RulemakingComments Resource

From: Timothy Maloney <t.maloney@bex.net>
Sent: Tuesday, July 07, 2015 1:55 AM
To: RulemakingComments Resource
Subject: [External_Sender] public comment re LNT

Docket ID NRC-2015-0057

Dear Committee Members,

The As Low As Reasonably Achievable - ALARA - program of action is a consequence of the unsupported Linear No Threshold hypothesis - LNT. It should be replaced by rationalized values of radiation doses determined by actual observed biological effects.

It is unfortunate, and a dereliction, that so little research has been done regarding actual biological effects of various radiation dosages, radiation types (alpha, beta, gamma), and exposure durations. But what little research knowledge that is extant should be used to displace non-rational ALARA based on LNT.

One instance of this state of affairs is the USA drinking water standard for tritium content. Its present limit is 740 becquerels per liter. This is a factor-of-14 lower than the World Health Organization limit of 10,000 Bq / liter, and a factor-of-103 lower then Australia's limit of 76,000 Bq / liter. Clearly, there can be no rationality to such disparate values. They are merely a consequence of differing estimates of what is reasonably achievable, unfounded on biological evidence.

Please work to move America's national energy policy onto a sound scientific basis regarding the issue of ionizing radiation by removing LNT from consideration.

Appended is my discussion of this particular tritium issue, extracted from my blog post at http://tinyurl.com/mc6qmf7 .

Sincerely,

Timothy J Maloney, PhD

Fortunately however, regarding tritiated water biology, we are fortunate to have a series of controlled studies performed on mice at the Brookhaven National Laboratory in New York state during the 1970s, supported by the US Department of Energy Office of Science. The results of several of these studies have been summarized in a 2012 publication by the Health Physics Society, published in the peer-reviewed journal Health Physics, at http://journals.lww.com/health-physics/toc/2013/01000 which is downloadable at

http://journals.lww.com/health-physics/Fulltext/2013/01000/Commentary_What_is_the_Health_Risk_of_740_Bq_L_1.15.aspx

or at

http://journals.lww.com/health-physics/toc/2013/01000.

It was authored by Brooks, Couch, and Chad - referred to here as the Brooks report.

The Brookhaven experiments yielded numeric conclusions about tritium dosage regimes in drinking water given to mice that resulted in the following biological outcomes:

1) No Observed (Biological) Effects Level - NOEL

2) Chromosome aberrations, mutations, and cell death

3) Lethal dose - 50% mortality

4) Specific localized mutations in DNA structure

Of most interest for public policy is the No Observed Effect Level - NOEL. It is 37 million becquerels per liter[m]. That value is identified and called out in Fig. 1 (copy enclosed) of the Health Physics article, p. 109, fourth horizontal axis from the top[n], which spans the range from 10 to 100 MBq /L.

That radioactivity is due to tritium alone, with no other radionuclides present in laboratory-pure tritiated water. Such water is symbolized H_TO, as distinguished from normal surface water, H_2O, which contains an average of 7 Bq per liter due to tritium alone[q].

That is to say, the No Observed Effect Level for tritium in water is about 5,000,000 X greater than the average background level of tritium on earth's surface. [37,000,000 Bq / 7 Bq]

[m] Equivalently, 1000 million picocuries /liter.

Conversion factors are: 1 Bq = 27 pCi, 1 pCi = 0.037 Bq (1 / 27). The SI preferred unit of radioactivity is becquerel.

[n] Each horizontal axis in Fig. 1 represents a factor-of-10 increase in radioactivity relative to the axis below it.

[q] 189 pCi /L

Below are other scientific findings of the Brookhaven research and pieces of explanatory information that are featured in the Brooks report.

1) The US EPA drinking water standard (the permitted limit) for tritium content is 740 Bq per liter. This is about 100 X greater than earth's surface water's natural tritium radioactivity.

2) The EPA standard is 50,000 X less than the 37 million becquerel Brookhaven NOEL level.[r] This is perhaps better understood as one fifty-thousandth (0.000 02) of the Brookhaven no-effects level.

3) The United Nations World Health Organization's value is 10,000 Bq per liter. It is more tolerant than the USA by a factor of 14.

4) The drinking water standards for western industrialized nations range from 100 to 76,000 Bq /L. This 760 X multiple-of-difference among nations implies that the values were not selected on rational scientific bases.

5) Mouse chromosome aberrations, genetic mutations, and cell death began at the level 110,000,000 Bq /L. This is 11,000 X greater than the WHO guideline value.

6) The 50% lethal dose for mice was 37 billion (e9) becquerels per liter. This is perhaps best understood by observing that WHO's tritium guideline was set at 0.000 000 000 027 of the lethal dose. [10,000 Bq / 37 e9 Bq]

7) Calculated values of human equivalent dose[s] for people consuming water at the 740 Bq per liter EPA limit, averaged over age ranges and water-consumption habits in America, are

9.0 microsieverts per year for males and

9.4 microsieverts per year for females

These calculated estimates were derived in a 2011 study by authors Kocher and Hoffman titled Drinking Water Standard For Tritium - What's the Risk? It too was published in Health Physics and was utilized by the Brooks study. The Kocher and Hoffman paper is available at the US National Center for Biotechnology Information - NCBI website, at www.ncbi.nlm.nih.gov/pubmed/21799344.

[r] It is believed that this is the reason the value 740 Bq was chosen - to tout the impressive multiple 50,000.

[s] For this purpose, the human equivalent dose is defined as the biologically "effective" dose, taking into account whether radiation exposure is external or internal [as for water ingestion]; also the proximity of particular internal organs to the emitting radionuclide [tritium, in this case]; also the specific type of radiation (alpha, beta, gamma, or free neutrons; it is mostly beta for tritium]; and also the body mass and gender of the person exposed.

The Brooks study, in its Fig. 2 chart[t] on page 111, relates the EPA-standard equivalent dose values of 9.0 - 9.4 microsieverts per year, called out on the bottom axis, to various other relevant doses. For public-policy purposes the most useful comparison is to the average USA natural background dose, 3.1 mSv per year [3100 microsieverts per year], called out on the fourth axis from the bottom.

To put a numeric interpretation on this information, USA's average natural background exposure is about 330 X greater than the 9 microsieverts /year dose resulting from tritiated drinking water at the EPA limit. That's the average. But for Denver residents, at 11,800 microsieverts /year, their background dose is 1300 X greater than EPA-limit water. It's due to their high altitude, plus being surrounded by lots of radon-emitting granite.

[t] In that Fig. 2 chart (enclosed), the rightmost (maximum) value on each axis is equal to the leftmost (minimum) value of the axis just above it, though the values may be expressed in different prefixed units (micro, milli, or the base unit Sievert). As in Fig. 1, each horizontal axis represents a factor-of-10 increase compared to the axis below it. Thus 7 axis-steps span a range of 107, or 10,000,000 to 1.

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