UCS Perspectives on the Regulatory Application of LNT and ALARA

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Union of Concerned Scientists' position

- There is absolutely no technical or practical basis for changing the NRC's use of the LNT model and ALARA principles in its radiation protection regulations.
- The NRC's rejection of the 2015 petitions for rulemaking in 2021 was definitive. Any reversal of that position would need extensive technical documentation and regulatory justification to be taken seriously.
- We are not aware of any credible studies in the intervening period that would invalidate the NRC's conclusions in 2021. In fact, several studies only reinforce those conclusions.

2021 petition denial

- Based upon the current state of science, the NRC concludes that the actual level of risk associated with low doses of radiation remains uncertain and some studies … show there is at least some risk from low doses of radiation. Moreover, the current state of science does not provide compelling evidence of a threshold, as highlighted by the fact that no national or international authoritative scientific advisory bodies have concluded that such evidence exists. Therefore … the NRC has determined that the LNT model continues to provide a sound regulatory basis for minimizing the risk of unnecessary radiation exposure to both members of the public and occupational workers."
- "The commenters have not provided any substantive evidence demonstrating that the ALARA concept or the LNT model inhibits innovation or growth. The NRC has determined that current ALARA requirements … reasonably account for economic considerations."

Studies since 2021

- UNSCEAR (2022):
  - "Little in the way of robust data could be identified that would prompt the need to change the current approach taken for low-dose radiation cancer risk inference as used for radiation protection purposes …"
- Rühm et al., (2022) (synthesis of recent epidemiological studies):
  - *"growing evidence for doses below 100 mGy* that acute and protracted exposures to ionising radiation cause cancer"
- INWORKS update (2023):
  - "The study provides evidence for a positive association between radiation dose and solid cancer mortality in the 0-100 mGy and 0-50 mGy cumulative dose ranges."
  - "The estimated association between radiation and solid cancer mortality in INWORKS … is larger than, albeit statistically compatible with an estimate from a mortality analysis of male survivors of the Japanese atomic bomb exposed at ages 20-60 years…"

Studies since 2021 (cont.)

- ICRP draft report, “Scientific Evidence Relevant to the Assessment of Solid Cancer Radiation Risk at Low Dose and Low Dose Rate”:
  - “While considerable uncertainties remain, the ranges of LDEF [low does effectiveness factor] and DREF [dose rate effectiveness factor] values obtained here are narrower than those obtained in previous evaluations. The overall conclusion of this report is that, based on current scientific evidence, an LDEF of much more than 3 is not supported, and much less than 1 likewise. Similarly, it is concluded that a DREF value much larger than 3 or less than 1 is also unlikely. These ranges appear largely consistent amongst the various sources of data reviewed in this report.”
- Low-dose/dose rate effect (for low-LET radiation) to account for observed curvature consistent with NRC’s current use of a DDREF of 2

Non-cancer endpoints

- Recent studies have identified significant low-dose or low dose-rate impacts on other diseases:
  - cardiovascular disease (Little, et al., 2023),
  - metabolic syndrome (Huang, et al., 2023),
  - dementia (Laurent, et al., 2022)
- Results are preliminary but indicate the need for continued conservatism in radiation protection

ALARA

- It is bizarre that some are challenging ALARA requirements as an operational and cost burden. ALARA was designed to provide flexibility by allowing operational and economic factors to be considered in implementing radiation protection programs. Replacing it with specified dose limits would likely increase the difficulty for operators and for regulators.
- ALARA is a widely accepted, common-sense international practice.
- Removing ALARA requirements could stifle innovation in developing approaches to reduce occupational doses and therapeutic/diagnostic doses to patients and bystanders.

Other questions

- There is no technically defensible “de minimis” dose limit; any specific value would be highly speculative
- Increasing time periods over which stochastic dose limits would apply could accelerate rates of exposure and increase radiological risk (assuming low-dose-rate effects do exist)
- Cost-benefit guidance should not change, for the reasons cited above
- Rather than weakening standards, NRC should be addressing gaps in the current framework that leave members of the public (such as children and other sensitive subpopulations) inadequately protected

Unintended consequences

- As the NRC's independence and scientific integrity continues to degrade, its status as a "gold standard" nuclear regulator is appearing increasingly shaky
- An eroding of the NRC's safety and radiation protection standards (and deviating from international norms) will likely discourage other countries from seeking US nuclear technologies