Rebuttal to Dan Hirsch's Presentation to the NRC Meeting on Executive Order 14300 Section 5(b)

Phil Rutherford

Presentation to
NRC Meeting on Executive Order 14300 Section 5(b)

Implications of Weakening Radiation Protection Standards

by Daniel Hirsch

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16 July 2025

No matter which side of the nuclear debate we find ourselves on, we were shocked and saddened by the untimely death of Daniel Hirsch on July 19, 2025, three days after his presentation to the NRC.

The following commentary on Dan's presentation to the NRC is not meant to denigrate the departed, but to acknowledge a worthy adversary and continue a debate in which he excelled.

The Dirty Little Secret of the Nuclear Executive Order

It could result in allowing radiation exposures to the public 100 to 1000 times higher than permitted today.

Radiation at those levels is estimated to cause cancer in 4 out of 5 people exposed

Slide 2

- Dan’s written and oral pronouncements are always full of outrage and hyperbole
- Inspection of the following pages will show that his claims are incorrect

Executive Order 14300 Issued 23 May 2025

"The NRC utilizes safety models that posit there is no safe threshold of radiation exposure and that harm is directly proportional to the amount of exposure. Those models lack sound scientific basis and produce irrational results, such as requiring that nuclear plants protect against radiation below naturally occurring levels."

https://www.whitehouse.gov/presidential-actions/2025/05/ordering-the-reform-of-the-nuclear-regulatory-commission/

Slide 3

- The EO 14300 citation, *"requiring that nuclear plants protect against radiation below naturally occurring levels"* could be interpreted in two ways …
  - **gross** NRC radiation protection limits are below background levels - incorrect
  - **net** NRC radiation protection limits are below background levels - correct
- All **net** dose (or risk) limits are, of course, always incremental **above** natural background levels, therefore by definition, **gross** dose limits can never be below background
- However, the criticism on slides 3 and 8 intentionally misinterprets EO 14300
- The **net magnitude** of NRC environmental dose limits (100 mrem/y at facility boundary, 25 mrem/y license termination rule) and EPA environmental dose limits (10 mrem/y airborne, 4 mrem/y drinking water) are indeed all less than U.S. average background exposure of 300 mrem/y
- Both sides often intentionally obfuscate the distinction between **net and gross**

The EO Thus Flies in the Face of More Than Half a Century of Findings by the National Academy of Sciences and Virtually All Other International Scientific Bodies

Slide 4

- The LNT model of hypothetical radiation risk at low doses has, for decades, been chosen as a simple, expedient, politically correct, but overly conservative model
- All scientific progress is founded upon re-investigation of old hypotheses using new data and new paradigms. That is called progress
- Refusal to change is akin to preferring to travel by horse and buggy rather than by airplane

Indeed, Radiation Risk Estimates Per Unit Dose Have Generally Increased Over Time

TABLE 4-4 Comparison of Lifetime Excess Cancer Risk Estimates from the BEIR III and BEIR V Reports

	Continuous Lifetime Exposure, 1 mGy/y (deaths per 100,000)		Instantaneous Exposure, 0.1 Gy (deaths per 100,000)	
	Males	Females	Males	Females
Leukemia				
BEIR III[a]	15.9	12.1	27.4	18.6
BEIR V	70	60	110	80
Ratio BEIR V/ BEIR III	4.4	5.0	4.0	4.3
Nonleukemia				
BEIR III				
Additive risk model	24.6	42.4	42.1	65.2
Relative risk model	92.9	118.5	192	213
BEIR V	450	540	660	730
Ratio BEIR V/ BEIR III	4.8–18.3	4.6–12.7	3.4–15.7	3.4–11.2

[a] Based on Table V-16, page 203, and Table V-19, page 206 ($\overline{LQ-L}$ model for nonleukemia) (NAS80).

BEIR V was 3-18 times higher than BEIR III.

And the BEIR VII excess cancer risk estimate is a further 35% larger than BEIR V

Source: National Academy of Sciences BEIR V, pg. 176

Slide 5

- BEIR V estimates a risk of ~500 deaths per 100,000 for a lifetime of ~100 mrem/y
- Implies an individual fatal risk of background radiation exposure (300 mrem/y) of (300/100) x 500 / 100,000 = 1.5%

As recently as four years ago, the NRC itself, citing this scientific consensus, strongly rejected Petitions for Rulemaking to reject LNT.

NRC, Linear No-Threshold Model and Standards for Protection Against Radiation, Petition for rulemaking; denial., 86 FR 156, 2021
https://www.govinfo.gov/content/pkg/FR-2021-08-17/pdf/2021-17475.pdf

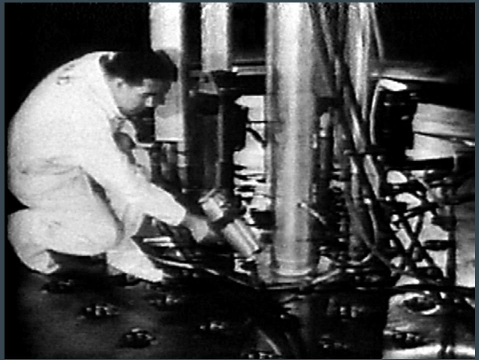
Slide 6

- The NRC did indeed reject petitions to reject LNT
- In 2015, NRC received three coordinated petitions to reject LNT, reject ALARA, and raise the occupational dose limit from 5 rem/y to 10 rem/y
- **The petitions also proposed raising the public dose limit by a factor of 100 from 100 mrem/y to 10 rem/y**
- Dan has latched onto this unsettling proposal to mock the current LNT discussions
- Although BEIR VII, the Health Physics Society, and the American Nuclear Society all agree that below a **lifetime dose of 10 rem**, uncertainties make cancer estimation unreliable, **none have proposed using 10 rem/y as a public dose limit**
- Therefore, subsequent slides in Dan's presentation casting ridicule on a 10 rem/y public dose limit is "tilting at windmills"
- "Tilting at windmills" means fighting imaginary enemies or pursuing futile, misguided battles, often with noble intentions but with little practical value. Don Quixote's attack on windmills has become symbolic of idealistic but impractical crusades

Recent Science Continues to Support LNT

Recent high quality studies such as INWORKS and EPI-CT have further reinforced LNT, confirmed cancer risks in the low-dose range, and in fact found low-dose cancer risks greater than one would presume from extrapolating from A-bomb survivors who were exposed to higher doses. The INWORKS research, for example, found excess relative rates for solid cancer mortality at low doses "larger than estimates currently informing radiation protection."

https://pubmed.ncbi.nlm.nih.gov/37586731/



https://epi-ct.iarc.fr/

Slide 7

- No comment

Furthermore, NRC regulations *do not* require exposures be below background, as claimed by the EO.

“10 CFR § 20.1301 Dose limits for individual members of the public. (a) Each licensee shall conduct operations so that—

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, *exclusive of the dose contributions from background radiation* …” (emphasis added)

Slide 8

- See comment on slide 3

And Background Radiation is Far From Harmless

The NAS BEIR VII report's risk factors indicate that ~10 million of the current U.S. population will get cancer from background radiation.

Adding to that exposure adds to the risks.

Slide 9

- The way this statement is written implies that the authors of the BEIR VII report state, *“10 million of the current U.S. population will get cancer from background radiation.”*
- I challenge anyone to find that statement in BEIR VII or any other governmental/medical/regulatory/scientific literature
- Dan calculates ...
  - 0.00117 cancers per person-rem x 0.3 rem/y x 70 year/lifetime x 347 million US population $\simeq$ 10 million
- Dan intentionally uses the invalid “population risk” feature of LNT that has been refuted by most reputable organizations
  - Multiplying small doses by large exposed populations to derive large hypothetical statistical cancers is invalid

Slide 9 (continued)

- Applying the BEIR VII risk factors and the invalid population risk feature of LNT does indeed predict 10 million of today’s U.S. population will die of cancer induced by background radiation
- However, have we ever heard that statement from our government, the medical industry, the EPA, or the authors of BEIR VII?
- No, because either they are afraid of the public’s reaction, or they do not believe the BEIR VII estimates and/or the population risk feature of the LNT model

Slide 9 (continued)

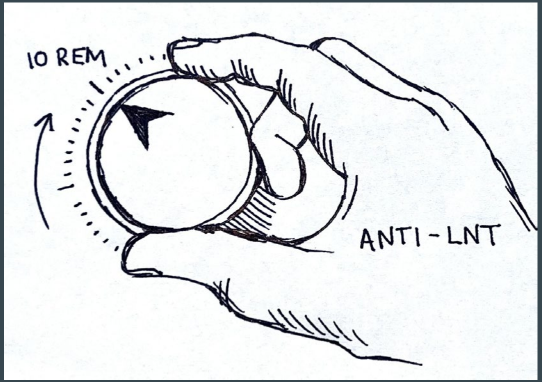
- Notwithstanding Dan's use of BEIR VII as a crutch for his arguments, the BEIR VII report states that …
  - *"the committee has defined low dose as doses in the range of near zero up to about 100 mSv [10,000 mrem]"* Page 2
  - *"at doses less than 40 times the average yearly background exposure (100 mSv (10,000 mrem)), statistical limitations make it difficult to evaluate cancer risk in humans"* Page 7
  - *"approximately 1 person in 100 would be expected to develop cancer (solid cancer or leukemia) from a dose of 0.1 Sv (10 rem) above background, while approximately 42 of the 100 individuals would be expected to develop solid cancer or leukemia from other causes."* Page 8
  - states that, *"the [cancer] risk at low doses will be small"* Page 10
  - states that, *"the occurrence of radiation-induced cancers at low doses will be small"* Page 10
- The BEIR VII report does NOT state that, *"there is no safe level of radiation"*

Slide 9 (continued)

- Notwithstanding the BEIR VII recommendation to keep LNT, the National Academy of Sciences stated in the earlier 1990 BEIR V report,
  - *“Studies of populations, chronically exposed to low level radiation, such as those residing in regions of elevated natural background radiation [50 - 100 times average U.S. levels], have not shown consistent or conclusive evidence of an associated increase in the risk of cancer.”* Page 5
- BEIR VII was equivocal on the issue of high background radiation areas, though did not refute the earlier BEIR V statement

WHAT WOULD BE THE PUBLIC HEALTH IMPACT IF REGULATIONS BASED ON LNT WERE OVERTURNED?

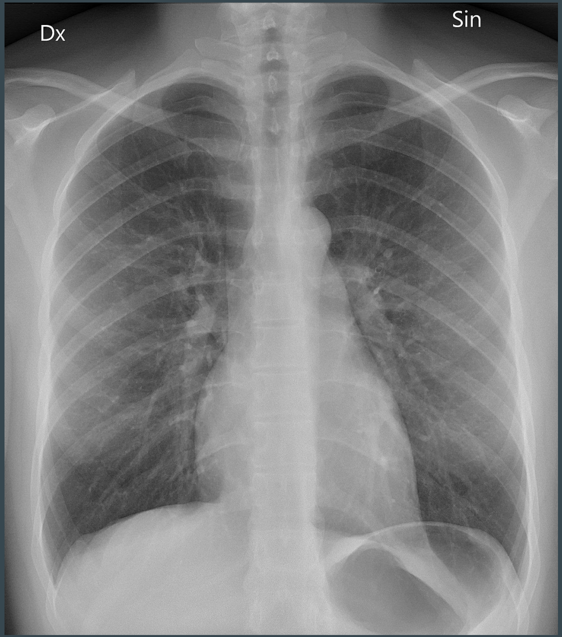
The LNT Petition for Rulemaking that NRC rejected in 2021 proposed increasing permissible workers doses to 10 Rem/year and limits for the public to the same amount. Anti-LNT advocates generally claim a "low dose" threshold of 10 Rem.



Slide 10

- Here, Dan begins his intentional misleading of the reader by juxtaposing
  - a “low dose” limit of 10 rem below which cancer risk is uncertain and not proven
  - an imaginary regulatory limit of 10 rem/y for the public

Equivalent to 5000 Chest X-rays Annually



If dose limits for the public were increased to 10 Rem/year, that would be the equivalent of 5000 chest X-rays per year, from conception to death.

Slide 11

- No one in the nuclear industry is currently proposing a public dose limit of 10 rem/year. See comments on slide 6
- However, going along with Dan's allegation, and using the chest X-ray dose of 10 mrem would imply …
  - 10,000 / 10 = 1,000 chest X-rays NOT 5,000 chest X-rays
- Dan's desire for hyperbole overshadows his math ability

100 to 1000 Times Higher Than Current Permissible Limits

10 rem/year would be *100 times higher* than the current NRC 10 CFR 20.1301(a)(1) limit of 100 mrem/yr

10 rem/year would be *~1000 times higher* than the current EPA limit for cleanup of contaminated sites and *~1000 times* the current EPA 40 CFR 190 & NRC 10 CFR 20.1301(e) limits for public exposures from nuclear fuel cycle facilities*

*40 CFR 190 and 10 CFR 20.1301(e) establish for nuclear fuel cycle facilities limits to the public of 25 mrem/yr whole body, 75 thyroid, and 25 to any other organ. EPA has determined that to be generally equivalent to 10 mrem/yr effective dose equivalent. (EPA, "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination," OSWER No. 9200.4-18, Aug. 22, 1997, Attachment B, p. 4) EPA has further found that for cleanup of contaminated sites, any dose greater than 12 mrem/yr is outside the acceptable risk range. (EPA, "Radiation Risk Assessment at CERCLA Sites: Q&A," OSWER 9285.6-20, June 13, 2014

Slide 12

- Dan continues with his claim that the industry seeks a 10 rem/year public dose limit

Key Risk Figure for Addressing Adequacy of Radiation Protection Limits

1.17×10^{-3} cancers/person-rem at what are considered "low doses."

Source: National Academy of Sciences, Committee on Biological Effects of Ionizing Radiation, *Health Risks from Exposure to Low Levels of Ionizing Radiations,* BEIR VII Phase 2; (derived from Table 12D-3, for 100 mrem/year over a lifetime)

Slide 13

- Dan uses “data” from BEIR VII , Table 12D-3
  - Estimated average cancer incidence for male & female ((621 + 1,019)/2)/100,000 = 0.0082
  - Exposure 100 mrem/y x 70-year lifetime = 7.0 person-rem
  - Cancer incidence per person-rem = 0.0082 / 7.0 = 1.17×10^{-3}
- Note that Table 12D-3 is not measured data but are *“estimates obtained as combined estimates based on relative and absolute risk transport and have been adjusted by a DDREF of 1.5 , except for leukemia, which is based on a linear quadratic model.”*

EPA Affirms Essentially the Same Risk Figure

Drawing from the National Academy's BEIR VII, EPA uses 1.16×10^{-3} cancers/person-rem.

So, roughly 1 cancer per 1000 people exposed to 1 rem.

EPA, Radiogenic Cancer Risk Models and Projections for the U.S. Population, ("Blue Book"), EPA 402-R-11-001

Slide 14

- Agreed. Let’s keep the math simple.
- 1 cancer per 1,000 people exposed to 1 rem

10 Rem/Year Over a Lifetime Would Thus Result in an Excess Cancer in More Than 80% of People Exposed

1.16×10^{-3} cancers per person-rem x

10 rem/year x 70 years = .81 = 8.1×10^{-1} = 81%

Slide 15

- OK, so we are back to the allegation that the industry wants a public dose limit of 10 rem per year
- And forget keeping the math simple, let's use 1.16×10^{-3} for the risk factor
- $1.16 \times 10^{-3} \times 10 \times 70 = 0.81$ = individual cancer risk of 81%
- 10 rem per year would be 30 times the average US background of 300 mrem/y
- Let's say that industry might try to propose a 20 rem per year limit
    - That would mean an individual cancer risk of 1.6 or 160%
    - But wait, individual risks are probabilities limited to a range of 0 to 1, so these simple linear extrapolations are giving the wrong answers

    - Or maybe the original data does not make sense

Hugely Unacceptable Risk

The EPA acceptable cancer risk range for exposure to carcinogens is 10^{-6} to 10^{-4} (1 in a million to 1 in 10,000). If LNT and regulations based thereon are thrown out and replaced with a “low dose” threshold of 10 Rem/year, the risk to members of the public at such exposures would be *nearly 10,000 to 1,000,000 times higher than the acceptable risk range.*

Slide 16

- Again, a false premise of 10 rem/year for the public dose limit
- An individual risk of ~1 is certainly 10,000 to 1,000,000 higher than EPA's acceptable risk range of 10^{-6} to 10^{-4}
- Garbage in, garbage out

NRC Radiation Regulations Should Be Changed

They should be markedly tightened.

Slide 17

- Sorry Dan. You have not proven your point because of your false premises

Current Public Limits Are 35 Years Old
Worker Limits are Two Thirds of a Century Old

In finalizing the current regulations in 1991, NRC noted that BEIR V had come out after its proposed rule and had *s*ubstantially increased radiation risk per unit dose, but NRC declined to tighten the permissible exposures. Even decades ago, NRC conceded its radiation limits produced risks higher than standard allowable risks, and the situation has only gotten worse since then.

Peterson et. al., NRC, "OVERVIEW OF THE REVISED 10 CFR PART 20, "STANDARDS FOR PROTECTION AGAINST RADIATION";

NRC, Standards for Protection Against Radiation, Proposed Rule, 51 FR 1092, pp. 1102-1103

Slide 18

- The NRC is a dose-based regulatory agency
- The fact that NRC resisted changing its dose limits demonstrates that NRC believed its dose paradigm and did not believe the artificial radiation risks that LNT (BEIR V, BEIR VII and EPA) assigned to dose

NAS BEIR VII/EPA Excess Cancer Risk Estimate for NRC's Current Worker Dose Limit: 1 in 5 Would Get Cancer

The current archaic U.S. occupational dose limit is 5,000 millirem/year, equivalent to 10 chest X-rays every day you work. Over a working life from age 18-65, that would yield a risk of excess cancer of approximately <u>1 in 5</u>, according to BEIR VII.

In other words, if 100 workers began nuclear employment and received radiation each year at the permissible level, 20 of them would be predicted to get cancer from their occupational exposure. This is grossly non-protective.

Slide 19

- The 5,000 mrem/year radiation worker dose limit would be equivalent to 100 mrem/week assuming a minimum annual 2-week vacation
- That would be equivalent to a 20 mrem/day limit
- Chest X-rays provide 10 mrem
- Therefore, the occupational limit is equivalent to 2 chest X-rays per day, not 10 chest X-rays as Dan alleges

NRC Radiation Limits for the Public Are Far Outside the Acceptable Risk Limits for Any Other Carcinogen

BEIR VII risk coefficients indicate that the NRC's current regulatory permissible dose for the public of 100 millirem/year received over a lifetime result in approximately a cancer risk of 1 in 100. That is 100 to 10,000 times outside the standard acceptable risk range for all carcinogens (10^{-6}-10^{-4}).

Slide 20

- Using the same lifetime cumulative properties of LNT, the cancer risk of 300 mrem/y background radiation would be 3 in 100.
  - That is 300 to 30,000 times the EPA's acceptable risk range
- So, what does Dan want to do about that?
- Perhaps we should be questioning ...
  - BEIR VII risk estimates and,
  - Practicality of EPA's 1-in-a-million risk goal

EPA: Radiation Should Not be a Privileged Pollutant

"To put it bluntly, radiation should not be treated as a privileged pollutant. You and I should not be exposed to higher risks from radiation sites than we should be from sites which had contained any other environmental pollutant."

Photo: Janak Bhatta CC BY-SA 4.0

Statement on the Nuclear Regulatory Commission's Rule on Radiological Criteria for License Termination, by Ramona Trovato, Director, EPA Office of Radiation and Indoor Air, April 21, 1997.

Slide 21

- The cited 1997 statement by EPA's Ramona Trovato was the start of the EPA/NRC conflict over NRC's proposed 25 mrem/y license termination rule,10 CFR 20.1402
- At the time, EPA maintained that 15 mrem/y was "safe," but 25 mrem/y was "unsafe"
- EPA believed that two essentially similar numbers, 20 +/- 5 mrem/y were "significantly different," from a public safety point of view
- However, EPA also believed the opposite ends of its risk range of 10^{-6} to 10^{-4}, differing by a factor of two orders of magnitude are both "acceptable" from a public safety point of view
- Amazing!!!

What Would be the Real World Effects if LNT and the Regulations Derived Therefrom Were Abandoned?

Slide 22

- See comments on next slide

Cleanup of Contaminated Sites Would Almost Completely Stop

- Cleanup would be abandoned at numerous highly contaminated Superfund sites that are part of the DOE nuclear weapons complex (e.g. Hanford, Los Alamos, Oak Ridge).
- Cleanup obligations would be voided for abandoned uranium mines on tribal lands such as Navajo Nation.
- Former Manhattan Project contamination (e.g., Westlake MO.) would never be cleaned up.
- Decommissioned nuclear plants would be able to leave much of their radioactive contamination and just walk away.

Hanford Superfund Site

Slide 23

- Cleanup at DOE and NRC sites would continue using rational cleanup goals based on measured quantities of radioactivity and dose limits, not artificial risk estimates
- The current cleanup goals for DOE sites would remain unchanged governed by DOE-STD-1241-2033, “Implementing Release and Clearance of Property Requirements”
- The cleanup goals of NRC-licensed sites would remain unchanged, governed by 10 CFR 20.1402
- EPA Superfund sites would need to utilize dose compliance concentrations (DCC) rather that hypothetical preliminary remediation goals (PRG) based on risk

Allowing Massively Increased Radioactive Releases from Nuclear Power Plants

Diablo Canyon Power Plant in California sits right on the Pacific Ocean.
Photo: [Doc Searls CC BY-SA 2.0]

Eliminating most controls for routine radioactive releases into air, rivers, lakes and oceans.

Slide 24

- Airborne and liquid effluent limits for DOE and NRC sites are based on safe, low dose limits, not artificial risk limits
- EPA NESHAPS airborne limits are based on a 10 mrem/y dose limit not artificial risk limits
- EPA drinking water limits are based on a 4 mrem/y dose limit not artificial risk limits
- These would not change if LNT went away

Authorize High Level Waste Repositories Even if Projected Doses From Leakage Far Exceed Current Limits

Slide 25

- Anti-nuclear activists, including Dan, have long opposed both low-level and high-level radioactive waste repositories as part of their LNT-based, radiation paranoia fueled, opposition to nuclear power

The EO To Gut Radiation Protections Should Cause Great Concern For Both Critics & Supporters of Nuclear Power

- Critics should worry about the harm that would result from extreme increases in permissible radiation exposures to the public.

- Supporters of nuclear expansion should worry that massively weakening radiation protection standards will damage prospects for public support since it demonstrates that nuclear plants can’t operate unless allowed to expose the public to unacceptable radiation levels.

Slide 26

- Most existing NRC, DOE and EPA radiation protection standards are based on measurable quantities of radioactivity that are directly related to radiation dose
- These are reasonable and are unlikely to change appreciably if the proposals of EO 14300 5(b) are successful
- What will change is the religious reliance of an artificial risk metric and its association to dose, i.e. LNT, and a belief in ALARA that pushes dose goals far below what existing dose-based limits require
- It will also disassociate the practice of radiation protection from the unattainable, impractical and meaningless EPA goal of 1-in-a-million risk

Conclusion

Radiation protection standards should be markedly strengthened, not gutted.

Slide 27

- Quad erat demonstrandum