

11

From: "Budhi Sagar" <bsagar@swri.edu>
To: TWFN_DO.twf4_po(NAE,JPK,KIM,TJM3)
Date: Fri, May 14, 1999 6:54 PM
Subject: Fwd:Proposed rule for Yucca Mountain

DOCKETED

'99 MAY 24 P2:21

I think all of you know Mikael Jensen at SSI in Sweden. he has sent the attached unsolicited comments on Part 63. This is for your information.

OFFICE
ADJUTANT

Budhi

Forward Header

Subject: Proposed rule for Yucca Mountain
Author: <mikael.jensen@ssi.se >
Date: 5/7/99 11:02 AM

DOCKET NUMBER
PROPOSED RULE **PR 2,19,20 et al.**
(64FR8640)

Some personal thoughts on NRC's proposed rule for Yucca Mountain

Mikael

[[NRCPRO~1.DOC : 2060 i NRCPRO~1.DOC]]

Template = SECY-067

ACKNOWLEDGMENT
Acknowledged by  *Email* MAY 25 1999
SECY-02

Personal Comments on NRC's Proposed Rule for Yucca Mountain

Mikael Jensen, the Swedish Radiation Protection Institute, SSI, 171 16 STOCKHOLM, phone +46 8 72 97 239, fax +46 8 72 97 162, email: mikael.jensen@ssi.se

1 INTRODUCTION

Please regard this as informal comments from the author, not necessarily the comments SSI's would submit, if NRC should explicitly ask SSI for comments. Some of the comments may not be relevant, since the author is not sufficiently acquainted with the US regulatory system. Also it was written in haste to be available at the time of the discussion NRC may have after receiving the comments.

2 BACKGROUND

2.1 The mandate to the National Academy of Sciences.

The mandate to the US Academy of Sciences, NAS, is reproduced in the National Research Council's publication "Technical Basis for Yucca Mountain Standard".

The picture which evolves from the formulations in the mandate and NAS' subsequent work is that a general standard is proposed to be made for one repository only, and that this standard is not applicable to the rest of the US. The impression it creates to someone outside the US is that information has been given to (the US) Congress, making Congress to be concerned that the existing standard might exclude certain designs such as the one proposed by the DOE for a repository in Yucca Mountain.

In that case, it would seem natural to conclude that this circumstance reveals a flaw in the thinking in connection with design of the original standard. The natural action would have been to promulgate a new general standard, not to create a special standard for a certain repository. In the context of the Swedish legal system, the process above would be more similar to a license condition imposed on an activity covered in a preliminary license, obtained by the implementor to cover an introductory step.

In the Swedish legal verbiage (in my interpretation), we would consider the congress as having directed the government to grant a preliminary license, acting as an authority, to construct a repository with certain conditions imposed, and these conditions would be given in the Yucca Mountain standard.

2.2 The concept of a site

The congressional mandate refers to "a repository at the Yucca Mountain site" (NAS, p 141). It appears from the fact that the work has been going on that site for a considerable time, and from the National Research Council's further work, that both Congress and the National Research Council take "the Yucca Mountain site" to include "the current DOE proposed design, location, and content for a repository". For instance,

the possibility of exploiting very deep bore-holes at the same site is not mentioned. It appears that the Congress considered that the standard should give guidance for determining relevant conditions for a repository built along the lines of what the DOE had presented in a preliminary form, regarding perhaps such features as the precise location, the main characteristics of the barrier system etc.

3 POSSIBLE CHANGES OF THE STANDARD CAUSED BY EPA'S STANDARD

The standard includes a reference to a future EPA standard. Although it may be to someone more familiar with the roles of NRC and EPA, it is not clear to the author of these lines, what future changes an EPA standard would be able to induce in NRC's standard and what part is not expected to change, simply because some matters are supposedly already now within NRC's domain.

4 REGULATING CONSEQUENCES IN THE DISTANT FUTURE

Assuming, as Congress does, that the National Research Council's advice is accepted, what remains to be decided upon by the regulator?

Since the standard proposed by the NAS is expressed as a maximum individual dose expected to occur after closure, it is clear that the level of protection is related to doses received by individuals living in the future. The two main issues left are then related to i) the dose value chosen and ii) the choices of exposed individuals and their behavior in the local scale, the biosphere and its pathways, and the future global society and preconditions for environmental development.

There are a range of philosophical questions about the future that the proposed standard is not addressing, nor is there much guidance available from the NAS study. The NAS study concludes that there is no scientific basis for describing human intrusion thousands of years into the future. Still the standard assumes that persons will receive a dose, and a sequence of events can be described, leading to this dose being delivered. It follows by the same logic that there is no scientific basis for the individual dose calculations. In that case, what is gained by using a reference critical group? This assumption poses a number of questions about assumptions regarding the distant future.

In the current formulation of NRC's standard, including a series of alternative similar formulations referring to individuals or critical groups, the problem of "real people in the future" can never be completely avoided. It is closely related to what the standard claims to achieve. This is not very clear in the present formulation. The NAS study considered the endless speculation possible about the future for intrusions scenarios, but the choice of individual dose in the standard for the undisturbed case requires, humans to be present at the endpoint.

5 THE VALUE OF A FORMULATED EXPLICIT AND GENERAL GOAL

In order to review a standard, it is necessary to consider alternatives, and this requires that an objective is formulated on a higher level of abstraction, in order to see which formulation would serve the objective best. Such a formulation of a general goal would also be of great value for the proposed standard. It could be relatively simple and developed along the following lines:

We do not know the distant future in any respect, but we can design protection as it is used in society today. It is not an expression of neglect regarding the protection of individuals or society in the future. We simply acknowledge that we cannot know the society and we cannot know even (distant) future individual's need of protection, should it be different from our own. We can give them the best protection as it is seen today, using for example realistic but cautious assumptions. This is the purpose of our reference population, it is not a guess of what will be in the future.

This formulation removes the need for an elaborate description of the local, regional and global society in the future. However, the goal is not met by protecting people today from a hypothetical newly established repository. The evolution of the repository must be described. The scientific and engineering point of departure is could then be the thought experiment that a repository were created a number of years in the past, corresponding to the time in the future under consideration in a particular study. If a million year performance assessment is studied, then it must be assumed that repository were created a million years ago, if 10 000 year performance is studied then assume the repository was built 10 000 years ago, etc.

The above formulation avoids some speculation, but it would still be necessary to describe for instance the consequences of an earthquake. There is a far more solid scientific basis for describing what effects an earthquake might have had, than for describing future societies.

There is, both in NRC's standard and the NAS recommendations, no explicit formulation as to what the critical group choice is meant to imply in terms of protection. The subsistent farmer is probably seen as a conservative choice and it appears that both organizations postulate that if such an individual or group is protected then individuals are protected both today and in the future. However, there is no indication of the exact assumptions made. NRC is in a better position if it has an answer to this question before it is posed.

The standard is a long way from letting the proponent show compliance on the dose calculation details. The burden of proof which would otherwise be laid on the proponent is now on NRC. First, the critical group concept must be proved to be a good strategy. It must be remembered that it was not developed for the purpose NRC is using it. Secondly, the choice of the group and its characteristics must be defended.

6 THE CRITICAL GROUP

NRC acknowledges that the concept of critical group was constructed by ICRP as a tool to regulate existing releases, but still uses the concept for regulating post-closure repository performance.

The critical group is mentioned by ICRP in many publications, for instance in ICRP publication 46. Unfortunately, ICRP has given little guidance regarding events in the distant future. ICRP is also beginning to address some of the problems of the distant future as can be seen in the following text:

ICRP also reviewed a draft report on 'Radiological Protection Principles for the Disposal of Long-lived Solid Radioactive Waste'. This report will study existing recommendations on radiological protection in the context of long-lived waste (such as spent nuclear fuel). The advice in ICRP Publication 46 on this topic is still regarded as valid, but there is a need to consider its overall usefulness to decision-makers. The final report of the Task Group is expected to consider particularly potential exposures from long-lived wastes, protection objectives in the long-term, the weight to be given to future doses, and the application of optimization of protection. (Excerpt from the Annual Progress Report for 1998 of ICRP).

The ICRP explains that persons in the critical group may be real or hypothetical. A hypothetical group may be compared to a real group with respect to dose from a nuclear facility. Also, a hypothetical group may be described using existing real practices. A hypothetical group does not rely on speculation alone. It may, at any time, be verified or discarded, by practical investigations. Also, the choice of a group evens out the odd case of extremes.

However, for the calculation of the dose to a person in the distant future, there is no particular use of defining a group. It seems pointless to speculate about differences in individual behavior or habits in the far future, and for this reason there is no use for a group for which to calculate a mean dose. It could be meaningful to calculate over lifetime doses and perhaps to average over male/female risks for the same dose.

6.1 If the critical group is protected, who else is then protected?

The value of a goal is mentioned above. It would be valuable for NRC to explain the reasoning behind the choices of the critical group. The rationale in connection with existing releases is clear enough, but to maintain that if a critical group of farmers is protected then all future constellations of individuals are protected is dangerously close to an invitation of endless speculation that NRC wishes to avoid for human intrusion. According to the information given by NRC:

The Commission is proposing criteria at § 63.115 for identifying a critical group and reference biosphere that the Commission believes provide a reasonable basis for demonstrating compliance and that preclude unbounded speculation.

There is a wording that may be seen as a circular or at least a somewhat convoluted reasoning. A reference biosphere will obviously limit the speculation (about the biosphere), but here is the natural place for the argument mentioned above, giving the reasons why it may be a good basis for demonstrating compliance. The two obvious questions are: Why is it a good basis for demonstrating compliance, apart from not inviting to speculate, and if compliance were demonstrated, what goal would be met?

Another possibility, is a more generic option, currently discussed in SSI, is to regulate referring to maximum biosphere burdens to describe conditions that are favorable for humans to live in. It has not been discussed by the NAS, and it might not be reasonable to discuss it too much, given the assumption that the advice of NAS must be taken into account.

6.2 regulation methodology

The alternative would be to require that "cautious but reasonable assumptions", mentioned in page 8645, were made by the implementor. The disadvantage of the present formulation is that there may be a risk of a mistake in the assessment by NRC, so that for some reason a group at the chosen location might does not correspond to the highest dose, or "cautious but reasonable assumptions".

In order to avoid speculation, NRC has used the existing local society as a reference, and assumed a mean dose. At this point, there appear to be several possibilities, and NRC chooses a proscriptive one. The reference activity is taken to be that of a subsistence farmer in a precise location, 20 km from the repository.

There is a some ambiguity in the text describing the 20 km location on page 8645:

"The (regulator's choice of the) 20 km location (near Lathrop Wells) represent an informed assumption regarding the accessibility ..."

"Review of current well use information for Nevada suggests that irrigation constructed for water table depths greater than 150 m are rare. Because well cost is related to depth, it is economically preferable to establish irrigation wells in areas where the water table is near the surface"

The reader is here lead to assume that the 20 km location is a assumption of future accessibility of water, but perhaps also that this choice is an informed assumption about future or existing farmers' practices. It is mentioned on the same page that

Because current farming practices are concentrated in the Amargosa farms region (approximately 30 km south of Yucca Mountain), the 20 km critical group distance is considered reasonably conservative.

It is clear from this passage that the reference group is chosen to conservative in connection with assessing doses from present day farmers. Perhaps this is behind the phrase "present day knowledge of the habits and the characteristics of the local population" also on p 8645. The phase is open to another interpretation, that an assessment is made - contrary to all advice- of the future critical group's habits and characteristics, but this assessment uses present day knowledge as an assessment tool. Surely what is meant is "present day habits ..." and not somebody's knowledge of these objective conditions?

7 SUSTAINABLE DEVELOPMENT

The Swedish standard, takes into account as is explained in the background document that energy production may continue with a unchanged risk burden, that is that risk centers might be created through millennia, or rather that if it were the case, the Swedish repository would represent an intolerable risk anomaly. Suppose for the sake of argument that nuclear energy simply were perpetuated and every 50 years a repository was built. The process cannot be assumed to go on infinitely, it is necessary for obvious

reasons related to survival, that at some point a sustainable society was reached, perhaps in 1000 years.

A pessimistic version of this thinking would place all the waste in one repository, leading to the simple equation. 1000 years = 20 periods of 50 years each and producing the current risk load of the Yucca Mountain repository, and this would occur in Yucca Mountain. This would lead to a dose level 20 times lower than proposed by NRC all other things equal.

Another version would be to distribute the wastes, but it could lead to a regional risk pressure. This has been assumed as a background for the Swedish regulations.

Some of these issues may seem exotic, but the fact is that the issue of sustainability is mentioned recently by OECD/NEA as a concept of value to all member states for waste management.

8 COLLECTIVE DOSE

The old standard contained a provision for limitation of collective dose. The new does not. In the US therefore, there has been a jump from one extreme to the other. The collective dose has been given an unfortunate treatment in the recent process.

Using the collective dose value from EPA cited by NAS, 1.1×10^{-10} manSv/Bq it can be seen that the total content of carbon-14 in the Yucca Mountain repository corresponds to the collective dose from the Chernobyl accident - about 0.5 MmanSv - (delivered over a much longer time period because of the longer half-life of carbon-14). It is therefore worth a discussion. It should be kept in mind that extremely low doses (or dose-rates) such as 0.01 mSv/year (1 mrem/year) does not exist. Everything adds up and the mean dose in Sweden for example is about 4 mSv/y (400 mrem/year).

If every country had all its energy produced by nuclear and all waste emitted all its carbon-14, there would be a considerable build-up in 1000 years leading to a rising mean global individual dose. The build-up of the global mean dose has been taken as a basis for the Swedish regulation for nuclear power plants to limit the collective dose to 5 manSv/year per installed GW. This will (assuming 10kW/inhabitant and a partition value of 10 to allow for other sources, 10 kW of energy production/capita and individual dose limited to 0.1 mSv implies under equilibrium 1 GW corresponding to 10 manSv, of which 5 manSv is assumed to be attributed to mining) ensure, if followed by all, a limitation to a yearly mean global dose rate below 1 mSv/year.

The Swedish nuclear waste regulations are general and cover all "final management" including hypothetical methods like transmutations, which might release a large amount of carbon-14. The collective dose from early releases must be calculated, and it is likely that a large hypothetical release of carbon-14 before 10 000 years would have a role in the decision-making. In the Yucca Mountain concept, the canister failure may be calculated with some degree of credibility, and it is a natural option that the expected release of carbon-14 is taken into account at least qualitatively. There has been an

improvement of the barriers in Yucca Mountain and author understands that there is a possibility that DOE's design may actually meet the old criteria.

8.1 Regulating linear dose response

Observe that the concern over a high global mean individual dose, makes it less relevant to speculate over negligible doses. Note also that even if there were a threshold for dose effects, it would be necessary to divide responsibilities between those responsible for the sources to ensure that effective efforts to prevent an addition of doses sooner or later would exceed the threshold (risk-sharing). Otherwise the last small release would be responsible for a large effect occurring just above the threshold.

9 THE PROSCRIPTIVE REGULATION OF THE CRITICAL GROUP

Two circumstances are worth mentioning, i) the conservatism in the group and ii) the pathways within the community.

NRC is maintaining that the choice of a farming community is a conservative choice compared to the existing farming community. This can only make sense if the conservatism is prevailing throughout the dose calculations. There is no point in conservatism in one issue while some other issue is determined by a choice that would underestimate the dose. It is therefore a crucial issue to determine, and for NRC to defend, the conservatism in the assumption that the farming community consumes or 'captures' the plume in its entirety, considering the dilution involved in this process relative to other alternatives. The assumption that the whole plume is captured is coupled to assumptions regarding consumption patterns, so that the larger community would perhaps be more likely to be able to grow all the locally consumed food, with a larger variety of products etc.

The "water demand" of a larger group seems to indicate a larger demand than a smaller group in the center of the plume, and perhaps also a larger dilution. The conservatism in the assumed "undiluted" consumption must be balanced against the less conservative assumption of diluted water for drinking and irrigation.

Another issue is the build-up of contaminants within the farming community. It must be shown that a build-up during perhaps 1 000 or 10 000 years of contaminants does not lead to another population group being exposed to a higher dose than the chosen critical group. For this reason it would be natural for NRC to know about the possible streams of contaminants, for instance the present waste streams from Amargosa valley.

10 THE COMPLIANCE PERIOD

The compliance period is determined by NRC partially by formal, legal considerations. Also, some scientific reasons are given. In Sweden SSI has made a first milestone out of the first thousand years. From a point of view of jurisprudence, this period is the maximum period normally overviewed in legal contexts. Unbounded speculation is in principle possible, but not more than for other areas in society. For longer periods, SSI considers that the dose received in a dose assessment is giving valuable information about the barrier system. It is then treated as a safety indicator and the qualitative

requirements from SSI are that the repository is constructed using "best available technology" meaning as robust as reasonably possible. The regulation of this issue is mainly done by another authority, the Swedish Nuclear Power Inspectorate.

The NAS recommended that the compliance period should include the time of maximum dose. This was deemed to be after 10 000 years. This assumption was made by NAS because they assumed some of the features already proposed by DOE.

A possible conclusion of NRC's 10 000 year compliance period, in accordance with international guidance, regarding uranium mill tailings, from ICRP and IAEA, is to consider the source to be released from regulatory control. In this case the dose limit should be expected to be lower than the intervention level of 10-100 mSv (1 to 10 rem).

11 HUMAN INTRUSION

SSI has required a specification of human intrusion similar to NRC's requirements. In the first, preliminary version of SSI's standard, SSI stated that no measures were allowed to be taken, to protect the repository from intrusion and/or access so that the repository's protective function was lowered. It was pointed out in the review period that since SSI has a numerical safety goal, the safety should be allowed to be lowered, as long as the main goal was met. In the present formulation, it is simply stated that any measure taken in connection with a possible future access or prevention of intrusion in mind, should be reported.