Health Physics Society Webinars
Nuclear Executive Orders with Focus on LNT
(Comments Submitted to HPS and NCRP)

HPS and NCRP are commended for hosting the twin webinars on the recent Trump Administration Executive Orders aimed at re-invigorating the U.S. nuclear energy industry. HPS and NCRP requested comments on the material presented and the subsequent discussions. The following are comments and observations on the linear no-threshold (LNT) issue.

1. Reinvigorating the US Nuclear Energy Industry

The Administration's objective is admirable, though the means are questionable. It is interesting that the Biden Administration proposed the same objective in November 2024, immediately after its election loss.[1] We should be heartened that finally the US appears to have a bi-partisan objective to expand nuclear energy as a primary source of the nation's baseline power supply.

2. Radiation Paranoia

Of course, we all know the various reasons that the nuclear industry has been in a slump for the last 45 years. The major reason why the anti-nuclear energy advocates have been so effective is the general radiation paranoia that has permeated much of western society for the last 80 years, since the exploding of the first (and only) atomic bombs in warfare. The initial praiseworthy "ban-the-bomb" protests of the 1950s and 1960s quickly morphed into opposition to nuclear energy. This radiation paranoia has been exacerbated by the linear no-threshold (LNT) theory of radiation risk that enables activists to repeat their favorite mantra *"there is no safe level of radiation exposure."* The LNT model and the associated ALARA process are rightfully primary targets of one of the Executive Orders, "Ordering the Reform of the Nuclear Regulatory Commission."[2]

3. Risk vs Dose?

It is however myopic of the Trump Administration to target the NRC in its attack on LNT. The NRC, at its roots, is a dose-based regulatory agency. In contrast, it is the EPA, and specifically the

[1] White House, "Safely And Responsibly Expanding U.S. Nuclear Energy: Deployment Targets And A Framework For Action." November 2024.
https://philrutherford.com/US_Nuclear_Energy/US-Nuclear-Energy-Deployment-Framework.pdf

[2] White House, "Ordering the Reform of the Nuclear Regulatory Commission." May 23, 2025.
https://www.whitehouse.gov/presidential-actions/2025/05/ordering-the-reform-of-the-nuclear-regulatory-commission/

Superfund arm of EPA, which has mandated that "safety" be assessed in terms of "hypothetical risk" rather than "radiation dose." In EPA's own words, *"Superfund is **NOT** a dose-based program."*

4. 15 mrem/y vs 25 mrem/y?

EPA's disdain for dose, and preference for risk, was not always the case. In 1994, the EPA issued a draft regulation for public comment, 40 CFR 196, "EPA Radiation Site Cleanup Regulation" in which it proposed a soil cleanup standard based on 15 mrem/y for a residential land use.[3,4] EPA provided a technical support document to justify the selection of 15 mrem/y.[5] The 40 CFR 196 technical support document formed the basis of demonstrating that a 1-in-1,000,000 risk-based cleanup for agricultural (family farm) land use is technically infeasible.[6]

40 CFR 196 was ultimately withdrawn. Perhaps those current and past EPA members of HPS and NCRP who were decision makers at the time, would care to elaborate on the political reasons for 40 CFR 196 being withdrawn?

At around the same time, NRC was developing its cleanup standard based on 25 mrem/y plus ALARA, that would ultimately become 10 CFR 20.1402, Subpart E, "License Termination Rule."[7] This led to a protracted battle between EPA and NRC over what standard was appropriate and what standard was safer.

Numerically, 15 mrem/y is certainly less than 25 mrem/y. But does it achieve a significant amount of additional safety? EPA, whose CERCLA regulations define an "acceptable risk range" of 10^{-6} to 10^{-4} (range of a factor of 100) argues that 15 mrem/y was safe and 25 mrem/y was unsafe, two similar numbers with a range of only 20 +/- 5 mrem/y, or +/- 25%.

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[3] EPA, 40 CFR 196 (Draft), "Environmental Protection Agency Radiation Site Cleanup Regulation." 1994.
https://philrutherford.com/Radiation_Cleanup_Standards/Draft_40_CFR_196.pdf

[4] EPA, 40 CFR 196 (Draft), "Environmental Protection Agency Radiation Site Cleanup Regulation - Notice of Proposed Rulemaking (NPRM)." 1994.
https://philrutherford.com/Radiation_Cleanup_Standards/Draft_40_CFR_196_NPRM.pdf

[5] EPA, EPA-402-R-96-011 (Draft), "Radiation Site Cleanup Regulations - Technical Support Document for the Development of Radionuclide Cleanup Levels for Soil." September 26, 1994.
https://philrutherford.com/Radiation_Cleanup_Standards/402-R-96-011A.pdf

[6] Boeing, "Technical Feasibility of Detecting Radionuclide Contamination in Soil at a 10^{-6} Risk Level for Agricultural Land Use." March 6, 2007.
https://www.philrutherford.com/SSFL/Cleanup_Standards/Technical_Feasibility_Rev_A.pdf

[7] NRC, 10 CFR 20.1402, Subpart E, "Radiological Criteria for Unrestricted Use."
https://www.nrc.gov/reading-rm/doc-collections/cfr/part020/part020-1402.html

OSWER 9200-4-18 argued that 15 mrem/y (equivalent to a risk of $3x10^{-4}$) was equally protective as the upper end of the CERCLA acceptable risk range of 10^{-4}, a factor of 3 times lower, but that 25 mrem/y (equivalent to a risk of $5x10^{-4}$) was unacceptable. [8]

5. Linear No-Threshold (LNT) Theory

In 2005, BEIR VII assessed an individual lifetime cancer incidence risk of ~0.01 resulting from an exposure of 10 rem.[9] Using this correlation and the LNT model at low dose levels, the individual risk for a 30-year exposure duration at the NRC 25 mrem/y standard would be 0.00075. The equivalent individual risk for a 30-year exposure duration at the draft EPA 15 mrem/y standard would be 0.00045. The equivalent individual cancer incidence risk for an 85-year lifetime of exposure to the average US background radiation of 300 mrem/y would be 0.0255 (or 2.55%).

Why isn't the EPA and medical community warning the US public of this major cause of cancer from background radiation, which will eventually kill 4.4 million of Americans who are alive today?[10] Perhaps it is because the EPA does not really believe the inconvenient consequences of a religious belief in LNT? Perhaps EPA does not wish Jeff Bezos to get any richer selling lead-lined overcoats?

In comparison, the notorious EPA CERCLA individual risk "point of departure" of 0.000001 (10^{-6} or one-in-a million) would be equivalent to a dose-based standard of 0.033 mrem/y for a 30-year exposure duration, a factor of ~1,000 times less than the NRC License Termination Rule and a factor of ~10,000 times less than the average US background radiation exposure. 0.033 mrem/y is equivalent to 0.0038 microR/hr or ~2,600 times less than typical background exposure rates of 10 microR/hr.

Clearly EPA regulations requiring an LNT-based, 1-in-1,000,000 risk goal are meaningless and impractical to implement.

[8] EPA, OSWER No. 9200-4-18, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination." August 22,1997.
https://philrutherford.com/Radiation_Cleanup_Standards/OSWER_9200-4-18.pdf

[9] BEIR VII, "Health Risks from Exposure to Low levels of Ionizing Radiation." June 2005.
https://philrutherford.com/Radiation_Risk/11340rb.pdf

[10] 347,000,000 (U.S. population) x 0.0255 x 0.5 = 4.4 million

6. Nonsensical Consequences of LNT

EPA LNT modeling of radiation risk is replete with nonsensical anecdotal calculations. In 2010, a presentation was made at the HPS Annual Midyear Meeting, entitled "Radiation Risks in Everyday Life",[11] illustrating some of this foolishness ...

- The additional lifetime risk from 30-year exposure to cosmic radiation increases by 1-in-1,000,000 between one's feet and one's head.
- The additional lifetime risk from drinking less than half a teaspoon of orange juice each day for 30 years is 1-in-1,000,000.
- The additional lifetime fatal risk from driving one extra mile per year for 30 years is 1-in-1,000,000.

During the webinars, one commentator observed that drinking excessive quantities of water can kill you, but we do not worry about drinking water in smaller quantities. Explaining the concepts of LNT, individual risk, cumulative risk, and population risk, to a lay person can be difficult. However, it can be simplified using the following anecdote.

- Alcohol is a known poison. Medical opinion says that if you drink 30 shots of 80 proof alcohol at a party you will die if you do not get an immediate stomach pump. Using EPA's LNT model the individual fatal risk of a single shot would be 1/30 or 0.03. Three shots, the fatal risk would be 0.1 or 10%. That may be enough to persuade some of us to give up alcohol. However the cumulative risk aspect of LNT would mean that drinking one shot per day for one month would also kill you. If that appears unrealistic, then consider the following. The population risk aspect of LNT means that if 30 people at the same party drank one shot each, then 29 would be unaffected but one would die. Again, that appears to be unrealistic.
- Of course, the analogy is imperfect since radiation cancer risk is probabilistic, but alcohol poisoning risk is deterministic. However, it illustrates the illogicality of stochastic models to a lay person perfectly.

7. As Low As Reasonably Achievable (ALARA) - Cost Benefit Analysis

Much was said in the webinars about problems associated with the implementation of ALARA (as low as reasonably achievable). ALARA is a numerical process, not a numerical goal, and definitely not zero. What is reasonable to one person may not be reasonable to another person. NUREG-1727, "Decommissioning Standard Review Plan", Appendix D (ALARA)[12] demonstrates via

[11] Rutherford, "Radiation Risks in Everyday Life." Presented at the 2010 Health Physics Society Midyear Meeting, January 27, 2010. https://philrutherford.com/Conf_Papers/Radiation_Risks_in_Everyday_Life_Rev_1A.pdf

[12] NRC, NUREG-1727, "NMSS Decommissioning Standard Review Plan, Appendix D, ALARA Analysis." September 2000.
https://www.nrc.gov/docs/ML0037/ML003761169.pdf#page=433

quantitative cost benefit analysis that the NRC License Termination Rule of 25 mrem/y is already ALARA.

Excavating additional soil to achieve lower contaminant concentrations in order to increase person-rem averted by miniscule amounts would not be cost-beneficial. Additional real workplace injuries and transportation/traffic injuries/fatalities incurred would far exceed theoretical radiation induced fatalities averted.

Cost benefit analysis using the NUREG-1727 methodology was performed at the Santa Susana Field Laboratory in 2007.[13] Two radiological remedial projects were shown to effectively save one theoretical fatal cancer at a cost of $1.5 billion and $5 billion. These figures significantly exceeded the US Government's value of a statistical life (VSL) of $5.5 million in 1999 dollars.[14]

[13] Rutherford, "Radiation Risk and Cleanup Standards." Presented at the 2007 Health Physics Society Midyear Topical Meeting on Decontamination, Decommissioning and Environmental Cleanup. January 23, 2007.
Paper -
https://www.philrutherford.com/Conf_Papers/Radiation_Risk_%26_Cleanup_Standards_Rev_3_Short_Paper.pdf
Presentation -
https://www.philrutherford.com/Conf_Papers/Radiation_Risk_%26_Cleanup_Standards_Rev_1_Presentation.pdf

[14] EPA, "Value of Statistical Life Analysis and Environmental Policy: A White Paper." April 21, 2004.
https://www.epa.gov/sites/default/files/2017-12/documents/ee-0483_all.pdf