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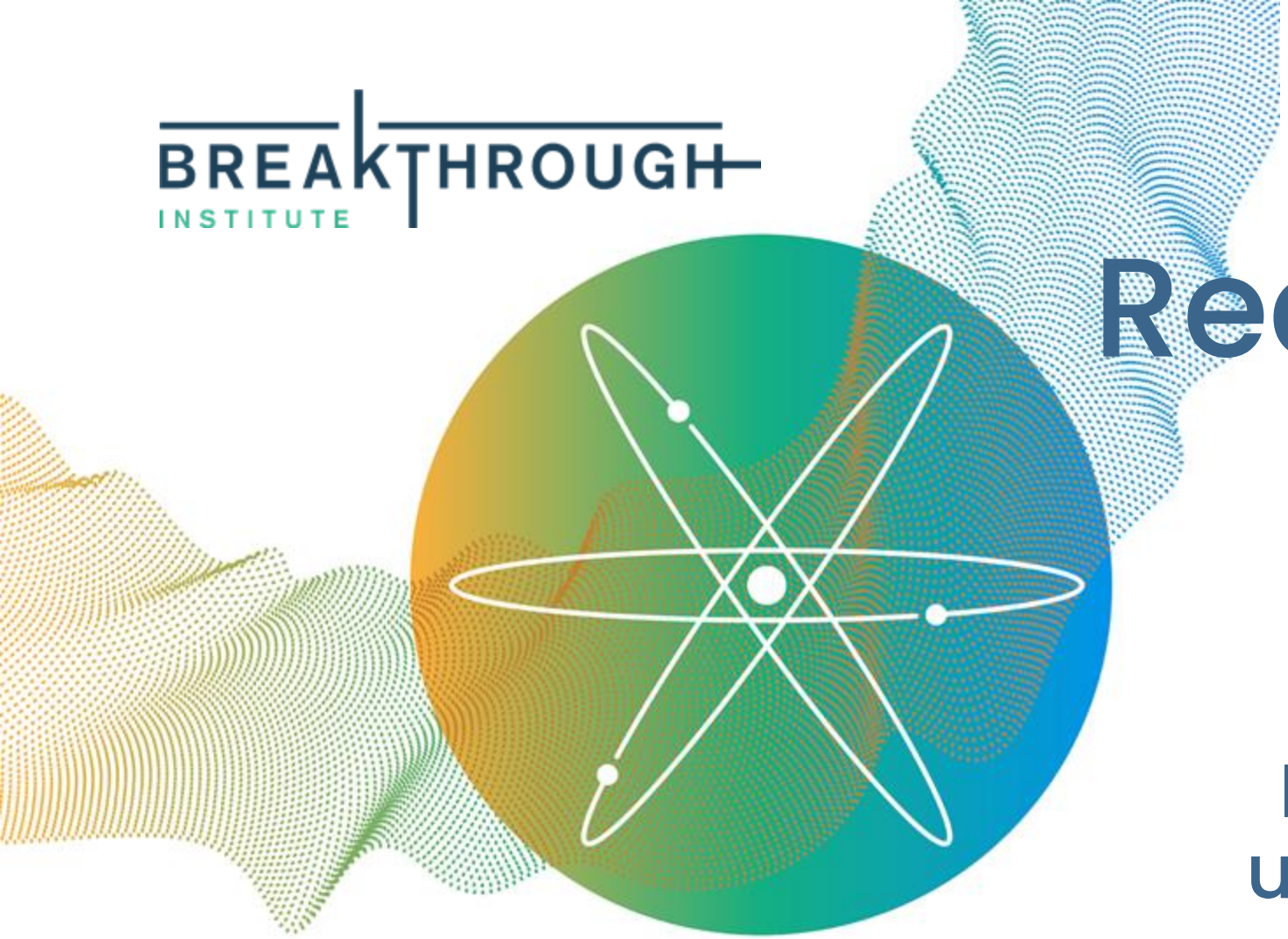

Reconsideration of LNT and ALARA

In the face of scientific uncertainty, change risk management

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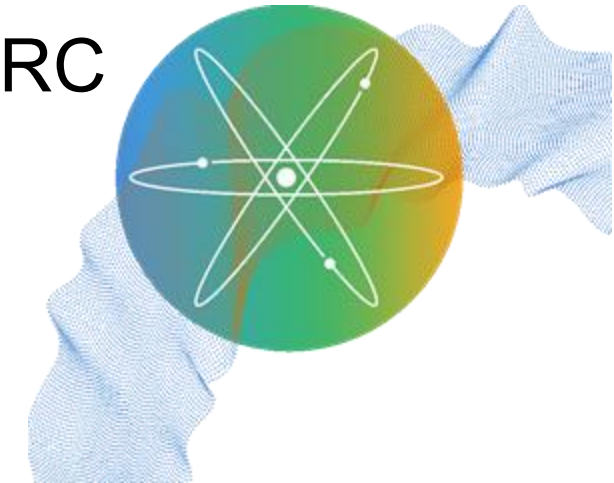
The Breakthrough Institute

- 501(c)(3) Non-Profit
- Global research center that's pro-growth, pro-technology, and pro-development
- We are non-partisan and advance durable solutions that are grounded in empirical and cutting-edge research
- Based in both Washington, DC and Berkeley, CA
- The Nuclear Team attends the vast majority of all NRC meetings and publishes positions on policy



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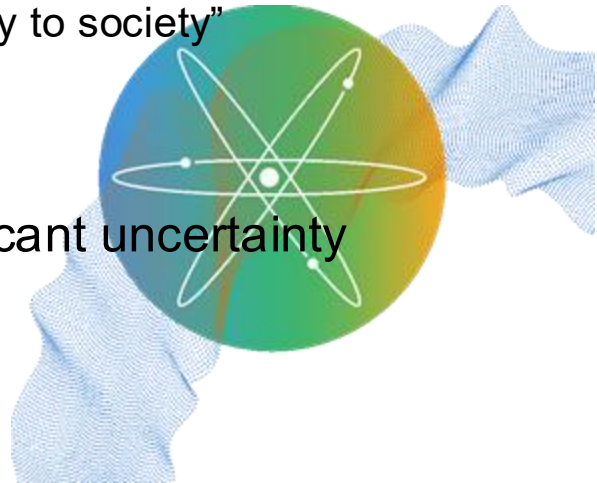
Context

- A lot has changed and very little has changed
- Multiple relevant Executive Orders
  - Reconsider LNT/ALARA including adoption of radiation dose limits (14300)
  - Wholesale reconsideration of regulations (14219)
  - Sunset regulations (14219 + Memo)
  - Gold Standard Science (14303)
- ADVANCE ACT
  - Regulation must be “conducted in a manner that is efficient and does not unnecessarily limit
    - The civilian use of radioactive materials and deployment of nuclear energy; or
    - The benefits of civilian use of radioactive materials and nuclear energy technology to society”
- Scientific Uncertainty
  - Has barely improved since Part 20 established in 1991
  - NRC acknowledged in NRC-2015-0057 (Denied RM) that there is significant uncertainty
  - Scientific consensus is that LNT is unprovable



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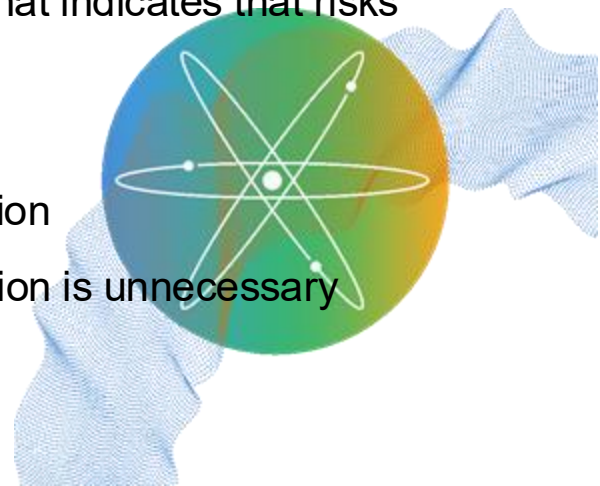
Further Context

- Atomic Energy Act of 1954
  - Adequate protection
- Adequate protection
  - Not specifically defined. Assumed that the amalgamation of existing regulations results in adequate protection at a minimum
  - Commission and Courts affirm adequate protection is not “absolute protection”, or “zero risk”
- Safety Goals
  - Goals not requirements.
  - Intended to compare risks and weigh benefits, but derived values (QHOs) are based on cancer prevalence and disconnected from nuclear power operation
  - Commission affirmed that the QHOs plus other regulations achieve adequate protection. That indicates that risks below the QHOs are more than adequate
- Clean Air Act (1990 Amendments)
  - Congressional values for acceptable risk for nuclear power, equivalent to adequate protection
  - Level of acceptable risk and ample margin of safety, below which further regulatory protection is unnecessary



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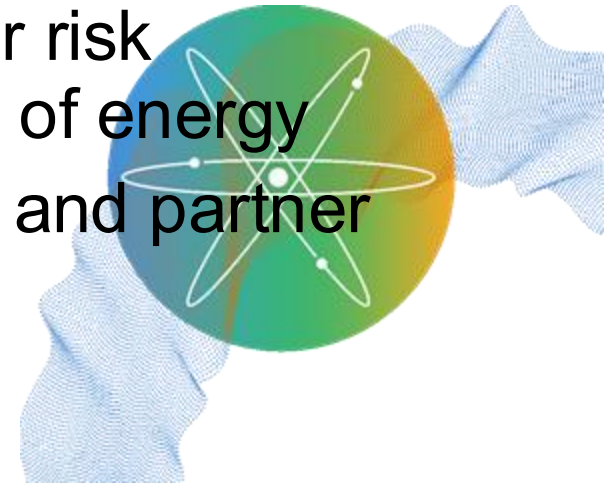
Overview of our Position

1. No other model is more certain than LNT
2. Underlying assumptions about LNT prudence should be reconsidered
3. The NRC should adopt similar risk wording to the EPA based on the 1990 Clean Air Act Amendments
    i. Acceptable risk and ample margin of safety have quantitative value
4. The NRC should initiate rulemaking to adjust dose limits that will be safe and provide further flexibility
    i. Most importantly a *de minimus* or clearance dose should be set
5. The NRC should continue its work to communicate nuclear risk effectively and include the tradeoffs of utilizing other forms of energy
6. The NRC should lead re-evaluation of radiation protection and partner agencies should harmonize



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Dose-response model

- The NRC needs a dose-response model
- Low-dose data for radiation risk is still sufficiently uncertain, after decades of research.
  - Research is predominantly based on correlation, not causation, with extremely large error
  - All models are within the uncertain range, LNT has the most direct assumptions
  - LNT is still “science-based” to the extent of available evidence
  - This warrants changing the risk paradigm, but not the risk model
- Nothing substantial has changed in the scientific field since the NRC’s previous 2021 decision or NCRP’s 2019 recommendation to maintain LNT
- These frequent challenges point to the fact that this is a discussion about values in risk assessment, not just a scientific debate
- The NRC’s response should reflect this issue

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Necessary Means of improving LNT

- Internationally-supported options to improve the application of LNT already exist such as the DDREF, which is being further refined, and modifies the expected harm of chronic low exposure
- Continue maintaining the study populations for the Million-Person Study, INWORKS, and the Life Span Study while acknowledging that this work will likely take decades more
- Establish a clear understanding that this is an imperfect model but that it is sufficient since **regulation makes up the gaps**
- The LNT dose-response model is not the same as the regulatory application of the model or associated assumptions
- Consider means, such as the dose limit changes included, that balance the **possibility** of risk when the uncertainty could mean it is possible safe
  - Is precaution a virtue? Precaution can unnecessarily limit and inspire concern

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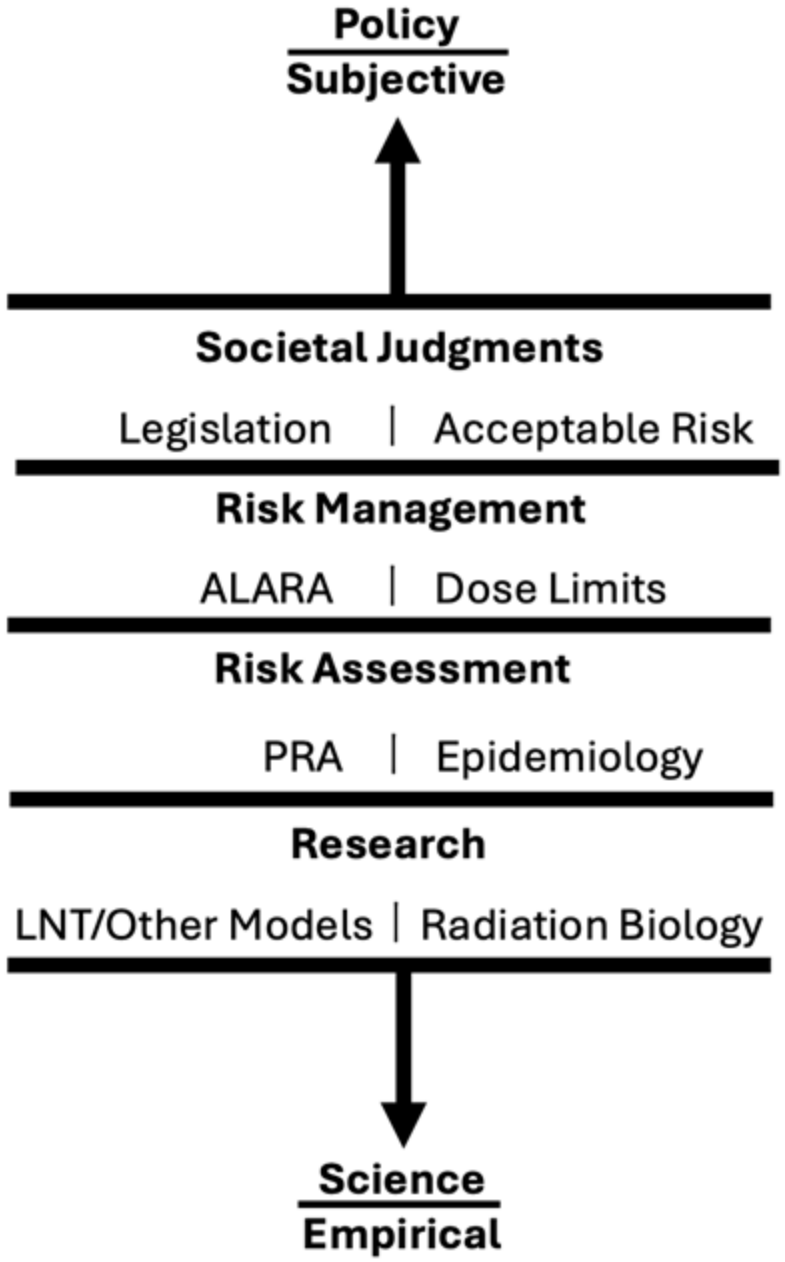
REGULATION in Context

- Arguments about LNT often miss the gradient of decision making
- Science should inform regulation, and regulation can shape science
- "Adequate protection" needs have quantitative measures
  - Dose is most appropriate as a measurable quantity
  - Level of acceptable risk from dose is a value judgment
- Legislation is the most concrete tool for translating societal values



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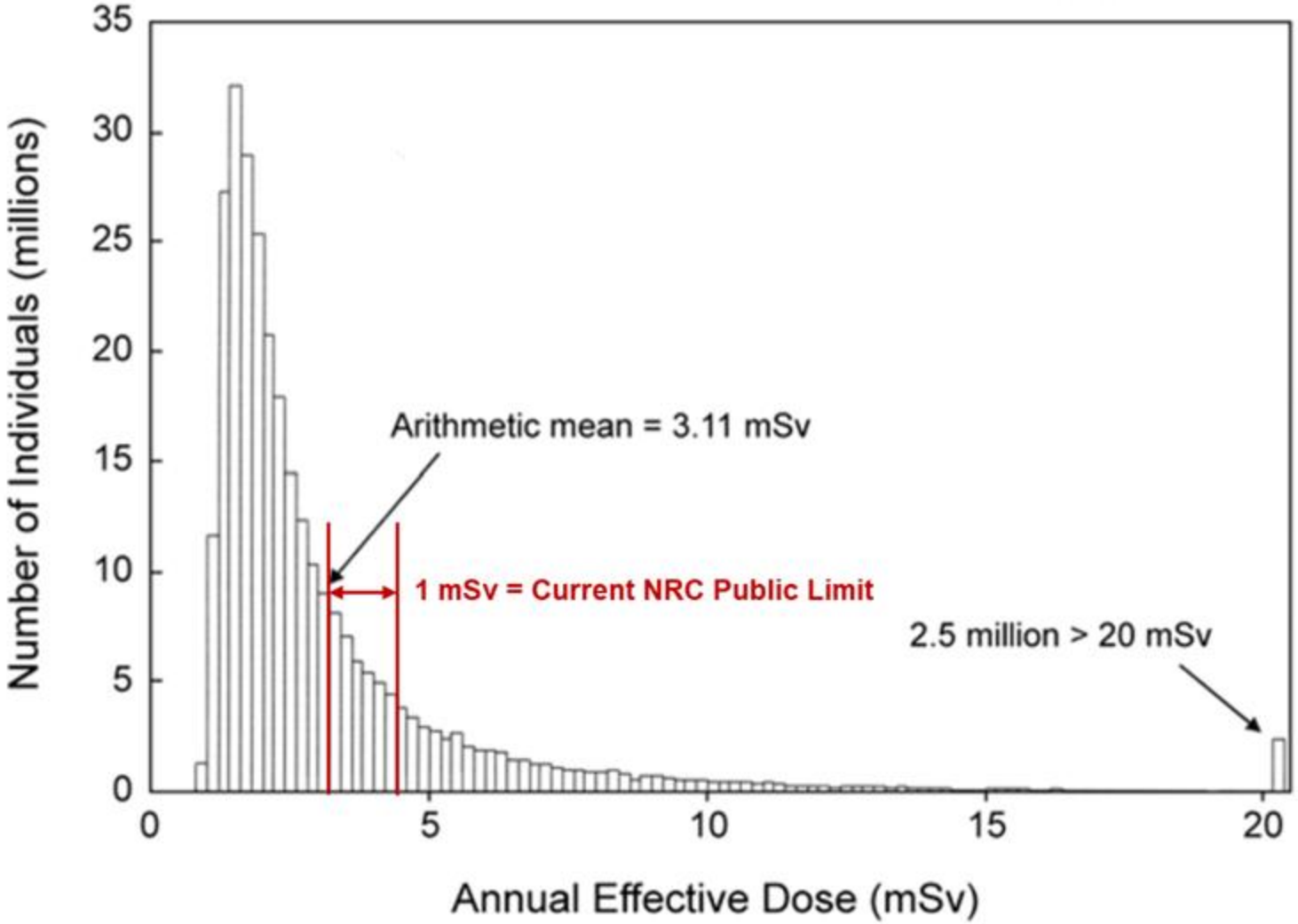
Seel, P, and Stein, A. "How to Regulate Radiation Exposure." The Breakthrough Journal (blog), January 29, 2025. https://www.breakthroughjournal.org/p/how-to-regulate-radiation-exposure.

Public Limit versus Background Variation

- NCRP 160, and subsequent studies do not show increased rates of cancer in background variation
- Other regulators, such as the FAA's response to passenger exposure in flight, don't regulate small doses
- Options exist for 5 mSv already (medical release, public exemption)



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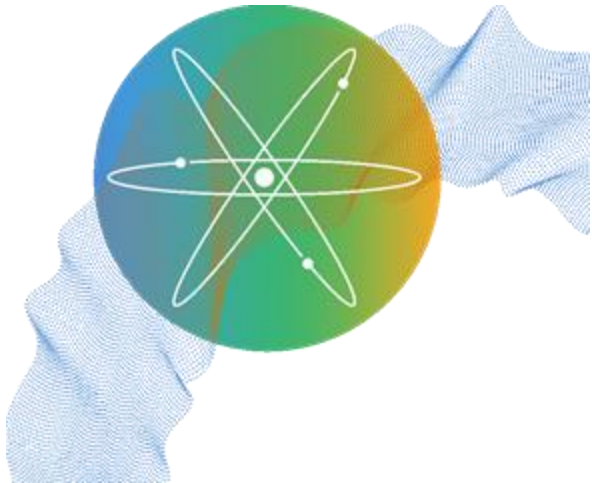
Adapted from "Ionizing Radiation Exposure of the Population of the United States." NCRP Report 160. National Council on Radiation Protection and Measurement, March 3, 2009.

Optimization and Comparative Risk

- The NRC should change ALARA to just be called Dose Optimization
  - Internationally aligned
  - No implication to minimize vs general optimizing of exposure
- ALARA makes two strong assumptions that must be reconsidered
  - Assumes that reducing any dose improves safety. This is a policy choice, not a scientific fact.
  - Assumes a wholesale dose reduction provides benefits to society, without unduly limiting other benefit
    - $/person-rem cost justification to licensees
    - ALARA has ensured protection beyond adequate protection
    - Has not previously been balanced with societal benefit - is that still justifiable?
- An ALARA Dose cutoff is more “reasonable” than no cutoff
  - Diminishing returns of action
  - Main purpose to create a *de minimus* dose
- Continue to apply the new mission statement in response to ADVANCE Act
  - Risks of nuclear technologies should be considered comparatively
  - Aligned with EO



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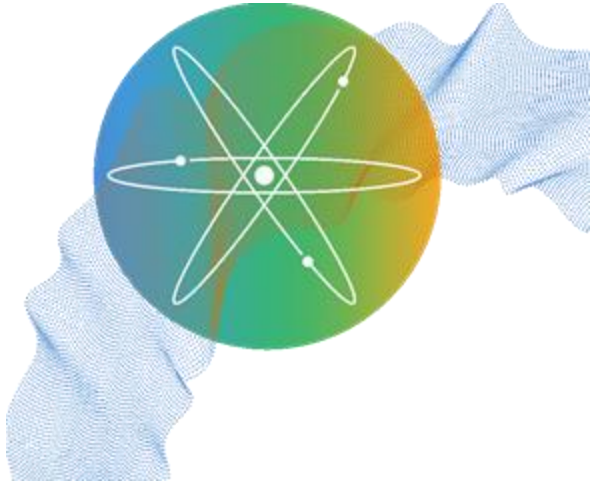
Intention of the EO and the NRC

- The decision to evaluate LNT was given to the NRC
  - Specifically asked to “consult with the Department of Defense (DOD), the Department of Energy (DOE), and the Environmental Protection Agency.
  - The NRC has demonstrated capacity and energy for change
- The NRC should lead efforts to harmonize regulations of radiation risk
- Additional executive clarification should be sought to avoid EPA-NRC conflict as in the past
- Potential joint issue of new Presidential Guidance



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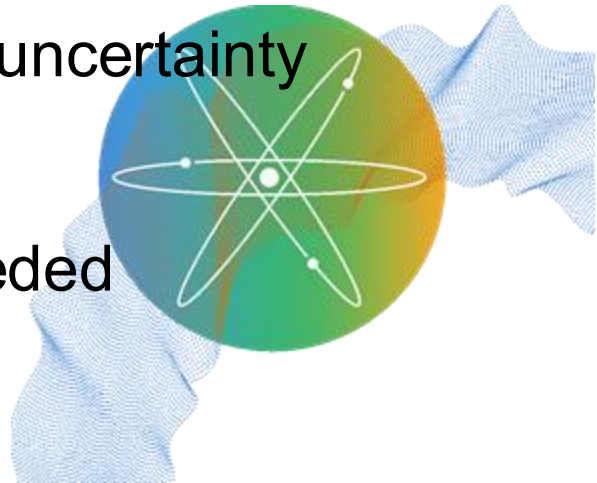
Keeping LNT still necessitates Change

- Radiation protection needs streamlining and stronger communication
- NRC can drive industry change
  - INPO unlikely to change ALARA comparison without NRC change
- Evidence exists to justify reconsidering the assumptions behind LNT
  - Assumed stochastic effects at any dose
  - Concrete actions are still needed in the face of perpetual uncertainty
- More flexibility benefits the current moment
  - New technology and implementations = more options needed



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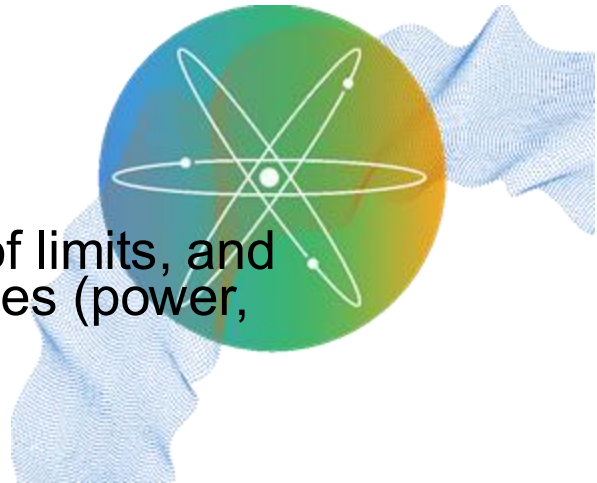
Proposed Dose Limits

- Tier 1: Background/Exempt/Clearance/*De Minimus* Dose
  - **1 mSv (0.1 rem)**
  - Variation in US background dose is already more than 3 mSv (NCRP 16)
  - Within “acceptable risk” determination
  - **Sets a lower limit on ALARA and decommissioning**
- Tier 2: Public Action Limit
  - **10 mSv (1 rem)**
  - Sets an optimization target instead of hard initial limit
- Tier 3: Occupational Action Limit
  - **20 mSv (2 rem)**
  - Optimization should be set to 20 mSv in line with DOE and international targets
- Tier 4: Maintain overall limit of **50 mSv (5 rem)**
  - Joint dose limits for public and workers
    - Better describes the reality of dose risk
    - Can be useful for explaining medical doses
    - Controlled through optimization
- These recommendations are just as safe, work within the current scope of limits, and provide the ability to balance the benefits of the use of nuclear technologies (power, medicine, etc.)



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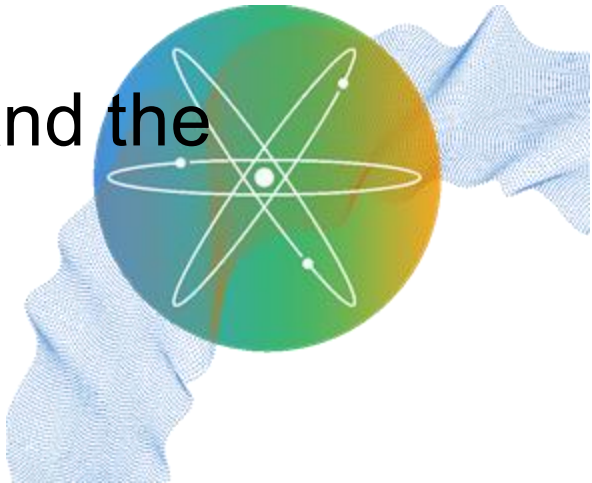
NRC Quotes on Assumptions

- In the 1991 final rule, the NRC stated that these “assumptions are necessary because it is generally impossible to determine whether or not there are any increases in the incidence of disease at very low doses and low dose rates
- “It was prudent to assume the validity of the LNT model because of the considerable uncertainty with respect to the effect of low doses of radiation”
- ADVANCE directives can change this calculation and the validity of these assumptions



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