiry leading to the conclusion that a health-or dose-based individual protection standard provides the best measure of geologic repository performance. In proposing a different measure, EPA is reopening debate about a policy choice that has already been made by Congress. EPA has neither the statutory authority, nor any stated scientific basis, for attempting through this rulemaking to come to a contrary conclusion.

EPA’s decision to protect separately groundwater as a matter of policy is not necessary for the goal of protecting public health and safety in three respects:

- A separate groundwater standard represents a sub-system performance requirement that, as concluded by the NAS, could result in a sub-optimal repository design – one that provides less protection for public health and safety. Sub-optimal design is the inevitable result of a deviation from a total systems approach to evaluating repository performance – one that carefully evaluates the collective contribution of all natural and engineered barriers to radiation release – to focus on intermediate parameters such as groundwater contamination. This singular focus detracts from the overall evaluation and forces the inclusion of unneeded design features to meet the sub-system objectives. These unneeded features impose additional risks and uncertainties on the overall system that adversely affect protectiveness of the repository as a whole. Evidence that this is, indeed, the case is found in DOE’s Draft Environmental Impact Statement (DEIS). The DEIS evaluated three different

repository designs, all of which met both proposed NRC and proposed EPA standards for overall health protection, and found that the designs that resulted in the lowest groundwater contamination levels actually resulted in higher overall radiation exposures. This was due to increased airborne exposure to naturally occurring Rn-222 in the designs calling for more repository tunnels (hence, more exposed rock surface from which radon could evolve) and increased ventilation (hence, increased release of radon from the tunnels) in order to reduce marginally radionuclide concentrations in groundwater. The design scenarios resulting in lower groundwater contamination also require more fuel handling operations, hence increasing worker exposures. Therefore, the net design effect that would result from efforts to comply with groundwater limits would be a reduction in long term, low probability groundwater contamination levels in trade for an increase in near term, certain, radiation exposures with no discernable difference in overall long term radiation exposures. Thus, the only substantial effect of such a standard would be to impose higher radiation exposures on current and immediately following generations by negatively impacting repository performance over the next 100 to 300 years (projected time frame of repository operations).

- Licensing a repository to a groundwater standard would be very difficult, because the proposed contaminant levels, while not more protective, are more restrictive. The proposed limits correlate to individual dose limits as low as 0.2 mrem via the groundwater pathway. Demonstrating that such unreasonably restrictive limits could be met would require considerably more analysis and design work. In addition to the fact that, as explained above, much of this design work would result in a less protective repository, this would certainly make the repository more expensive. Furthermore, it could result in the repository being unable to obtain a license if this limit could not be met – even though public health and safety was shown to be adequately protected by the overall radiation dose results. Either case would have adverse consequences to public health and safety. DOE's DEIS documents the potentially significant public health and safety consequences of hypothetical no action alternative where the fuel is simply left in place over the long term.
- A groundwater standard does not represent an objective measure of repository performance. An "all pathways" standard requires science to use the best available knowledge to evaluate comprehensively the health and safety effects of the proposed repository. In contrast, the proposed groundwater standard pre-selects arbitrary values for factors such as the representative volume for ground water, pumping rate, screened interval, health physics parameters, etc. rather than leaving these to be more appropriately addressed by DOE and NRC through the performance assessment and licensing process.

EPA seeks to justify groundwater protection requirements by stating a desire to prevent placing the burden upon future generations to decontaminate water by implementing expensive treatment procedures. First of all, if the use of groundwater could not lead to unacceptable overall exposures (see our response to

question 2), there is no real reason why future generations would need to decontaminate it. Secondly, EPA should note that unnecessary groundwater requirements could result in extreme costs to the current generation. Specifically, billions of dollars will have been spent characterizing and attempting to license Yucca Mountain for little or no public health and safety benefit - and perhaps even at a detriment to public health if the repository can not meet the groundwater standard.

16. *We are proposing to require, in the individual-protection standard, that DOE must project the disposal system's performance after 10,000 years. Are the specified uses of the projections appropriate and adequate?*

NEI response: Yes, as long as the purpose of any post-10,000 year performance assessment is used for regulatory insight only. Again, this is a matter that should be left for the implementing regulator - the NRC - to consider, including what weight should be given to such speculation. The EPA should make no such requirement.

II. NEI views on alternatives provided in the rule

Human Intrusion, What Standard must DOE meet (§ 197.25)

This is an implementation issue that should be left to the NRC. We have proposed an alternative approach to NRC that proposes NRC treat human intrusion in a manner analogous to the way pre-closure Category 2 design basis events are treated in proposed 10 CFR Part 63 (§ 63.111)⁽¹⁵⁾. In this approach there would be no attempt to assess the likelihood of human intrusion, but rather a straightforward consequence-only analysis that would be compared to a compliance limit more appropriate for a deterministic evaluation. This limit would be consistent with public exposure guidelines set in existing NRC regulations for other nuclear accident scenarios for which probabilities can not be estimated. This approach would also satisfy the NAS recommendations by more evenly equating the conditional risk of a deterministic human intrusion scenario with the probabilistic results of the overall performance assessment.

Groundwater Protection Standards, where is the point of compliance (§ 197.37)

As we have stated above in our response to question 15, separate groundwater protection standards are neither necessary nor appropriate for Yucca Mountain. In no event should any standard place any point of compliance no closer than assumed location of the critical group (or RMEI). It would be inconsistent and unreasonable to choose a different location for the critical group (those most at risk) yet assume the public drinking water supply that this group would use to be in a location even more at risk.

III. Specific Comments

- III On Page 46983, Column 1, EPA requests comment upon “how we should view and weigh the NAS findings and recommendations” and further asks “whether we have given proper consideration to the NAS’ findings and recommendations”

With respect to the first question, we do not agree with the statement made by EPA on page 46981 that characterizes the NAS report as a mere “starting point” for rulemaking. The NAS report should be viewed as the substantial basis for this rulemaking as was called for in Section 801 of the Energy Policy Act. Wherever NAS has made a definitive determination regarding the technical basis for the standard, EPA is bound to apply that determination in its rulemaking.

It is, however, apparent that there were a number of areas (such as time of compliance) where NAS conceded that there might be policy reasons for not following its technical recommendations and, hence, was not definitive. It is therefore appropriate that, in such instances, EPA can deviate from the NAS recommendations provided that there is a public health and safety policy reason for doing so. We also point out that any decision to depart from the NAS recommendations must be made with great care, as the NAS report – as well as the legislation that requested it – represented the culmination of two decades of worldwide scientific study of geologic repositories. The extensive knowledge that is behind the NAS report should not be dismissed lightly.

With respect to the second question, we find, in the majority of cases, that EPA has given proper consideration to the NAS findings and recommendations. However, in the case of whether or not to apply a separate groundwater standard, EPA has chosen to deviate from the NAS recommendations without sufficient reason for doing so and contrary to the EnPA’s specific instructions.

Section 801 of the Energy Policy Act specifically provided a prescription against separately protecting groundwater by directing EPA to promulgate standards that “prescribe the maximum annual effective dose equivalent to individual members of the public” as “the only such standards applicable to the Yucca Mountain site”. In the case of groundwater, EPA has departed from the NAS recommendations, not on public health and safety policy grounds, but by countermanding established public health and safety policy as codified by law. In other words, using the terminology stated on Page 46981, Column 3, of the proposal, EPA has been given no “discretionary decision-making authority” to promulgate a separate groundwater standard. Our response to question 15 outlines in detail the technical reasons why a

separate groundwater standard is not appropriate.

III.A On Page 46984, Column 1, EPA requests public comment on whether or not EPA should promulgate new standards for management and storage activities at the site. We agree with EPA that the EnPA does not provide for the development of such standards, and that application of Subpart A of 40 CFR Part 191 would not be inappropriate.

III.B.4 We agree with the statement on Page 46987, Column 1, that "it is appropriate to use many of the current characteristics of members of the public in the vicinity of Yucca Mountain in the compliance assessments required by these standards". EPA should also clarify that this also means that these "current characteristics" include those having to do with location. That is, assessments should assume people in the future live in the same locations as those present in the Yucca Mountain vicinity today. To allow different locations would invite endless speculation.

III.B.4 On Pages 46987 and 46988 EPA addresses the 'subsistence farmer' approach discussed in the NAS report. We recommend that, in doing so, some consideration should be made of the number of people who would likely have all the 'subsistence farmer' characteristics that have been included in EPA's proposed RMEI concept. That is, there will likely be only a handful of people who would obtain all potable water and grow all food using water withdrawn from the aquifer contaminated with radionuclides from the disposal system at the point of maximum concentration in the plume at the downstream position of interest. Thus, the 'subsistence farmer'/RMEI characteristics are probably well above the 99th percentile of individuals living downstream of Yucca Mountain (when the probability of the individual withdrawing water from the highest concentration in the plume is also taken into account). EPA notes that the RMEI concept should be at roughly the 90th percentile. Given the specifics of the Yucca Mountain system - minimal dilution of radionuclides in a relatively narrow plume due to the relative dryness of the site - lack of consideration of the number of people with 'subsistence farmer'/RMEI behavior will penalize these potentially positive characteristics of the candidate repository system at Yucca Mountain when Congress directed EPA to set Yucca Mountain site-specific standards.

In conclusion, the proposed RMEI concept forces DOE to assume the RMEI will withdraw water from the highest concentration in the plume without consideration of the likelihood. Forcing such an assumption neglects a very important site-specific aspect of the Yucca Mountain system.

III.B.4 On Page 46988, Column 3, EPA requests public comment on the alternative of adopting the 'critical group' (CG) approach rather than the RMEI. Adoption of the CG approach is much more appropriate and more consistent with the NAS report. Regarding EPA's further request for input on the level

of parameter detail that would be appropriate in specifying a CG, we endorse the CG approach proposed by the NRC in 10 CFR Part 63 as containing an appropriate level of detail.

III.B.4 We agree with EPA's comment on Page 46989 column 3 that "the likelihood of small or economically viable agricultural activities in this area [where groundwater is deep - ~300 meters] is questionable when the depth to the water table is taken into consideration." We support the logic for where the choice of the downstream location for the RMEI at Lathrop Wells. However, we would propose a CG at the same location defined by the NRC (as was done in proposed 10 CFR Part 63). Accordingly our answer to EPA's request on Page 46990, Column 2, for comment on whether or not to leave location determination up to the NRC is 'yes, this should be left to NRC'.

III.B.5 With respect to EPA's statement on Page 46991, Column 1, that a negligible incremental dose (NID) or risk (NIR) approach "is not appropriate in all circumstances" we point out that EPA's charge in this case is to promulgate a site-specific standard, not something appropriate "in all circumstances".

Also, we request clarification on EPA's reference to IAEA's recommendations regarding 'exempt practices' in this same column. The IAEA's recommendations concern the complete exemption of an entire practice. That is, IAEA would 'exempt' the practice *in its entirety* if even the RMEI received doses less than 1 mrem/yr. This is not at all what NAS was considering when they recommended adoption of a NIR approach. NAS was not recommending complete exemption. Rather, NAS was proposing limiting the extent of dose assessments to include only those hypothetical individuals who would have an individual risk greater than some floor value.

- III.B.5 On Page 46992, Column 3, EPA states, "We recommend that DOE calculate the collective dose without truncation and with full consideration of the appropriate factors." Such an approach would not be useful, would interfere with NRC's authority to determine how the standard is implemented, and would drive DOE to choose a more expensive design simply to reduce already insignificant individual dose contributors (e.g. C-14). In contrast, both ICRP⁽¹⁶⁾ and IAEA⁽¹⁷⁾ have advocated truncated population estimates. The point of doing the truncated population estimates is two-fold. It gives an estimate of how many people have an average dose in a certain range (which would show how few people would exhibit RMEI behavior), and some estimate of how large a population would receive something greater than an insignificant dose. It is unclear what a global population dose estimate would provide in terms of regulatory insight.
- III.B.6 On Page 46933, Column 1, EPA notes "that consideration should be given to changes in population near the location of the RMEI". This would be inconsistent with the approach taken elsewhere in the standard to limit speculation. Such speculation could easily become open-ended, leading to situations where one can always imagine "somebody" who might be even more exposed. Thus, such "consideration" should be avoided.
- III.B.7 On Page 96993, Column 2, EPA notes that calculations beyond 10,000 years would be used "to see if dramatic changes in the performance of the disposal system could be anticipated". First of all, this is an implementation issue that would be more appropriately addressed by the NRC. Secondly, "dramatic" is a subjective term not an established regulatory criteria. For example, the measure of "dramatic change" might be interpreted to mean a large increase in doses between 10,000 years and appearance of the peak, but still well below the intended risk limit. This would tend to penalize the best designs (those that hold releases to as close to zero for as long as possible). In such case, "dramatic" could characterize a change from several orders of magnitude below 15 mrem to only one order of magnitude below 15 mrem. Thus, we suggest that the final rule delete all references to the use of "dramatic" or other subjective measures.

- III.B.7 On Page 46996, Column 1, EPA provides good sound logic concerning why trying to model climate change results in the need for “potentially arbitrary assumptions” in support of the choice of a 10,000 year regulatory period. We support this position and have expressed similar rationale for limiting the regulatory period in our response to question 14.
- III.C.2 We generally agree with EPA’s views on expert elicitation expressed on Page 46997. However, setting guidelines in this area is an implementation issue that should be left up to the NRC. We therefore respond to EPA’s request for comment on whether it is appropriate for EPA to set such guidelines with a ‘no’ answer.
- III.D On Page 46998, Column 2, EPA requests comments on whether it is appropriate for EPA to establish assurance requirements. This is also an implementation issue that should be left up to the NRC. We therefore respond to this question with a ‘no’ answer.
- III.E On Page 46998, Column 3, EPA indicates that the human intrusion dose limit be used to “inform a qualitative judgment”. This statement in and of itself is contradictory. Efforts to demonstrate compliance with any quantitative dose limit would naturally override attempts to make a purely qualitative judgement. As stated above, with respect to the alternatives provided in § 197.25, we have proposed a different alternate approach to the NRC that would resolve this dilemma. We also note that ICRP Committee 4 is currently considering a similar approach. Again, this is an implementation issue that should, more appropriately, be addressed by the NRC.
- III.F On Page 47003, Column 2, EPA’s criterion that DOE assume the well, “is centered at the highest concentration in the plume of contamination at the point of compliance; and [the] pumping rate is set to produce an annual withdrawal at the point of compliance” interferes with NRC’s authority to determine how this standard is to be implemented and violates EPA’s own recommendation on Page 46998, Column 1 that states:

“Overestimating or underestimating the values of parameters, or ignoring the positive effects upon performance for other processes and parameters because they cannot be precisely estimated would essentially result in the performance assessments actually being analyses of extreme performance scenarios. These extreme assessments have a high probability of being unrealistic or of such low probability that they would not represent the range of likely performance for the disposal system”.

In other words, EPA is proposing to require DOE to assume the very same

type of "extreme scenario" as part of its groundwater protection standard that EPA recommends against elsewhere.

We also point out that attempting to specify detailed sub-system performance requirements by rule will inevitably result in inconsistencies in implementation of safety goals. This is an essential reason why every major scientific body, including the NAS, recommends against a separate groundwater protection standard. Our position on a separate groundwater standard is more completely discussed in response to question 15.

III.F EPA's requirement described on Page 47004, Column 1, that the MCLs include the natural contributions is inconsistent with the 15 mrem/yr individual dose limit, which represents an allowable *incremental* dose. Although we oppose the application of these MCLs to groundwater in general, we find it highly inappropriate to attempt to regulate natural sources of radiation through a standard specifically intended for a high level waste repository at Yucca Mountain. The legislatively established purpose of this standard is to limit the incremental risk due to the repository.

III.F.3 EPA's statement on Page 47007, Column 1 that, "we emphasize that all ground water pathways, including drinking water, are also covered under the proposed individual-protection standard" suggests that even EPA itself recognizes the redundancy of promulgating a separate groundwater standard. See our response to Question 15 for additional reasons why EPA should withdraw the groundwater provision from its proposal

III.F.4 On page 47007, Column 3, EPA states "The Yucca Mountain disposal system will contain all of these types of radionuclides. To express a regulatory limit for ground water protection in terms of a single limit on peak concentration may be impractical because of the separate, multiple, and distinct MCLs established by regulation". This further points to the unnecessary difficulties brought on by attempting to promulgate a separate groundwater standard. See our previous comments and our response to Question 15 for additional reasons why EPA should withdraw the groundwater provision from its proposal, and simply maintain an individual protection standard as directed by the EnPA (for which all radionuclides will be considered simultaneously).

§197.12 Definition of aquifer: EPA should specifically exclude perched water bodies from this definition. Given the limited availability of such formations and the abundance of water in the saturated zone, perched water would be of little value to future residents. Specific predictions about the location and characteristics of perched water would be difficult to make. It would not be meaningful to attempt to model perched water in any performance assessment. This comment also applies to the definition found in column 1 on page 47014.

§197.12 Definition of barrier: "...reduces the rate of movement of water or radionuclides from the Yucca Mountain *repository* or prevents release...". EPA should use "site" instead of "repository" since some geological features cannot be claimed as barriers then.

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