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TITLE: Linear No-Threshold Model and Standards for Protection Against Radiation
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From: William Schenewerk [mailto:wschenewerk@msn.com]
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09/01/2014 From: William Ernest Schenewerk, wschenewerk@msn.com, +1 (323) 257 6672
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Subject: Docket ID NRC-2015-0057
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"Linear No-Threshold Model and Standards for Protection Against Radiation.
1.0 Introduction
The Linear No-Threshold model of radiation health effects must be ignored below 0.4 Sv or atomic power will not arrive in time to mitigate CO2. Mitigating CO2 requires fossil emissions decrease to 1/10 present value while world energy consumption increases times 10.
2.0 Background: CONAES, Appendix I-30: Lugwig F. Lischer and Edward J. Gornowski
Without reprocessing, the growth of nuclear power will be slow, at best. No manufacturer could afford the high development costs to bring an interim nuclear reactor system to licensable status. If reprocessing is permitted, any advanced converter would have to compete with the fast breeder reactor. In that event, the breeder is the obvious choice.
No mention is made of the Clinch River breeder reactor (CRBR), yet this was the primary issue leading to the formation of CONAES. To proceed with the orderly development of the LMFBR, the construction of the CRBR is of vital importance. The United States has operated successfully the 20-MWe EBR-II at Idaho Falls for over 15 years. CRBR represents the next logical step (350–400 MWe) in scaling up plant size. It is essential to construct and operate a unit of this size prior to proceeding with commercial designs on the order of 1000 MWe. At the present stage of development, one learns little from more paper and analytical work as proposed by some. The direct scale-up from 20 MWe to 1000 MWe is simply too large a step for prudent engineering and design. CRBR is not an outmoded plant; its design has been continually updated, and it has flexibility for accommodating a variety of nuclear fuel and core designs.
3.0 Results

3.1 Application of LNT (Linear No Threshold) theory of radiation exposure is increasingly confounded by improved cancer cures. The only usable existing data may only be from underdeveloped areas of human populations. This source is rapidly disappearing. There is also the inconsistency with LNT that populations living at high altitude do not have a corresponding higher cancer rate from increased cosmic radiation. Nagasaki bomb data may be the only usable human radiation exposure data that will ever exist. Based on curve fitting Nagasaki data [6.01], LNT is invalid at low exposures. This is because leukemia rate drops to zero as exposure increases from background to 0.4 Sv.

3.2 The primary reason this exercise is taking place is to decide whether or not plutonium is more dangerous than CO_2 [6.03]. Other than deciding whether or not to deploy ~50 TWe atomic power, All routine exposure to gamma and X-ray radiation is generally accepted as necessary and appropriate.

3.3 Primary benefit of using LNT is for on job safety analysis. LNT is used for Workers in the nuclear industry and in nuclear medicine to put an upper bound on radiation risk. Then employers can adopt policies that more than offset this risk. Example is subsidizing motor fuel costs ("Little Red Pump") so employees drive larger vehicles that have lower accident fatality rate.

LNT is not appropriate to determine nuclear accident risks unless the calculation also uses air quality LNT that is extrapolated from data on women cooking indoors with wood. Using nuclear LNT versus indoor quality "LNT" criterion, nuclear wins by a large margin.

3.4 Routine emissions from the nuclear power cycle, even using LNT, is more than offset by extracting uranium from phosphate fertilizer. Unintended consequence of LNT is to make electricity more expensive, resulting in greater exposure to indoor air pollution from coking with dung. Present world population low-level radiation exposure to ~20,000 tonnes-U/a in phosphate fertilizer vastly exceeds any routine emissions from a normal nuclear fuel cycle. After ~1000 a, fission-product curies is less than uranium curies consumed. Atomic power consumes radioactive waste.

3.5 below 0.4 Sv only 1 in 50 chance linear-no-threshold theory correct according to the singular Nagasaki 0.4 Sv bomb data results. Nagasaki population that got 0.4 Sv apparently had zero incidence of leukemia. Hiroshima data gives some support to LNT, but the Hiroshima gun-assembly Little-boy uranium bomb did not have neutron shielding. The implosion-assembly Nagasaki bomb had hydrogen in the explosives that blocked the neutron flash [CONAES 6.03 Page 474; Weinberg 6.08, page 52]

3.6 LNT is also not supported by populations living at high altitude, e.g. Denver where the cosmic radiation is twice that in Los Angeles. Recent studies on Pan American flight crews indicated an increase of cataracts due to UV radiation, but no mention of leukemia. 28 years has past since Chornobyl, meaning that most of the cancer deaths that have already occurred. The maximum worker radiation exposure at Fukushima is less than 0.4 Sv.

4.00 Design Input

4.01, References 6.01 and 6.02

Independent12312014.txt, plutonium 01102015, 01:45 GMT

Leukemia peaks out 7 years post-exposure. LNT, Linear No Threshold theory of gamma radiation has:

Leukemia dose-response = 1 incident/100 person-Sv, with peak rate 7 years after exposure; Hard tumor rate is 3 incidents/100 person-Sv, peaking out 20 years post-exposure.

Using UK 0.0005 Sv/a UK gamma background and 80 year life: 80 a * 0.0005 Sv/a * 1 leukemia * 100/100 Sv-person-life = 4/100 person-life

80 year age, all leukemia, 1935 birth: males = 7, Females = 4: average = 5.5 per 10,000 person/year, concave upwards curve. For 80 year life, this is 4.4/100-person-life.

Result: If LNT is true, background gamma radiation accounts for most leukemia at sea level.

2% of world population (200 million people) lives above 3 km altitude. Average radiation at 6 km is 0.6 micro-sieverts/hr. Assuming 1/4 that for 3 km, cosmic gamma radiation exposure is 0.15 micro-sieverts/hr

For lifetime exposure, assuming LNT: 8766 h/a * 80 a * 0.00000015 Sv/h * 1 leukemia * 100/100 Sv-person-life = 10.5/100 person-life.

For LNT to be true, Leukemia rate from cosmic radiation for persons living above 3 km altitude will be double the leukemia rate at sea level.
Most leukemia is now curable, unlike exposures 50 years ago. This makes getting usable data even harder
4.02 Phosphate Rock Reference 6.04
4.03 Kenneth E. Boulding [6.03] "We do not really know whether carbon dioxide is worse than plutonium as a hazard to the human race."
1997 world phosphate rock production = 150,000,000 short tons per year, ~140 Mt/a, ~1/3 P_2O_5 by mass. to feed 5.8 billions.
5.0 Assumptions
5.01 World population 2100 = 11 billions, 1999 was 6 billions,
Population = 6 billions * Exp (0.006 * (year - 1999))
5.02 Phosphate rock required to feed 11 billions = ~200 Mt/a,
11 billions /6 billions * 140 Mt/a * (1 - 1/4 recovery in sewerage)
5.03 Reference 6.05: 2010, phosphate rock production 176 Mt/a, 70 to 200 ppm U3)8,
18-40% P_2O_5, potential to recover 11 MtU/a. U recovery can be 90%.
100 ppm and 200 Mt rock/a = 20 Mt uranium/a
5.04 LNT: 1 leukemia/10.000 person-rem peaking 7 years after exposure;
3 tumors/10,000 person-rem peaking 20 years after exposure. 1 Sv = 100 rem.
References
6.01 Science 09121980 Volume 209, pages 1197 through 1199
Charles E. Land, "Estimating Cancer Risks from Low Doses of Ionizing Radiation" Science, September 12, 1980, Volume 209 pp. 1197 > 1199
6.02 http://www.independent.co.uk/news/science/nuclear-power-is-the-greenest-option-say-top-scientists-9955997.html, Steve Conner 01042015, Independent, Nuclear power is the greenest option, say top scientists
6.03 Energy In Transition, 1985-2010: Final Report on Nuclear and Alternative Energy Systems (1980)/Appendix A: Individual Statements By CONAES Members
6.04 Better Crops, Volume 83, Number 1, Pages - 4 through 7, http://www.ipni.net/ppiweb/bcrops.nsf/$webindex/871709C9E65488D3852568EF0063BE8C/$file/99-1p04.pdf
6.05 World Nuclear Association, Tower House, 10 Southampton Street, London WC2E 7HA UK, Uranium from Phosphates, updated February 2015, http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Uranium-Resources/Uranium-from-Phosphates/
6.06 "Researchers discover the processes leading to acute myeloid leukemia," 01302012, http://phys.org/news/2012-01-acute-myeloid-leukemia.html, Norman Reich, UCSB: "There's definitely the idea that this may be a new way of developing therapeutics, because you don't have to kill the cancer cell," Read more at: http://phys.org/news/2012-01-acute-myeloid-leukemia.html#jCp
6.07 M. K. Kim "Cosmic rays: are air crew at risk?," Occup Environ Medicine, Volume 59, Pages 428-433, 2002, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1740325/pdf/v059p00428.pdf, Cosmic ray exposure, micro Sv/h, versus altitude in feet: 0.06/sea level; 6.0/35,000 ft; ICRP standards mSv/a 1976: 50/Occupational; 13/pregnant; 5/public. 1990: 20/occupational; 2/pregnant; 1/public. 4 month mission to Mir space station: 0.147 Sv. EU airlines have recorded cosmic radiation since 05132000. "...[flight crew] epidemiological evidence remains inconclusive and will continue to do so for some time."
6.08 Alvin M. Weinberg, Institute for Energy Analysis, Oak Ridge Associated Universities, Oak Ridge Tennessee, "The Future of Nuclear Energy," Physics Today, Pages 49-56. Nagasaki and Hiroshima Mortality, from: H. H. Rossi, in "The Effects on Populations of Exposure to Low Levels of Radiation" (BEIR) National Academy of Sciences, (1980) page 320: The linearity of response at Hiroshima is usually attributed to neutrons."
7.01 Calculations Nagasaki ~0.4 Sv (38.9 rem) Exposure: zero leukemia My analysis, From Reference 6.01
25643 person-y/(y-1971 - y-1950) ~1200 persons, neglecting attrition

Background leukemia in 1200 persons between 1971 and 1950 =
1200 persons * 44 leukemia/1,000,000-person-y * (y-1971 - y-1950) = 1.1
Probability zero background leukemia = (1 - 1.1/1200)^1200 = 0.333
Result(1): Zero leukemia rate reasonable if no leukemia from radiation.
Linear-No-Threshold leukemia
= 1200 persons * 0.4 Sv * 1/100 person-Sv = 4.8
Leukemia peaks 7 years after exposure, so use 4 radiation leukemia
to allow for 3.5 years from Nagasaki bomb and 1950:
Result(2): Probability zero Linear-No-Threshold correct as far as predicting
Leukemia, ignoring background = (1 - 4/1200)^1200 = 0.018: 1/50 chance LNT correct.

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