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A "Gold Standard of Science": Revisiting the Complex Ties Between Federal Power and Science Policy

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ABSTRACT

This paper examines the Trump administration's 2025 executive orders aimed at reforming the Nuclear Regulatory Commission (NRC) to accelerate the expansion of nuclear power in the United States. Framed as a strategy to bolster national energy independence and meet the growing demands of data centers and artificial intelligence, the reforms revive longstanding debates about radiation safety standards, particularly the linear no-threshold model. While the administration claims to uphold scientific rigor, critics argue that the orders politicize science by favoring contested threshold-based models and sidelining concerns about low-dose radiation exposure. Such policies, they warn, could have direct consequences for public health and radiation safety, affecting not only the nuclear industry but society at large. The paper contextualizes these developments within the broader historical evolution of radiation protection standards. It argues that debates over radiation protection have always extended well beyond academic circles. They have carried profound implications for public health policy, regulatory standards, and environmental justice, while have often been historically shaped by the priorities of the nuclear industry. In addition, President Trump's recent executive orders exercise power through nuclear science and technology in ways that fall short of democratic ideals—particularly the aspiration for meaningful public participation in decision-making processes that directly influence human health and shape radiation protection policies.

Keywords: federal government, nuclear science, linear no-threshold model, science policy, nuclear industry

Introduction

In May 2025 President Donald Trump issued four executive orders that aim to reform the National Regulatory Commission (NRC) in order to quadrable nuclear power by 2050. Framing the initiative in geopolitical terms, the administration argued that "nuclear energy can liberate America from dependence on geopolitical rivals."[1-2] Beyond geopolitical strategy, the reforms are also driven by the growing energy demands of artificial intelligence and the rising power consumption of data centers. Thus, at the heart of the White House's executive orders has been the stagnation of the U.S. nuclear industry.

Although during the Cold War, the United States experienced a dramatic expansion of nuclear energy, since then, progress has slowed down. Between 1954 and 1978, the NRC authorized the construction of 133 civilian reactors at 81 power plants. Yet, in the nearly five decades that followed, the Commission approved only a handful of new reactors and only two have made it to commercial operation. As President Trump argues "the NRC has instead tried to insulate Americans from the most remote risks without appropriate regard for the severe domestic and geopolitical costs of such risk aversion."[1]

Critics have pointed out that President Trump's executive orders have reignited the longstanding debate over how much radiation is considered safe and whether small doses had proportional effects on human health. As a *Science* article points out 'To boost nuclear power, Trump orders controversial rewrite of radiation safety rules."[3] The president's goal is to restructure the NRC to accelerate the approval process for new nuclear reactors while downplaying the health risks associated with radiation exposure. Loosening current radiation exposure standards and abandoning the 1975 ALARA (as low as reasonably achievable) principle is expected to pave the way for the revitalization of the American nuclear industry.

These policies have found strong support from Edward Calabrese, an American toxicologist and outspoken critic of the linear no-threshold (LNT) model. Notably, his rejection of the LNT model has gained traction within the U.S. health physics community.[4] However, Jan Beyea—a senior scientist with over four decades of experience assessing the risks of low-level radiation—has recently mounted a serious challenge to Calabrese's assertions about threshold behavior, reigniting the long-standing debate over whether a safe limit of radiation exposure exists. At the same time, Beyea strongly questioned the role of the U.S. Health Physics Society, which had uncritically embraced Calabrese's position: "As a *Health Physics Journal* author and reviewer, I am concerned for the Health Physics Society (HPS) when people I respect, including two former presidents and Society staff members, embrace the scientific misconduct theories of Edward Calabrese, a critic of the linear no-threshold model, without any acknowledgement of the criticisms that have been published about his claims."[5-6]

In the midst of a scientific debate over radiation protection standards and a theoretical explanatory model for the effects of radiation on human bodies, President Trump's recent executive orders claim to uphold "a gold standard for science." They promise that federally funded research will be "transparent, rigorous, and impactful," even as the White House steers federal agencies toward a particular scientific stance. But as David Michaels and Wendy Wagner argue in *The Atlantic* "In practice, however, it gives political appointees—most of whom are not scientists —the authority to define scientific integrity, and then decide which evidence counts and how it should be interpreted."[7]

Here I argue, that indeed debates over radiation protection extend well beyond academic circles. They carry profound implications for public health policy, regulatory standards, and environmental justice, while have often been historically shaped by the priorities of the nuclear industry.[8] But in addition, I claim that President Trump's executive orders exercise power through nuclear science and technology in ways that fall short of democratic ideals—particularly the aspiration for meaningful public participation in decision-making processes that directly influence human health and shape radiation protection policies.[9-10] In what follows I briefly explore the history of the liner no-threshold model in radiation safety from the early 1930s to its establishment in the early 1960s.

The history of the linear no-threshold (LNT) model in radiation safety

In 1931, the League of Nations Health Organization commissioned the German physician and physicist Hermann Wintz—then Director of the University Gynecological Clinic and Röntgen Institute in Erlangen—to survey national radiation protection measures. His review showed that detailed regulations were already in place or under development in Austria, Czechoslovakia, Denmark, Britain, Germany, Greece, Hungary, the Soviet Union, Sweden, and Switzerland.[11] This wave of regulatory activity was likely spurred by developments at the Second International Congress of Radiology, held in Stockholm in 1928, where the Physics Section successfully promoted the adoption of simplified and abridged international radiation protection recommendations.

The momentum continued in 1931 when the International X-ray and Radium Protection Committee (IXRPC), what became later known as International Commission on Radiological Protection (ICRP), reconvened in Paris during the Third International Congress of Radiology. There, the Committee introduced several significant updates to the international guidelines, including extending the recommended X-ray shielding thicknesses to cover higher voltages. That same year, when a British physician criticized the international guidelines as "too strict", both physicists and physicians in attendance defended the recommendations, arguing that they were fully consistent with the accepted tolerance dose, a standard recommended in 1925 by the American physicist Arthur Mutscheller.[12-13]

Indeed, debates over whether radiation standards are "too strict" or "too lax" have persisted since the early 1930s. The extensive research conducted during World War II as part of the Manhattan Project led to the establishment of both radiation protection standards and a theoretical framework for understanding radiation exposure across the full spectrum of doses—from low to extreme ones.[8,14]

The establishment of the linear no-threshold dose-response model and its broad acceptance by regulatory bodies and the scientific community unfolded over the course of a decade. Its scientific foundation was laid in the late 1920s by geneticist Hermann Joseph Muller, whose research on radiation-induced genetic mutations challenged prevailing assumptions about safe exposure levels.[15-19] In the late 1940s Gioacchino Failla, who led the National Council on Radiation Protection and Measurements (NCRP) subcommittee on permissible dose from external radiation sources, presented his preliminary report at several conferences in England.[20-21] As Lauriston Taylor later recalled "It was not until 1949 that the first clear statement describing a permissible occupational exposure was developed by the National Committee on Radiation Protection (NCRP) and a year later was adopted, with some refinements in language, by the International Commission on Radiological Protection (ICRP)."[22-23] A review of the proceedings from the Chalk River Conference, held in Canada in September 1949 and organized by the United States, the United Kingdom, and Canada, reveals also that a majority vote supported the adoption of the non-threshold radiation model in establishing tolerance doses for radioactive isotopes.[24]

The model gained institutional traction in the fall of 1954, when the NCRP based on Failla's earlier report, issued a key recommendation through the National Bureau of Standards' handbook series—advocating the replacement of the term "tolerance dose" with "permissible dose," a shift that reflected growing recognition that no level of radiation exposure could be assumed entirely risk-free.[25-26] By 1956 concerns about the genetic impact of radiation gained renewed urgency because of nuclear weapons testing and the possible effects of the worldwide fallout. First, the British Medical Research Council, and later the U.S. National Academy of Sciences, touched on the topic. In response, both the ICRP and the NCRP recommended lowering the permissible dose to the gonads of radiation workers. This approach implied a linear relationship between radiation dose and genetic mutations, as well as the potential for somatic effects in humans even at low doses delivered over extended periods. In other words, if high doses produce effects proportional to the amount of radiation, the same principle was assumed to apply to low doses—suggesting that no level of exposure could be considered entirely risk-free. Justifying this claim required empirical data specifically related to low-dose radiation exposure.

In 1957, Edward B. Lewis, a biologist at the California Institute of Technology, published an article in *Science* on the induction of leukemia in humans by ionizing radiation. He drew on data from four main sources: survivors of the atomic bombings in Japan—the principal epidemiological basis for radiation studies throughout the Cold War; patients who received therapeutic X-ray treatments for ankylosing spondylitis, a chronic inflammatory disease, primarily between the 1930s and 1950s; infants irradiated from the 1920s to the 1950s for presumed thymic enlargement—a misdiagnosis based on the belief that a visibly large thymus posed a threat to breathing or development; and radiologists, who, as health physicists had already recognized, showed elevated rates of leukemia. Lewis concluded that "these data provide no evidence for a threshold dose for the induction of leukemia."[27]

Opposing the linear theory for cancer, a year later Austin Brues, Director of Biological and Medical Research at Argonne National Laboratory published a critical study.[28] At the time, Brues served also on the Atomic Bomb Casualty Commission (ABCC), a group of experts put together by the United States Secretary of War to study the effects of the atomic bomb on Hiroshima and Nagasaki survivors.[29] As he argued "Present data on human leukemogenesis by radiation indicate that a nonlinear relation is more probable."[28] Brues represented also the US in the scientific committee that provided data to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). The 1958 UNSCEAR report made clear that "the effects following exposure to relatively large doses are well known, whereas the effects of small doses are not understood nearly as well."[30] Yet, it did not rule out the non-threshold option.

At very low levels of radiation exposure—below the point where immediate functional or structural damage is observable—the UNSCEAR report argued, the body's responses become subtle and difficult to measure, often emerging only after long periods of time. In such cases, establishing clear thresholds for harm is extremely challenging, and for certain long-delayed effects, "it is uncertain whether they exist."[30] Eventually, as Ronald Kathren argues, concerns over the long-term effects of low-level radiation played a significant role in shaping the 1962 treaty that banned atmospheric nuclear weapons testing.[13] By then, however, nuclear tests had already inflicted severe damage on human health and the environment. According to the 2006 UNSCEAR report, thyroid cancer—particularly papillary thyroid cancer—has been the most significant health consequence of these tests, primarily due to exposure to the radionuclide iodine-131.[31-32]

Conclusion

In September 1987 *The Economist* published a cover story titled "Radiation Complacency".[36] The article accused the ICRP of being overly permissive in its exposure limits, suggesting that such leniency endangered public health. Although the charge was not unprecedented, the ICRP chose not to respond—perhaps out of fatigue with longstanding controversy or confidence in its scientific authority.[14,33] As Samuel Walker and Thomas Wellock have argued,

> *"The nuclear industry and materials licensees often asserted that regulatory requirements were too burdensome, too inflexible, and too strict. On*

> *the other hand, nuclear critics frequently lamented that regulatory requirements were too lax, too sympathetic to industry concerns, and too inattentive to public safety."*[34]

Both the Nuclear Regulatory Commission (NRC) and its predecessor, the Atomic Energy Commission (AEC), faced the persistent challenge of navigating between effective oversight and regulatory excess concerning nuclear power plants.[29] This tension has not been unique to the United States. Around the world, nuclear regulators have operated within a complex landscape shaped by political pressure, scientific uncertainty, and widespread public concern. In the aftermath of the Fukushima disaster in 2011, reporting in *Spiegel International*, Gordula Meyer argued that “the ties between the government and the nuclear industry have become so intertwined that public safety is at threat. Inspections are too lax, and anyone who criticizes the status quo can find themselves out of a job.” The article appeared under the striking title “Japan’s Nuclear Cartel.”[35-36]

The persistent entanglement of political interests and regulatory decisions has recently come to the front in the United States. The current US administration has framed nuclear energy as key to American energy independence and ordered a restructuring of the NRC. This policy shift raises serious concerns about efforts to lower radiation protection measures and facilitate the development of the nuclear industry at the expense of human health. Overall, government efforts to define scientific integrity have as a result to discredit established models like LNT, exert ideological control over research priorities, undermine academic freedom, privilege short-term industrial goals over broader societal and ethical considerations, and erode the foundations of democratic oversight in science policy.

Conflicts of interest:

The author has no conflicts of interest to declare.

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References:

[1] The White House. *Ordering the reform of the Nuclear Regulatory Commission*. Published May 23, 2025. Accessed July 23, 2025. https://www.whitehouse.gov/presidential-actions/2025/05/ordering-the-reform-of-the-nuclear-regulatory-commission/

[2] For an informative summary of the executive orders see: Office of Nuclear Energy, *9 key takeaways from President Trump's executive orders on nuclear energy*. US Department of Energy. Published June 10, 2025. Accessed July 23, 2025. https://www.energy.gov/ne/articles/9-key-takeaways-president-trumps-executive-orders-nuclear-energy

[3] Brown T. To boost nuclear power, Trump orders controversial rewrite of radiation safety rules. *Science*. Published May 29, 2025. https://www.science.org/content/article/boost-nuclear-power-trump-orders-controversial-rewrite-radiation-safety-rules. Accessed July 23, 2025.

[4] On Calabrese's work see for example: Calabrese EJ. The linear no-threshold (LNT) dose response model: A comprehensive assessment of its historical and scientific foundations. *Chem Biol Interact.* 2019; 301:6-25. doi:10.1016/j.cbi.2018.11.020

[5] Beyea J. False and misleading claims of scientific misconduct in early research into radiation dose-response: Part 1. Overlooking key historical text. *Health Phys.* 2025;128(6):507-523. doi:10.1097/HP.0000000000001932; Beyea has strongly criticized Calabrese's claims also in Beyea J. Response to, "On the origins of the linear no-threshold (LNT) dogma by means of untruths, artful dodges and blind faith.". Environ Res. 2016 Jul; 148: 527-534. doi: 10.1016/j.envres.2016.01.039.

[6] In 2018 the US House Science, Space, and Technology Committee passed a bill to revitalize low-dose radiation research, see: Beyea J. A better direction for low-dose radiation research. *Bulletin of the Atomic Scientists*. Published February 12, 2018. Accessed July 23, 2025. https://thebulletin.org/2018/02/a-better-direction-for-low-dose-radiation-research/

[7] Michaels D, Wagner W. Trump's 'gold standard' for science manufactures doubt. *The Atlantic*. Published July 20, 2025. Accessed July 23, 2025. https://www.theatlantic.com/science/archive/2025/07/trumps-gold-standard-doubt-science/683590/

[8] For an extended presentation of this argument see Rentetzi M. The politics of radiation protection. *NTM*. 2022;30:125–135; Rentetzi M. Creager A. and Lindee S. *Negotiating Radiation Protection in the Nuclear Age*, Pittsburgh University Press; 2025.

[9] See for example: Dalton RJ. *Critical Masses: Citizens, Nuclear Weapons Production, and Environmental Destruction in the United States and Russia*. MIT Press; 1999.

[10] McClanahan AS. *Zimmer: The Movement That Defeated a Nuclear Power Plant.* University Press of Kentucky; 2025.

[11] Serwer DP. *The Rise of Radiation Protection: Science, Medicine and Technology in Society, 1896–1935*. Informal Report. BNLL 22279. United States Energy Research and Development Administration; 1976.

[12] Cantril ST, Parker HM. *The Tolerance Dose*. Report MDDC-1100. Argonne National Laboratory, United States Atomic Energy Commission; 1945.

[13] Kathren R. Pathway to a paradigm: The linear no-threshold dose-response model in historical context. *Health Phys*. 1996;70(5):621–626.

[14] Patil K, Rentetzi M. Too Strict or Too Lax? IAEA and the Evolution of Nuclear Safety Standards. In: Rentetzi M, Creager A, Lindee S, eds. *Negotiating Radiation Protection in the Nuclear Age*. University of Pittsburgh Press; 2025:pp. 242-274.

[15] Campos L. *Radium and the Secret of Life*. University of Chicago Press; 2015.

[16] Carlson EA. *Genes, Radiation, and Society: The Life and Work of H. J. Muller*. Cornell University Press; 1981.

[17] Hamblin JD. 'A dispassionate and objective effort:' Negotiating the first study on the biological effects of atomic radiation. *J Hist Biol*. 2007;40(1): 147–177.

[18] Lindee S. Performing Anger: H. J. Muller, James V. Neel, and Radiation Risk. In: Gausemeier B, Müller-Wille S, Ramsden E, eds. *Human Heredity in the Twentieth Century*. Pickering and Chatto; 2014:205–216.

[19] Although not being historians of science, Edward Calabrese and James Giordano have discredited Muller's work, see: Calabrese E, Giordano J. Muller letter reveals scientific scandal that discredits evidence used to support LNT. *Chem Biol Interact*. 2023;386:1–5. doi:10.1016/j.cbi.2023.110787; Their claim has been strongly undermined by Jan Beyea, see reference 4 above.

[20] On Failla's early work see: Rentetzi M. *Seduced by Radium: How Industry Transformed Science in the American Marketplace*. University of Pittsburgh Press; 2022.

[21] On Failla's later post-WWII work see: Clarke RH, Valentin J. The History of ICRP and the evolution of its policies. *Ann ICRP*. 2009;39(1):75–110. doi:10.1016/j.icrp.2009.07.009

[22] Taylor L. Judgment in achieving protection against radiation. *IAEA Bull*. 1980;22(1):15–22.

[23] On Lauriston Taylor see: Dimitrokali M, Rentetzi M. Lauriston Taylor: The radiation protection man. *Med Res Arch*. 2025;13(5). https://doi.org/10.18103/mra.v13i5.6453. Accessed July 23, 2025.

[24] Minutes of the Permissible Doses Conference held at Chalk River, Canada, September 29–30, 1949. R.M.-10. p. 13. Accessed July 23, 2025. https://www.orau.org/health-physics-museum/files/library/warren1949_permissible_dose_conference_tripartite_conference.pdf

[25] National Committee on Radiation Protection. *Permissible Doses from External Sources of Ionizing Radiation*. Handbook 59. Washington, DC: US Department of Commerce, National Bureau of Standards; September 24, 1954

[26] Inkret W, Meinhold C, Taschner J. Radiation and Risk—A Hard Look at the Data. *Los Alamos Sci*. 1995;23:116–123. Accessed July 23, 2025. https://fas.org/sgp/othergov/doe/lanl/pubs/00326631.pdf

[27] Lewis E. Leukemia and ionizing radiation. *Science*. 1957;125(3255):965–972. doi:10.1126/science.125.3255.965. He was awarded, jointly, the Nobel Prize in Physiology or Medicine in 1995.

[28] Brues A. Critique of the linear theory of carcinogenesis. *Science*. 1958;128(3326):693–699. doi:10.1126/science.128.3326.693

[29] On the challenges that the AEC faced concerning the controversies around radiation safety see: Hacker B. Radiation safety, the AEC, and nuclear weapons testing. *Public Historian*. 1992;14:31–53. doi:10.2307/3378439

[30] United Nations. *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation*. General Assembly, Official Records, Thirteenth Session, Supplement no. 17 (A/3838). New York: United Nations; 1958:28-29. Accessed July 23, 2025. https://www.unscear.org/unscear/en/publications/1958.html

[31] Prăvălie R. Nuclear weapons tests and environmental consequences: a global perspective. Ambio. 2014 Oct;43(6):729-44. doi: 10.1007/s13280-014-0491-1.

[32] United Nations. *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation*. Report to the General Assembly with Scientific Annexes, Annex A - Epidemiological studies of radiation and cancer, New York: United Nations; 2008. Accessed August 10, 2025. https://www.unscear.org/unscear/en/publications/2006_1.html

[33] The Economist. Radiation complacency: The limits set for exposure to radiation are far too lax. *The Economist*. Published September 12, 1987.

[34] Walker S, Wellock TR. *A Short History of Nuclear Regulation, 1946–2009*. United States Nuclear Regulatory Commission; 2010:80.

[35] Myer C. Japan's nuclear cartel: Atomic industry too close to government for comfort. *Spiegel*

International. Published 2011. https://www.spiegel.de/international/world/japan-s-nuclear-cartel-atomic-industry-too-close-to-government-for-comfort-a-764907.html. Accessed July 23, 2025.

[36] Hecht G. Nuclear janitors: Contract workers at the Fukushima reactors and beyond. *Asia-Pac J*. 2013;11(1):2. https://apjjf.org/2013/11/1/gabrielle-hecht/3880/article. Accessed July 23, 2025.