Assessing Uranium-Related Radiation Issues

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CCAT Project
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About IEER

- Incorporated December 1984, non-profit
- Goals: to do sound scientific studies on health, environment, energy issues and to democratize science
- www.ieer.org
- Newsletter: Science for Democratic Action
- Publications other than books are freely available and not copyrighted
- Sources of funds: foundations, consulting contracts, individual donors

Some highlights

- First independent estimate of radioactivity emissions from a nuclear weapons plant (Fernald, 1988 and 1989)
- First independent dose estimates to a group of nuclear weapons workers (Fernald 1993, 1994)
- Part of international scientific team to assess habitability of Rongelap Atoll
- Monitored three court-ordered audits of Los Alamos National Laboratory Clean Air Act Compliance
- Published many books, reports, and articles on issues relating to health and environmental effects of the nuclear fuel cycle
- Annual technical training workshops for community leaders

U-238 decay chain (main branch)

- Uranium-238 (half-life: 4.46 billion years) alpha decay ==>
- Thorium-234 (half-life: 24.1 days) beta decay ==>
- Protactinium-234m half-life: 1.17 minutes) beta decay ==>
- Uranium-234 (half-life: 245,000 years) alpha decay ==>
- Thorium-230 (half-life: 75,400 years) alpha decay ==>
- Radium-226 (half-life: 1,600 years) ==>
- alpha decay Radon-222 (half-life: 3.82 days) ==> followed by radon decay products (polonium, bismuth, lead isotopes

Thorium-232

- Thorium-232 is, like U-238, a “primordial” radionuclide and has its own decay chain
- Dangerous decay products build up relatively quickly in Th-232
- They are thorium-228, actinium-228 (a beta-emitter), radium-228, and radium-224
- Radium-224 gives off radon-220 (which is similar to radon-222

Remediation perspective

- Long-term loss of site control must be assumed
- Reference family should be farmer family
- Currently doses are calculated for standard man
- Pregnant woman, including developing fetus, should be the reference for dose and risk
- Some perspective regarding cancer risk can be obtained by looking at mortality risk per unit radiation

Drinking water mortality risks in billionths per becquerel intake (Ref. value: Pu-239 = 2.85)

- U-238 decay chain (main risks)
- U-238: 1.13
- U-234: 1.24
- Th-230: 1.67
- Ra-226: 7.17

- Th-232 decay chain (main risks)
- Th-232: 1.87
- Th-228: 1.82
- Ra-228: 20.0
- Ra-224: 2.74

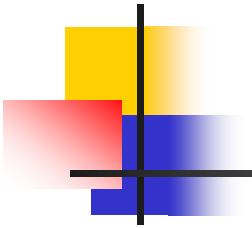
Perspective on clean-up levels

- Residual radioactivity must be determined by dose and risk
- Concentration of a radionuclide in soil in only one parameter
- Both U-238 and Th-232 decay chain can pose significant risks, with the latter being more risky per unit radioactivity ingested or inhaled
- Longer half-life (e.g. U-238 and Th-232) means greater mass intake to ingest (or inhale) one unit of radioactivity (Bq or pCi)

Uranium Mill Related Issues

- Mill Tailings – air and water
- Soil contamination
- Air emissions – routine
- Ore piles
- Accidents
- Mixture of radioactivity and chemicals
- Long-term stewardship

Inhalation radiation dose



- Worker dose is best estimated by monitoring data
- Offsite – measurement of emissions (routine and accident) from production and tailings
- Adequate air monitoring – onsite and offsite, with due attention to wind patterns
- Cross-check of air monitoring data with emissions data
- Location of individuals
- Compliance calculations

Models

- Continuous versus short-term emissions
- 10 millirem to the most exposed person
- Adequate consideration of terrain and wind patterns
- Complex terrain vs flat earth
- Transient receptors (golf course, for instance) vs. continuous presence

Perspective on Radioactive Waste

- Most radioactivity is in high-level waste (spent fuel) at nuclear reactors
- Mill tailings are largest volume
- Mill tailings have thorium-230, radium-226 (which gives off radon-222), plus some uranium
- Th-230 half-life: over 75,000 years
- Ra-226 half-life: 1,600 years
- Ra-226 derives from Th-230

Radiation and health

- Existing risk estimates are based mainly on Hiroshima Nagasaki data
- Traditionally cancer risk was the main one that was evaluated
- The best evidence analysis indicates that every additional dose of radiation creates additional cancer risk
- This "linear, no-threshold hypothesis" (LNT) has been put forward by the NAS, NCRP, and is used in all regulations in the United States and other countries
- Over time estimates of risk of radiation have grown larger
- Cellular level research supports LNT hypothesis
- Non-cancer effects may also be important – new indications from Hiroshima and Nagasaki
- Internal radionuclides need to be more evaluated
- Synergistic effects have barely been studied

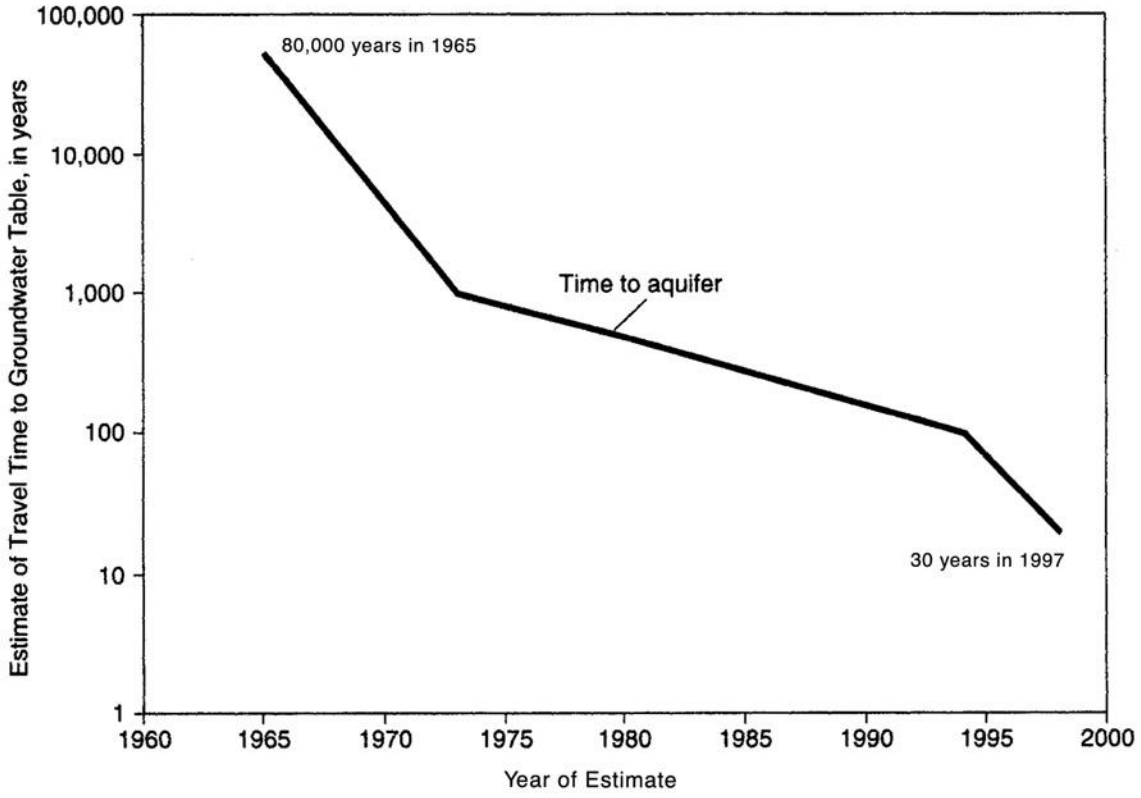
Official denials and admissions

- Government denied for 50 years that weapons workers were exposed to significant radiation risk, then admitted it in 2000
- Similar reversals earlier for uranium miners, downwinders, atomic veterans
- Much official reassurance has been misleading or proven wrong over time
- Past waste management practices have resulted in vast costs and risks

Long-term stewardship

- Stewardship over thousands of years cannot assume site control (NAS)
- Short-term measures must protect public health in ways that are compatible with long-term stewardship
- Adding radioactive waste increases long-term stewardship problem, even if concentrations are lower than the present average
- Composition of waste and total radioactivity are important in determining long-term risk
- US waste classification scheme is poor and getting worse
- Models, such as RESRAD, can help, but there are many caveats and cautions – the d---- is in the details
- Historical estimates of water related impacts have often been wrong – as illustrated by plutonium migration estimates

Change in official thinking on travel time



- Plutonium travel time estimates, Idaho National Engineering and Environmental Lab.
- Published by National Academy of Sciences

IEER Project Tasks

- Review official health assessment documents about Cotter Mill
- Review official environmental documents
- Review air pathway estimates, air monitoring, modeling
- Assess long-term stewardship issues
- Respond to CCAT review requests as they arise
- Prepare report(s), with recommendations
- Communicate reports to CCAT, state officials, public