



**INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH**

6935 Laurel Avenue, Suite 201  
Takoma Park, MD 20912

Phone: (301) 270-5500  
FAX: (301) 270-3029  
e-mail: [ieer@ieer.org](mailto:ieer@ieer.org)  
<http://www.ieer.org>

**IEER Comments on the Nuclear Regulatory Commission's Regulatory Basis and Preliminary Rule Language Regarding Low-Level Waste Disposal (10 CFR Part 61; Docket NRC-2011-0012)<sup>1</sup>**

Arjun Makhijani  
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These are initial comments of the Institute for Energy and Environmental Research (IEER) on NRC docket NRC-2011-012, including two documents cited below in Footnote 1.

1. The time allowed for comments – one month, including the Christmas and New Year's holidays – is unreasonably short, especially given the fact that the deadline for comments on the waste confidence rule scoping comments was January 2, 2013. IEER reserves the right to make future additional comments or more detailed comments at a later date but before February 7, 2013.
2. I have made a number of comments formally and informally on elements of NRC 2011 on many occasions, including at the invitation of the NRC staff. By-and-large, the proposed revisions ignore essentials of my comments at best. The NRC has ignored sound science and common sense in many aspects of the proposed rule.
3. The proposed rule revisions constitute a major federal action. For instance, they would potentially allow large amounts of long-lived radionuclides, including hundreds of thousands of tons of depleted uranium from enrichment plants and possibly even wastes currently defined as Greater-than-Class-C waste, to be disposed of in shallow land facilities. It is therefore incumbent on the NRC to prepare an Environmental Impact Statement on the proposed revisions, setting forth and analyzing reasonable alternatives as well as a no-action alternative.

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<sup>1</sup> U.S. Nuclear Regulatory Commission, "10 CFR Part 61 [NRC-2011-0012] RIN 3150-AI92, Low-Level Waste Disposal," *Federal Register* v.77, no.236 (December 7, 2012), pages 72997-72998, on the Web at <http://www.regulations.gov/#!documentDetail;D=NRC-2011-0012-0044>, hereafter NRC FR Proposed Rule 2012; and *November 2012 Preliminary Rule Language for Proposed Revisions to Low-Level Waste Disposal Requirements (10 CFR Part 61)*, Nuclear Regulatory Commission, November 2011, on the Web at <http://www.regulations.gov/#!documentDetail;D=NRC-2011-0012-0045>, hereafter NRC 2011.

4. I provided comments to NRC Chairman Macfarlane on a variety of issues in a memorandum to her dated November 14, 2012.<sup>2</sup> The comments on 10 CFR 61 are incorporated here by reference except that on one point, a method for setting limits on total quantities of radionuclides, they are amended somewhat and amplified here. On this one point, the present comments should be taken into account.
5. A definition of the term “member of the public” should be provided in the rule. It should explicitly include people of all ages, including infants and children, and including males as well as females. Annual dose compliance should be explicitly assessed to the member of the public who is estimated to get the largest dose according to this definition.
6. The proposed revised language of 10 CFR 61.41 (the proposed 10 CFR 61.41(a)) drops organ doses altogether from the rule. This is unacceptable; it would cause a massive relaxation of allowable pollution and organ doses from many radionuclides including all actinides, strontium-90, and various radioiodines. The language of the present 10 CFR 61.41 – “Concentrations of radioactive material which may be released to the general environment in ground water, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public” should be retained with the explicit clarification that “any member of the public” includes males and females of all ages, including male and female infants and children. Generally guidance for the rule and for compliance assessment and enforcement should explicitly reference the Executive Order on Children (Executive Order 13045 at [http://energy.gov/sites/prod/files/nepapub/nepa\\_documents/RedDont/Req-EO13045childenvtlhealth.pdf](http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/Req-EO13045childenvtlhealth.pdf) )
7. External dose compliance calculations should take into account that children are smaller and hence their various organs are closer to the ground (and hence to contamination that is present on the ground). These organs include their reproductive organs. This is especially important for female children.
8. The proposed language of 10 CFR 61.41a does not specify what guidance document will be used for dose calculations. It should specify that the EPA’s current guidance – Federal Guidance Report 13 – will be used. At present FGR 13 does not contain separate dose conversion factors<sup>3</sup> for males and females. Therefore, the rule should also specify that when the EPA publishes separate dose conversion factors for males and females that they will be automatically incorporated into compliance assessment.
9. Ten thousand years as a compliance period is both too short and too long. It is too short because some radioactive materials have half-lives that are far longer. For instance, the half-life of uranium-238, the main constituent of depleted uranium, is over 4.4 billion years. Its specific activity grows over hundreds of thousands of years due to the growth of progeny (uranium-234, thorium-230, and radium-226). The proposed rule is unacceptably vague about the protection of the public for long periods, including periods beyond the 10,000 years period to which explicit compliance with 10 CFR 61.41 is proposed to be limited. For instance, the proposed 10 CFR 61.13(e) simply says that

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<sup>2</sup> Arjun Makhijani (IEER) to Dr. Allison Macfarlane (Chair, NRC), Subject: Some notes and references regarding our meeting on November 13, 2012. (November 14, 2012), on the Web at <http://ieer.org/resource/letters/follow-up-memo-to-nrc-chair>.

<sup>3</sup> Dose conversion factors for internal dose convert an intake (inhalation or ingestion) of a unit of radioactivity of a particular radionuclide into an organ dose.

long-term radiological impact analysis will be required only if there are wastes exceeding Class A limits (by reference to Table 1 in 10 CFR 61.55) “or if necessitated by site-specific factors including engineering design, operational practices, and site characteristics.” This language does not specify what factors would trigger such a special analysis. Nor does it state that if long-lived radionuclides (according to the NRC’s proposed definition) are present, that such an analysis would be required.

10. At the same time, 10,000 years is a very long-time for analysis of performance of shallow land systems. Ice ages can occur and have occurred on time scales that are similar. Severe climate disruption due to warming is already occurring, according to the best available scientific evidence and analysis. The NRC’s own invited experts to the 2009 depleted uranium workshop considered 10,000 years far too long for reasonable modeling of shallow land facilities. Specifically, Peter Burns, a geochemist, stated “I was **particularly amused** by the climatic divisions, none of which can be relied on, even perhaps at 1,000 but certainly not in 10,000 or 100,000 [years]. As an example, I am a geoscientist. **So I have this rare ability to see into the far distant past.** (Laughter.) And I know, for example, that Death Valley was filled with about 1,000 feet of water 10,000 years ago. And that tells you how much the climate can change in the arid regions.”<sup>4</sup> The NRC has ignored this advice and the underlying science. No scientifically sound calculation for shallow land disposal can be done over such a long period without uncertainties that would be huge – potentially involving several orders of magnitude of uncertainty in the dose. The proposed 10 CFR 61.13 would require that “uncertainties” be taken into account (at (a)(6)) in providing the “reasonable assurance” of compliance. But it provides no clue as to how climate disruption would be taken into account. Indeed, the word “climate” does not even appear in the proposed text, let alone a definition of climate change or climate disruption. The language regarding uncertainties in the proposed 10 CFR 61 is clearly *pro forma*; as it currently stands it would have little scientific connection to the real world even over a few hundred years, let alone 10,000 years.
11. The rule should acknowledge that the risks from disposal of long-lived radionuclides, like plutonium-239 or the constituents of depleted uranium over time in shallow land facilities, are too uncertain to be accurately modeled. It would be unacceptable to dispose of large amounts of long-lived radionuclides or long-lived radionuclides in high-concentrations in shallow land facilities. This means that depleted uranium from enrichment plants, recycled uranium, and other such waste streams that resemble Greater-than-Class-C waste or transuranic waste should be banned from shallow land facilities and be explicitly designated for deep disposal without exception and without any loopholes allowing for special exceptions or permits.
12. It is acknowledged here that wastes containing mainly short-lived radionuclides cannot exclude every iota of long-lived material. This is the reason for having concentration limits. The current GTCC limits should be maintained. Depleted uranium and recycled uranium (whether depleted or not), large amounts of thorium-232 and other similar materials should be added to the GTCC list. Long-lived radionuclides should be defined

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<sup>4</sup> U.S. Nuclear Regulatory Commission, *Public Workshop 1 on Unique Waste Streams - Depleted Uranium*, September 2, 2009, Bethesda, Maryland, on the Web at <http://www.nrc.gov/about-nrc/regulatory/rulemaking/potential-rulemaking/uw-streams/workshop-1-transcripts-day1.pdf>, pp. 94-95. Emphasis added.

as those having half-lives of more than 10 years, which is compatible with an institutional control period of 100 years (ten half-lives). The definition of long-lived radionuclides in the proposed rule at 61.2 is far too expansive in the context of shallow land burial.

13. Total curie limits are needed in addition to the present GTCC concentration definition in 10 CFR 61.55, and the proposed additions to that definition in paragraph 12 above. For instance, Class C waste containing less than a hundred curies of carbon-14 (half-life 5,730 years), even under the current Class C concentration limits, can pollute groundwater (at least at Hanford) to levels exceeding safe drinking water standards as well as the 10 CFR 61 dose limits. This was the result as estimated by the Department of Energy's calculations for the reactor graphite disposal at the Hanford site.<sup>5</sup> Hundreds of curies disposed of in similar conditions would violate the present 10 CFR 61.41 without violating Class C concentration limits.
14. The above considerations indicate that a method must be found to protect the public based on the current 10 CFR 61.41 (modified to explicitly include all members of the public, including males and females of all ages) without crossing the boundary of scientific reasonableness and common sense. As can be seen from paragraph 13 above, the current rule does not do that. The proposed rule would, overall, make the problem a lot worse.
15. I proposed one way to limit the total amount of long-lived radioactivity in a waste disposal facility in my memorandum to Chairman Macfarlane of November 14, 2012. I stated: "One way to set these limits could be to examine a hypothetical worst-case pulse release of the entire inventory of long-lived radionuclides into the environment in various ways immediately after the end of the period of performance. The limits for long-lived radionuclides could be set so that the dose criteria would not be exceeded with any combination of long-lived radionuclides or release modes. This could allow upper curie limits to be derived in a scientifically reasonable way that would also ensure compliance with dose criteria." This is a reasonable approach for radionuclides, such as carbon-14, that do not have build up of decay progeny, such as uranium-238. In the latter case, the peak inventory should be assumed to be released instantly. For instance, the inventory could be assumed to be exposed to the surface instantly for external dose assessment, from radium-226. Or a mixture of uranium-238 and its progeny could be assumed to be deposited in groundwater instantly. This would not be modeling in the conventional sense of choosing parameters such as erosion for the long-term. It would be a heuristic calculation that would indicate maximum conceivable dose at the end of the compliance period without involving methods that are technically indefensible for periods of thousands of years. The goal would be to assure protection of the public according to the same standards we expect for ourselves today. Wastes exceeding the concentrations **or**

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<sup>5</sup> The DOE calculated that disposing of 37,000 curies of carbon-14 on the Central Plateau would cause a contamination of 1.3 million picocuries per liter, or 650 times the drinking water limit of 2,000 picocuries per liter. See Attachment 3, pages 13 and 14 in Comments on *Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington* (DOE/EIS-0391), by the Yakama Nation Environmental Restoration and Waste Management (ERWM) Program and the Institute for Energy and Environmental Research. (March 18, 2010), on the Web [http://ieer.org/wp/wp-content/uploads/2012/05/Tanks-Hanford-EIS-Comments-2010-YakamaNation\\_with\\_IEER.pdf](http://ieer.org/wp/wp-content/uploads/2012/05/Tanks-Hanford-EIS-Comments-2010-YakamaNation_with_IEER.pdf). Assuming the same concentration and environmental conditions, a total source term of 57 curies would produce contamination to the drinking water limit. Adding pathways other than drinking water would of course add to the dose.

quantities as discussed above should be slated for deep geologic disposal, as is the case for DOE transuranic waste.

16. The proposed “intruder” dose limit of 500 millirem per year is unacceptably high. There is no moral rationale for allowing doses to future generations beyond 500 years, the proposed period of barrier life after which “intruders” could come into the site unrestricted, to be greater than those for those of the present public or the public in the coming decades. The proposed limit is five times bigger than the 10 CFR 20 limit for members of the public from *all sources* of man-made radioactivity (except medical). Intruder doses should be limited to the same doses as for the present and immediate future. Only the method of calculating them after the formal modeling performance period would change.
17. With the above provisos, *and only with the above provisos*, the compliance calculations done by formal modeling such as by the use of RESRAD or similar approaches, can be limited to 500 years. This would be a reasonable period since the NRC would limit for the durability of intruder barriers is 500 years. If the NRC does not adopt total radionuclide and concentration limits as above and the calculation methods for long-term public health protection along the lines suggested above, then the present language of 10 CFR 61, which does not have a time limit of compliance, should be maintained. This would not be a very good result but greatly preferable to the proposed changes in NRC 2011.
18. The revised rule should address how the NRC is going to assure the scientific soundness of the modeling. It should also create a process for making corrections of errors if and when they occur in licensing-related technical documents along with license amendments as needed such cases. I have pointed out the problem of some specific egregious errors and their persistence over many years in a number of forums, including in my memorandum to Chairman Macfarlane. Please refer to that document for more detail as well as references. It is important for the NRC to have a formal external, independent review procedure in done through blind contracts awarded from an escrow fund not controlled by the industry or by the NRC. The NRC should also have a procedure for promptly addressing technical errors pointed out by the public as part of the rule and for making the needed corrections should they be verified. Verification calculations should be published promptly.