Presentation to
The Committee on Developing a Long-Term Strategy for Low-Dose Radiation Research in the United States

National Academies of Sciences, Engineering, and Medicine

by Daniel Hirsch
President, Committee to Bridge the Gap
and former Director
Program on Environmental and Nuclear Policy University of California at Santa Cruz

27 October 2021

What I’ve Been Asked by NASEM to Address

- History of AEC/DOE Conflicts of Interest With and Efforts to Influence and/or Suppress Studies of Elevated Radiation Risks
- Failures in Communication of Risk from Radiation
- What the Task of the Committee Should Be

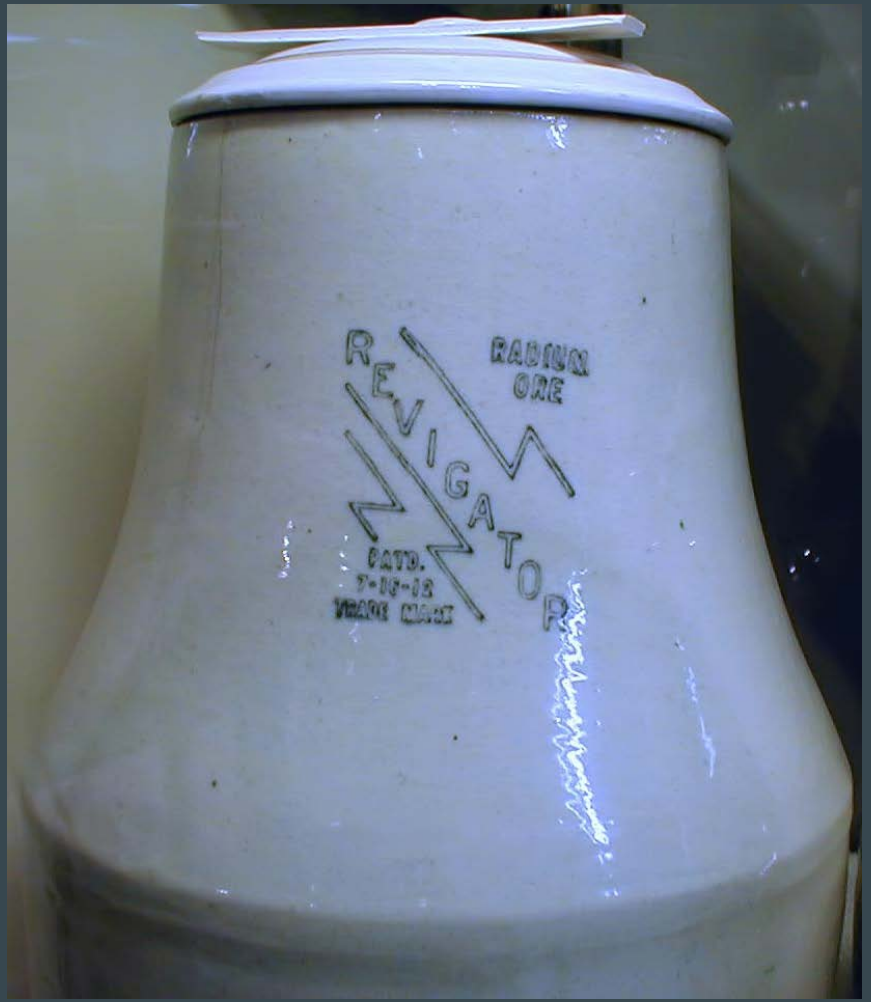
There is a Long History of Underestimating Radiation Risks

The Radiation-Damaged Hands of Roentgen’s X-ray Assistant

Source: *Protection Against Radiation: A Practical Handbook* (1961) by John D. Abbatt, J. R. A. Lakey, and D. J. Mathias. Cassell & Company Ltd.

Indeed, claims that radiation is even good for you have been made from time to time, with tragic consequences.

“REVIGATOR” RADIUM CROCK



Radium girls working in a factory of the US Radium Corporation without protection, circa 1922.

Source: https://commons.wikimedia.org/wiki/File:All_women_or_girls_using_radium_paint_with_no_protection_or_warnings_in_1922,_from-_USRadiumGirls-Argonne1,ca1922-23-150dpi_(cropped).jpg"This media file is in the public domain in the United States. This applies to U.S. works where the copyright has expired, often because its first publication occurred prior to January 1, 1926, and if not then due to lack of notice or renewal."

Hiroshima Changed Everything

Source: NARA, https://catalog.archives.gov/id/148728174

Effort to Suppress Disclosure of Radiation Risks from the Beginning of the Atomic Era

"Japan insisted that the bomb's invisible rays at Hiroshima and Nagasaki had led to waves of sudden death and lingering illness. Emphatically, the United States denied that charge."

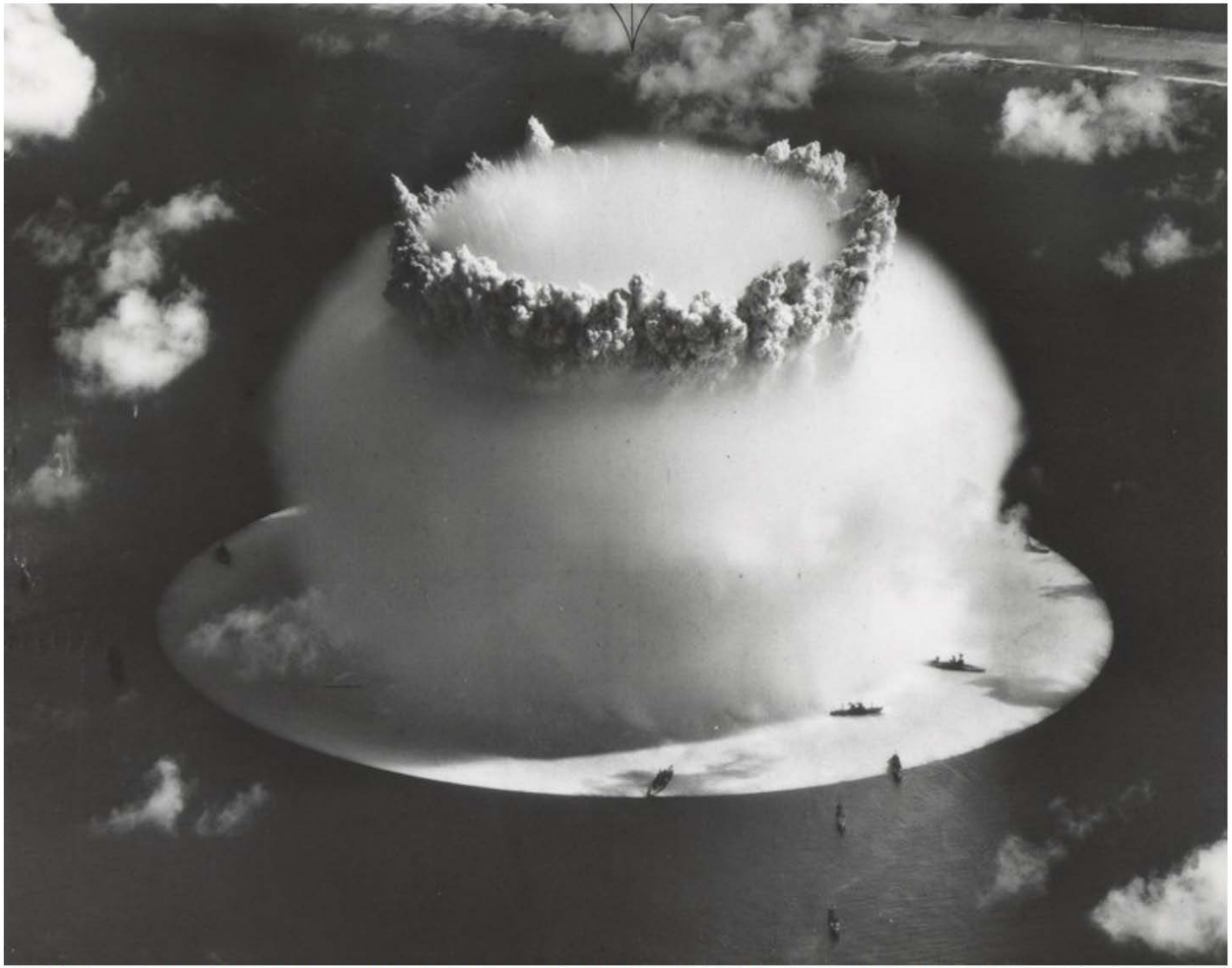
"The Black Reporter Who Exposed a Lie About the Atom Bomb: Charles H. Loeb defied the American military's denials and propaganda to show how deadly radiation from the strike on Hiroshima sickened and killed," by William Broad, *New York Times,* August 9, 2021

When the Truth Could No Longer Be Denied

General Groves changed tack and told Congress a few months after the bombings of Hiroshima and Nagasaki that radiation sickness was

“a very pleasant way to die.”

“How a Star Times Reporter Got Paid by Government Agencies He Covered,” by William Broad, *New York Times,* August 9, 2021



Aerial view of Shot Baker, OPERATION CROSSROADS, July 25, 1946, ships in foreground; US Army Photographic Signal Corps

Hundreds of A- & H-Bomb Tests Followed, Releasing Immense Amounts of Radioactivity into the Global Environment

The Unlucky “Lucky Dragon” Spreads Fallout Concern

Fallout from the 1954 Castle Bravo H-bomb test in the Bikini Atoll dosed a Japanese fishing boat 86 miles away. When they got back to port, the sailors were suffering from acute radiation sickness, triggering worldwide condemnation and accelerating fear of fallout from nuclear weapons tests.

A Campaign Erupted Worldwide to Ban Nuclear Weapons Testing

The Uproar Against Fallout Led to an Aggressive Campaign by the AEC to Deny Risks from Its A- and H-Bomb Testing

- For example, AEC commissioner Willard Libby tried to rebrand strontium-90 doses as “Sunshine Units”

Independent Analysis of Strontium-90 Uptake in Baby Teeth Disproves AEC's Claims

Scientists in St. Louis embarked on a project to have parents nationwide collect and send in for analysis children's first teeth. They found high levels of strontium-90, deeply damaging the AEC's credibility.

Dr. Alice Stewart & the Oxford Childhood Cancer Survey

Standard practice had been to routinely X-ray pregnant women to determine the position of the fetus. Beginning in the 1950s, Alice Stewart demonstrated that a single maternal X-ray doubled the risk of a childhood cancer in the offspring. The radiation establishment fought the findings vigorously, but they are now long accepted.

“Low Dose” Cancer Effects Have Thus Been Demonstrated Conclusively for Half a Century or More

Note in the context of the ever-returning claims of no harm for “low-dose radiation,” defined generally as 10 rem, that Dr. Stewart decades ago demonstrated measurable increases in cancers at doses more than an order of magnitude below that level, i.e., at a few hundred millirem.

AEC Tries to Suppress Gofman-Tamplin Estimates of Cancer Risks from “Permissible” Radiation Levels

In an effort in part to counter public concern about radiation from nuclear weapons testing, in 1962 the AEC asked John Gofman to establish a Biomedical Research Division at Lawrence Livermore. In 1969, Gofman and Arthur Tamplin were asked to present a paper at AAAS, and Livermore officials asked to see the draft.

But When They Got the Paper Back “All That Was Left Was the Prepositions and Conjunctions”

Gofman and Tamplin estimated that if the then-U.S. population received the then-permissible average dose of 170 millirem/year, 16,000 excess cancer deaths would occur annually. The AEC tried to block Tamplin from delivering the paper. He nonetheless delivered the paper; the following month most positions in his research program were eliminated and AEC subsequently cut the Livermore funding associated with Gofman’s research program.

This was the origin of the BEIR studies (BEIR I)

Congress intervened in the controversy, and recommended that NAS establish a committee to review who was right -- AEC or Gofman and Tamplin. BEIR I found that if the U.S. population received the then-current radiation limit, between 3,000 and 15,000 excess deaths would result annually, with their best estimate being 5,000-7,000. Thus the upper NAS estimate was close to the Gofman and Tamplin’s.

BEIR VII Vindicates Gofman

BEIR VII's estimate of increased cancer mortality per unit dose predicts 20,000 excess fatal cancers would occur annually if the U.S. population at the time of the Gofman controversy were exposed to 170 mrem/year over their lifetime. Thus the most current BEIR values vindicate Gofman's 16,000 annual excess cancer death estimate and indeed, indicate an even higher radiation risk level than what Gofman had predicted.

BEIR VII's Estimate of Cancers if the Current U.S. Population Received Radiation at the Current Regulatory Limit

NRC & DOE currently allow 100 millirem/year to members of the public over their lifetimes.

BEIR VII risk estimates indicate that were the current U.S. population to receive that allowable level, 2.7 million people would get a cancer over their lifetimes from that radiation exposure.

See BEIR VII Table 12D-3

The Mancuso Affair

In 1964, the AEC approached Dr. Thomas Mancuso about commencing an epidemiological research project regarding AEC nuclear workers. As one AEC consultant said, “much of the motivation for starting this study arose from the ‘political’ need for assurances that AEC employees are not suffering harmful effect.”

Crisis Triggered by Washington Health Dept.'s Dr. Samuel Milham's Findings of Harm to Hanford Workers

AEC tried to pressure Mancuso to approve a news release saying his research disproved Milham and that there was no evidence of harm to Hanford workers. He refused. Thereafter, AEC worked to remove Mancuso from the studies.

Mancuso, Stewart, and Kneale Find Excess Cancers at Hanford Associated with Radiation Exposure

Study found 10-fold higher risk than presumed by DOE in its standards. DOE's response: cutting off Mancuso's funding and removing his access to his own data, triggering a 10-year FOIA struggle to regain access to the data.

The Wilkinson Affair: "You should do research to please the DOE, your sponsors"

"In 1986, Dr. Gregg Wilkinson, an epidemiologist at DOE's Los Alamos National Laboratory, circulated the draft of a paper… showing an excess of brain cancer among Rocky Flats workers and suggesting the possibility that radiation dose/cancer induction risks were greater than the DOE then maintained to be the case."

"The DOE response was intense… [A supervisor] told him he should do research 'to please the DOE, your sponsors, not satisfy peer reviewers'. He was pressured to withdraw the paper, a request that was canceled only when he threatened to resign."

Geiger & Rush, *Dead Reckoning: A Critical Review of the Department of Energy's Epidemiological Research*

Chernobyl & Hanford N-Reactor Matters Lifted the Veil of Secrecy on Massive Environmental Problems Throughout the DOE Nuclear Complex

From Hanford to Savannah River, from Los Alamos to Livermore to Rocky Flats, from Oak Ridge to Paducah, DOE left an immense trail of radioactive contamination, releases and exposures. Getting out of those environmental remediation obligations is a part of the context for the proposals to claim smaller, zero, or even positive “low dose” effects.

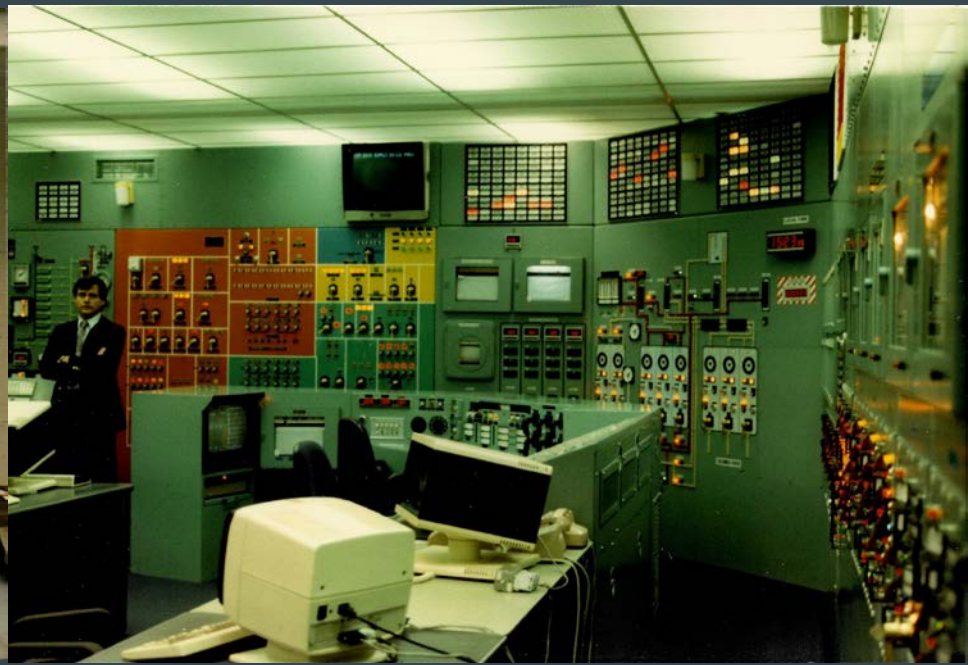
Wilkinson Told By Top Los Alamos Official:

You should “be writing to please the Department of Energy because they were the customer.”

Keith Schneider, New York Times, “*Panel Questions Credibility Of Nuclear Health Checks*,” Feb. 28, 1990

Chernobyl Accident Results in Pulling Back the Shroud of Secrecy Regarding DOE's Unsafe and Contaminated Nuclear Complex

It began with the Hanford N-reactor, due to its similarities to Chernobyl's RBMK reactor.



Secretarial Panel for the Evaluation of Epidemiological Research Activities (SPEERA)

“A recurrent theme of witnesses at every meeting was a lack of credibility in the Department and its epidemiologic activities.”

“The Panel believes that to restore public trust, to assure the highest scientific quality, and to assure the independence of investigators….the Department [should] enter quickly into a Memorandum of Understanding with the Department of Health and Human Services to manage the Department’s analytic epidemiologic research….”

SSFL Worker Study as a Model of Epidemiology with Strong Mechanisms for Independence & Community Oversight

Unique approach to assuring public credibility, insulating research from pressures from agencies with a vested interest in defending the federal government from potential findings that its activities harmed workers or the community.

SSFL Study Findings

- Although the cancer deaths at SSFL attributable to radiation exposure were dose-related, they occurred at doses substantially below those considered permissible by official U.S. and international regulatory bodies, thus raising questions about the adequacy of current regulations.
- The excess relative risk of “low-dose” radiation was at least 6 to 8 times greater than risks previously assumed on the basis of atomic bomb survivor data.
- There is an age effect – e.g., older adults (over 49 years old) are more at risk from radiation than younger ones for all cancers and for “radiosensitive” solid cancers, including lung cancers

SSFL & Other Studies Contributed to Establishment of Energy Employees Occupational Illness Compensation Program Act (EEOICPA)

Communicating Risk:
What We Have Here is a Failure to Communicate

1. Stop using opaque and inconsistent units. Radiation standards are set in millirem; using Sieverts and Grays makes comparison to permissible levels difficult.
2. Put the doses into readily understood terms--the equivalent number of chest X-rays.
3. Describe directly in terms of cancer risks, compared to the EPA longstanding acceptable risk range of one-in-a-million to one-in-ten-thousand.

Why Isn’t This Being Done?

Because radiation at levels permitted by official regulations is equivalent to such a huge number of chest X-rays, the public would never accept such standards if explained in plain English.

And because the cancer risk from radiation at the levels permitted by regulations is so high--using all official agency risk estimates, derived from NAS’s own BEIR VII--that the risk grossly exceeds risks allowed for any other carcinogen.

“Radiation should not be treated as 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.”

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.

Key Numbers for Communicating Risk

1.17 x 10-3 cancers/person-rem for “low doses.”

Source: BEIR VII (derived from Table 12D-3, for 100 mrem/year over a lifetime)

1.17×10^{-3} cancers/person-rem

TABLE 12D-3 Lifetime Attributable Risk of Solid Cancer Incidence and Mortality[a]

	Incidence: Exposure Scenario		Mortality: Exposure Scenario	
Cancer site	1 mGy per Year throughout Life	10 mGy per Year from Ages 18 to 65	1 mGy per Year throughout Life	10 mGy per Year from Ages 18 to 65
Males				
Stomach	24	123	13	66
Colon	107	551	53	273
Liver	18	93	14	72
Lung	96	581	99	492
Prostate	32	164	6.3	32
Bladder	69	358	16	80
Other	194	801	85	395
Thyroid	14	28		
All solid	554	2699	285	1410
Leukemia	67	360	47	290
All cancers	621	3059	332	1700
Females				
Stomach	32	163	19	94
Colon	72	368	34	174
Liver	8.7	44	8	40
Lung	229	1131	204	1002
Breast	223	795	53	193
Uterus	14	19	3.5	18
Ovary	29	140	18	91
Bladder	71	364	21	108
Other	213	861	98	449
Thyroid	75	139		
All solid	968	4025	459	2169
Leukemia	51	270	38	220
All cancers	1019	4295	497	2389

NOTE: Number of cases or deaths per 100,000 persons exposed to 1 mGy per year throughout life or to 10 mGy per year from ages 18 to 64.

[a]These estimates are 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.

Chest X-ray Equivalents

A Single Posterior-Anterior (PA) chest X-ray = 2 millirem

(see, e.g., https://www.epa.gov/radiation/how-much-radiation-am-i-exposed-when-i-get-medical-x-ray-procedure https://www.fda.gov/radiation-emittingproducts/radiationemittingproductsandprocedures/medicalimaging/medicalx-rays/ucm115329.htm)

Thus the current worker radiation limit of 5,000 millirem/year is the equivalent of **2,500 chest X-rays a year, or more than 1 chest X-ray every hour one works.**

The current public radiation limit of 100 millirem/year thus is the equivalent of **50 chest X-rays a year, or one chest X-ray a week from conception to death.**

How NOT to Communicate Risk: Language Sanitization & Obfuscation

Calling it “Low Dose” Radiation. 10 rem is not “low dose--it is the equivalent of 5000 chest X-rays, a level that BEIR VII estimates would cause one excess cancer per hundred people exposed

(BEIR VII, Figure PS-4)

Comparing to background radiation. Background is not harmless. The BEIR reports’ risk factors indicate that ~10 million of the current U.S. population would get cancer from background radiation.

Radiation Protection Standards Have NEVER Been Risk-Based

The original radiation “tolerance” levels were based on levels at which acute, immediate, visible damage would be prevented. They were designed to be below the level that would cause erythema--reddening of the skin.

The original standard (1934) was 0.1 Roentgen/day, or ~36/year, based on avoiding erythema

It remained in effect in the U.S. until the mid-1950s. In 1957, the Atomic Energy Commission's first regulations were arbitrarily set at ~ half the prior value, at 15 Rem/year for occupational exposures, and in early 1960, at 5 Rem/year, where it has essentially remained unchanged for the next 60 years to this day, despite repeated findings (e.g., by BEIR) of increased risks per unit dose.

Current Public Limits Are 30-35 Years Old
Worker Limits are 60 Years Old

In finalizing the current regs, NRC noted that BEIR V had come out after its proposed rule and had substantially increased radiation risk per unit dose, but NRC declined to tighten the permissible exposures.

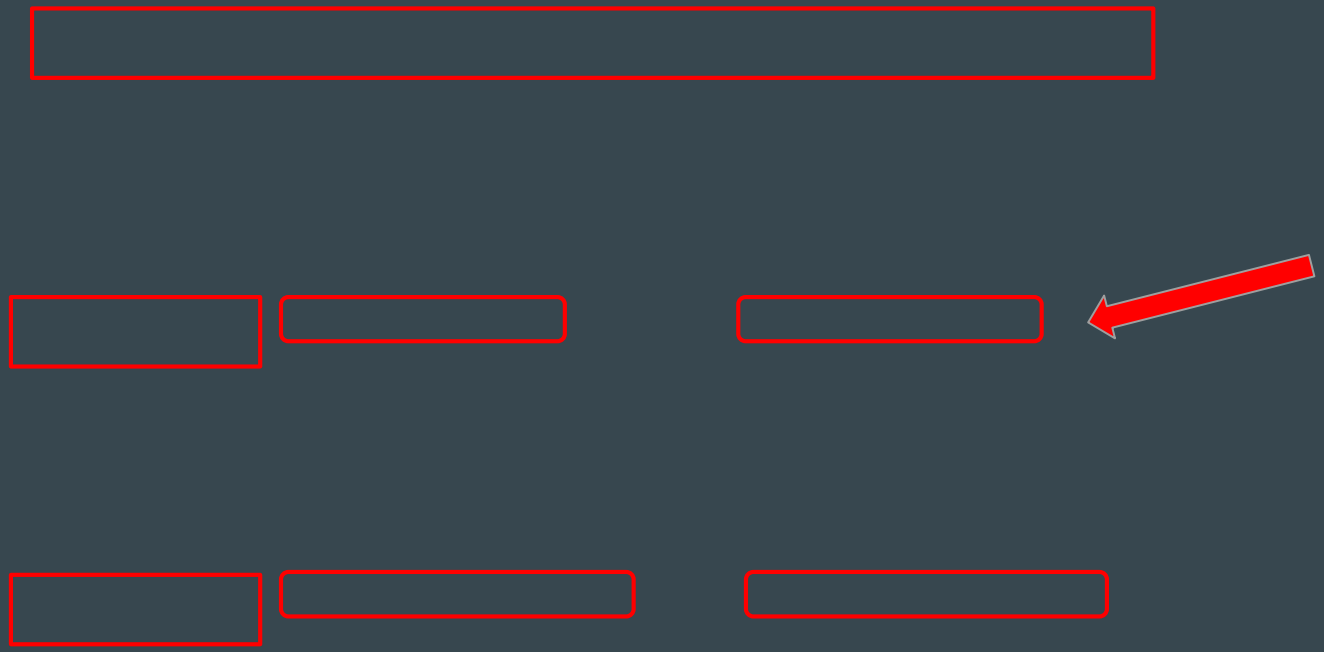
NRC/DOE Radiation Limits for the Public Are Far Outside the Acceptable Risk Limits for Any Other Carcinogen

BEIR VII risk coefficients indicate that the current regulatory permissible dose for the public of 100 millirem/year received over a lifetime would 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}).

BEIR VII Excess Cancer Risk Estimate for Worker Current Dose Limit: 1 in 5 Would Get Cancer

The current archaic U.S. occupational dose limit is 5,000 millirem/year. Over a working life from age 18-65, that would be a risk of excess cancer of approximately 1 in 5, 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.

Radiation Risk Estimates Per Unit Dose Have Generally Increased Over Time



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: BEIR V, pg. 176

Nonetheless, the decades of radiation research and BEIR reports have been stubbornly ignored by agencies in setting radiation protection standards

DOE & NRC have ignored ALL the BEIR reports (going back to BEIR I) by stubbornly adhering to the 1960 occupational limit of 5,000 millirem/year.

They have ignored BEIR V and BEIR VII in setting public limits of 100 millirem/year.

Both the worker and public radiation limits are grossly non-protective, based on the BEIR reports.

Therefore, the fundamental question is not whether to spend a lot more money on new research marginally refining NASEM's existing radiation risk estimates, but what can be done to get recalcitrant agencies to adopt protective radiation protection standards based on the work NASEM has already done.

What *Should* be the Committee's Tasks?

- First, do no harm.
- Tell the truth about radiation, clearly and without obfuscation, free of the pressure from agencies and industries that have a financial interest in downplaying radiation risks.
- Do not be radiation deniers, comparable to climate or COVID deniers.
- Insist that radiation protection regulations be based on the most current BEIR estimates, and be within the risk range allowed for all other carcinogens.
- Insist on full avoidance of conflicts of interests--cognizant of the troubled history of radiation studies--because "whoever pays the piper calls the tunes."

History of Conflicts of Interest

1968 Turning Point:

“The Atomic Energy Commission Brings the Academy to Heel”

See chapter by that title in Philip Boffey, *The Brain Bank of America: An Inquiry into the Politics of Science,* 1975

What Should the Committee's Report Say?

1. Your report should disclose and criticize, in crystal clear fashion, the fact that current radiation protection standards are grossly non-protective, are far outside the acceptable risk range, and have been set by ignoring the very studies by NASEM (the BEIR reports) that the agencies themselves requested.

2. Until the agencies adopt radiation protection standards that are based on the existing BEIR reports and which protect workers and the public at risk levels that are within the acceptable risk range for all other carcinogens, additional funds spent on further refining the NASEM risk estimates should not be a high priority.

3. Instead, those funds, and others, should be dedicated to cleaning up the immense radioactive contamination throughout the DOE nuclear complex, and compensating workers, downwinders, atomic vets, uranium miners, Native American communities harmed by uranium tailing piles, and other victims of the lax environmental controls and radiation standards.