



# NUCLEAR INFORMATION AND RESOURCE SERVICE

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The Secretary  
US Nuclear Regulatory Commission  
Washington, DC 20555-0001

November 19, 2015

**Comments of Nuclear Information and Resource Service  
in response to Docket ID NRC-2015-0057  
Petitions that Challenge the Linear-No-Threshold Risk Model and  
Advocate a 10 Rem Radiation Exposure Threshold and “Hormesis”**

Nuclear Information and Resource Service (NIRS) supports the view that the Nuclear Regulatory Commission (NRC) has overstepped the bounds of its authority when it accepted the Petitions for Rulemaking (even for comment) from Carol Marcus, Mark Miller and Mohan Doss (Petitioners). The Petitioners request that NRC cease regulating radioactivity and radiation exposures below a threshold, which the Petitioners define as 10 Rems (per year, though this is also not clear); NIRS strongly disagrees with these Petitions, and requests that the NRC withdraw them, or in the alternative, reject them. Presumably the “10 Rems” in the Petitions is assumed to be in Rems to an adult male since Petitioners also urge NRC to drop any differentiation of age or gender in the Human Life Cycle, while empirical data, cited in these comments clearly show that radio-sensitivity is variable across the life phases of our species and therefore protection should be geared to the most sensitive stage; adult males are the least sensitive (BEIR VII and ECRR).

The appropriate role of NRC in this matter is determined by the authority it has under the Atomic Energy Act. In the view of NIRS, NRC should have directed the Petitioners to the US Environmental Protection Agency (EPA) and not published the Petitions at all. Atomic Energy Act reserves the role of standard-setting for nuclear fuel-chain operations to the EPA.

In any case, NIRS will fight any changes in radiation standards that would lower the already not-good-enough protection that NRC provides.

If all three Petitioners’ requests are granted, NRC would cease to regulate any exposure below the worker “emergency” level of 10 rem and continue to make no meaningful regulatory differentiation based on gender or age or stage of the Human Life Cycle. NRC would also abandon ALARA, which is sometimes a “point of pride” for professionals in the industry. If this happens in

response to Marcus, Miller and Doss there will be no need for anyone to continue to try to improve the NRC's regulations.

NIRS is committed to mobilizing people to engage in positive contributions at the NRC such as participation in public meetings, hearings, legal interventions, and will of course continue with civil-society participation; however if NRC bows to the whim of career nuclear provocateurs it will leave the community NIRS serves little choice but to realize they have been right all along: "N" "R" "C" stands for "Nobody Really Cares." They will, if NRC allows 10 Rems to be the public exposure limit, declare that every reactor causes cancer on a daily basis. It is widely acknowledged that a 10 Rem exposure DOES cause cancer. Current exposure limits force us to say that the risks from reactors are a "numbers game" that may (or may not) result in cancer.

We underscore for you: MANY people care. If NRC Staff, legal team, and Commissioners want people to believe that you also care, you must act in a caring manner. Withdraw the petitions published in Docket ID NRC-2015-0057 from any further consideration; or at the least, reject them.

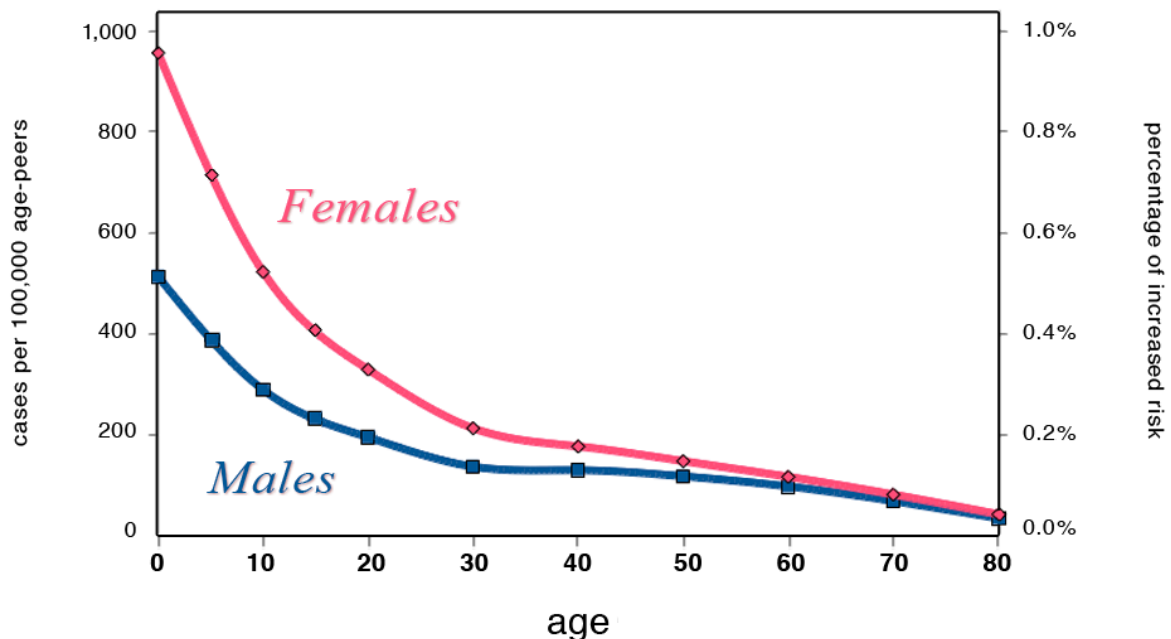
We look to the NRC to at least hold its own flawed line. We look to NRC to note the scope of its authority with respect to setting standards for fuel cycle facilities, and we vow to support people living near and working at non-fuel cycle facilities to oppose "unequal" protection should NRC decide to engage any part of these petitions for these people / places in our lives.

We offer now some time-honored points here....we have made these points many times, but there is new data to support them, so we bring this new information.

- A. The Petitioners provide no empirical evidence for a "safe" dose of radiation that does not require consideration in regulation, while there is a growing body of data to support the well-established finding that any exposure to ionizing radiation carries some risk of harm...therefore there is "no threshold." NRC regulation should be based on empirical evidence, and therefore maintain the "no-threshold" model.

The largest data-sets that have been established to study the impact of radiation on humans both (generally) support a linear-no-threshold risk model. One of these, the Hiroshima and Nagasaki A-bomb survivors includes all ages (post-birth) and both genders. These Hibakusha, atomic survivors have been tracked over their "life-span." 60 years on, the data was published in 2006 by the National Academy of Science in the "Biological Effects of Radiation (BEIR VII Phase 2)." It is worth noting that the NRC was part of the group that requested the NAS to publish this information (BEIR VII). The report includes data on cancer incidence and mortality for both genders and all ages (post birth). The report does not provide the data in graphical form. NIRS supporter Ian Goddard was, to our knowledge the first person to provide this image:

## Increased Cancer Risk by Age at Exposure to 20 mSv Radiation



U.S. National Academy of Sciences BEIR VII Phase 2 Risk Model

Also posted in 2011 here: <http://www.nirs.org/radiation/radhealth/radhealthhome.htm>

This graph is a visual representation of the age people were at the time of exposure to an estimated 2 Rem (“low”) radiation exposure on either August 6<sup>th</sup> or August 9<sup>th</sup> in 1945, who later, at some point in their lives got cancer. Note: the age they were when the cancer struck is not pictured here.

This graph shows unequivocally why age and gender must be factored when considering the outcome of radiation exposure at ANY DOSE level. Clearly exposure in childhood is far more “biologically effective” (as NRC likes to put it) than exposure to adults. In childhood the genders are not the same. When exposed as girls, females in the data-set were twice as likely to get cancer, at some point in their lives, than were males who were exposed as boys in August 1945.

The effect is less in those who were adults when exposed to ~ 2 rems in Hiroshima and Nagasaki in August 1945, but the gender factor is still there. For every two men who were exposed as adults (to 2 Rems), and died of cancer, three women with the same exposure died of cancer. This 50 percent greater harm should not be dismissed.

This dose level, 2 Rems, is in far excess of the annual regulatory limits that NRC “allows” the nuclear industry to “give” to the public. Clearly this dose is responsible for “excess” cancers. The Petitioners are wrong to assert that there is no harm from this level of exposure. NRC staff could take the 10 Rem the Petitioners advocate for and use the Linear-No-Threshold model to

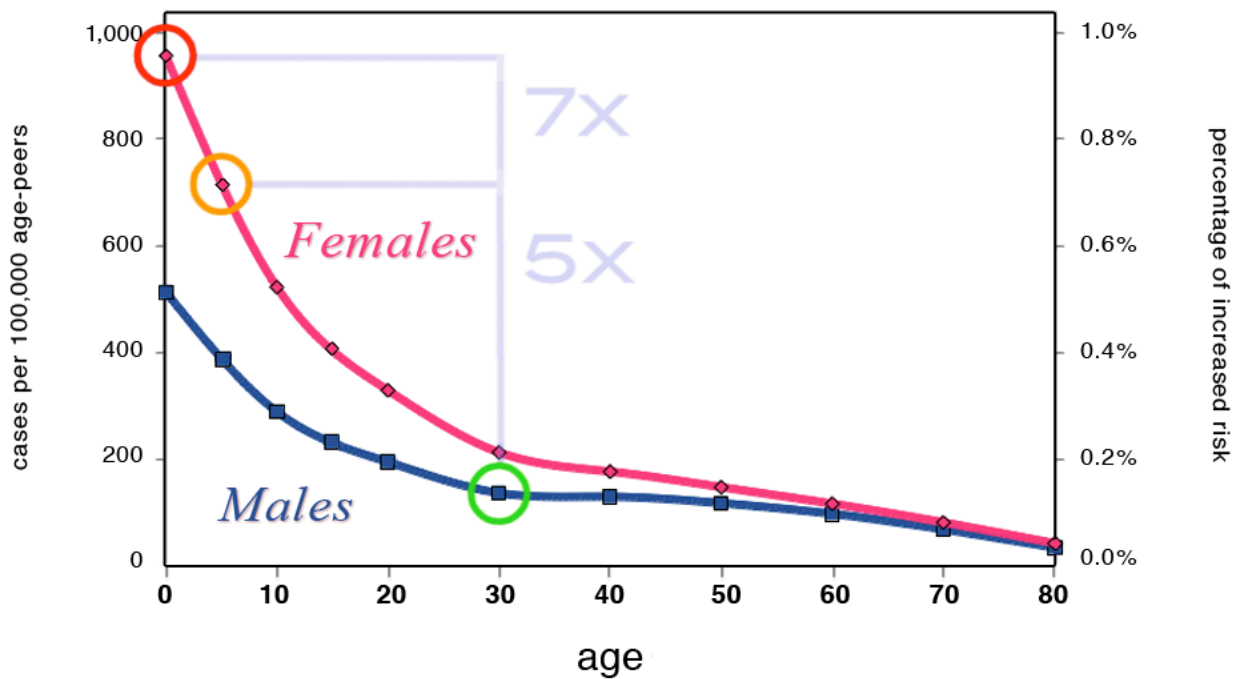
create a graph showing what the outcomes would be given these dose-response curves. A picture tells a thousand words.

The A-Bomb survivor data has many problems: data handling has been controversial; the group that survived the first 5 years to when the study began were “super robust” and therefore not representative of a general population; only external radiation exposure was assumed and tracked while internal doses may dominate in contaminated areas like around Fukushima Daiichi; finally, the origin of the study raises moral issues. Nonetheless, this data from the A-Bomb Survivors is, as stated, the only group that has been tracked for 60 years and the only large group (90,000 in the data core) that includes children and sufficient numbers of females to reflect the public. When a large study contains a “signal” as strong as the one shown here on gender difference, even with reservations about the data, it should not be dismissed.

NRC should disregard the Petition’s call to drop any differentiation or special consideration for the reproductive phase or for age or gender and instead move toward regulation that is more precisely based on the human life-cycle and where the weakest links are: females, particularly young girls, children as a group, and primary germ cells and the development stages pre-birth.

Current regulations define “safe” based on a single data point: the adult male military or paramilitary worker, pictured in the graph below as the GREEN CIRCLE.

### Increased Cancer Risk by Age at Exposure to 20 mSv Radiation



U.S. National Academy of Sciences BEIR VII Phase 2 Risk Model

Decision-makers often only see data that is relevant to the “Standard Man” (green circle) while they see none of the other data on this graph. That needs to change.

B. Linear-No-Threshold:

The second large Data-Set has been created from “Atomic workers” and therefore includes only adults. This group ~250,000 nuclear workers from France, UK and USA is a Data-Set constructed for study. A team lead by Richardson (UNC Chapel Hill, October 2015) looked at exposure-level cohorts in this group, cross-referenced with cancer registries. Their findings show a very high statistical significance that the Linear-No-Threshold model is the “best fit” to the observed human illness and death due to radiation in this enormous body of data.

NRC must not ignore these findings: there is no safe dose of radiation. All exposure, even very low exposure, carries some risk. Data must be the basis of federal protection and NRC is morally, and legally bound to remember that it serves “Human Health” and that, by definition, means all phases of the our species life cycle. As NIRS has, many times asserted: the Standard Man cannot reproduce by himself.

- C. Hormesis is claim that exposure to ionizing radiation is directly beneficial. It is not the same as asserting that medical diagnosis and treatment that rely on radiation confers benefits indirectly by giving the Physician diagnostic tools or means to kill abnormal cells. Hormesis is being promoted in the view of some as a means to limit liability for irresponsible handling of ionizing radiation and radioactivity, and to reduce costs in commercial for-profit businesses that currently must spend money to reduce their impact on people (both workers and the public) and the “Human Environment.”

There is sufficient evidence to end any debate and declare it a fact: radiation exposure never directly improves health. Claims of Hormesis are false.

An interesting aspect of the argument that “radiation is good for you” is the assumption that naturally occurring radiation is, at the very least benign. It has been a real opportunity for NIRS to teach when this assumption has been introduced at educational events that NIRS has sponsored. While NIRS does not subscribe to the “a millirem is a millirem” adage, it is interesting to engage the argument in reverse: if radiation can be used to kill a cancer cell, then why is natural radiation “safe” for other cells?

Two of the more intrepid researchers of the current era, Moeller and Mousseau decided to “ventilate” this question directly.

In 2012 Moeller and Mousseau published “The effects of natural variation in background radioactivity on humans, animals and other organisms” a meta-analysis of 46 papers in the literature, collectively reporting 373 different findings of impact from radiation exposure. The pa-

per looked solely at exposure from background radiation away from industrially contaminated zones.

From the Discussion section of the paper (page 24—25):

Hormesis is defined as a beneficial effect of normal background radiation on life-history traits such as fecundity and longevity compared to levels achieved in the complete absence of radiation (reviews in Kondo, 1993; Luckey, 1991). If hormetic effects of radiation on fitness exist, we should expect that the optimal level of radiation should increase with background radiation level. If hormesis has evolved as a consequence of local adaptation to specific levels of radiation, we might even find that all populations should perform best at some local level of radiation; exceeding their performance in the absence of radiation. The latter scenario would suggest that fitness should be independent of level of natural background radiation. In either case, we should not expect to find increased mutation rates, impaired immune function, increased incidence of disease and increased mortality in areas with higher levels of normal background radiation. Our findings are clearly inconsistent with a general role for hormesis in adaptation to elevated levels of natural background radiation. We note that some effect sizes reported herein were negative, thereby deviating from this expectation. However, these effects were of a level that would be expected by chance, inconsistent with expectations for a hormesis hypothesis.

This is empirical evidence-based conclusions. The authors of the Petitions do not offer similar data to support the assertion that Hormesis exists.

The US EPA concludes its comment on the current proposal:

Given the continuing wide consensus on the use of LNT for regulatory purposes as well as the increasing scientific confirmation of the LNT model, it would be unacceptable to the EPA to ignore the recommendations of the NAS and other authoritative sources on this issue. The EPA cannot endorse basing radiation protection on poorly supported and highly speculative proposals for dose thresholds or doubtful notions concerning protective effects from low-level ionizing radiation. Accordingly, we would urge the NRC to deny the petition.

In addition, NIRS incorporates the comments of the US EPA by reference, here.

Respectfully Submitted,

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Mary Olson  
Director of the Southeast Office  
Nuclear Information and Resource Service

# References and Resources

NAS 2006, BEIR VII (entire free download) Summary: [http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/beir\\_vii\\_final.pdf](http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/beir_vii_final.pdf) and Full: <http://www.cirms.org/pdf/NAS%20BEIR%20VII%20Low%20Dose%20Exposure%20-%202006.pdf>

European Commission on Radiation Risk (ECRR) 2010: *ECRR 2010: The Health Effects of Ionising Radiation Exposure at Low Doses and Low Dose Rates for Radiation Protection Purposes: Regulators' Edition* <http://www.euradcom.org/2010/2010recommendations.htm>

Richardson, et al, October 2015. BMJ. <http://www.bmj.com/content/351/bmj.h5359>

Moeller and Mousseau, 2012. <http://www.researchgate.net/publication/233382836> The effects of natural variation in background radioactivity on humans animals and other organisms

Olson, Atomic Radiation is More Harmful to Women: <http://www.nirs.org/radiation/radhealth/radiationwomen.pdf>

And Arjun Makhijani / IEER Healthy From the Start Campaign on radiation and girls: <http://ieer.org/projects/healthy-from-the-start/>

Stewart, et al, 1958. "Survey of Childhood Malignancies" British Medical Journal, June 28, pages 5086 – 1508. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2029590/>

Ian Fairlie slides: download page here: <http://www.nirs.org/radiation/radhealth/ianfairlieepalecture415.ppt>

Michael Mariotte did a Blog post on Green World: <http://safeenergy.org/2015/08/10/climate-denial-and-radiation-denial/>

**Short 4 minute video on gender and radiation:** <https://www.youtube.com/watch?v=HXRHnfYICrA>

**More general resources on radiation and gender:**

And <http://www.nirs.org/radiation/radhealth/radhealthhome.htm>

Paper I wrote in 1998 with classic references on impact of low-dose radiation:

<https://www.researchgate.net/publication/237320449> Nuclear Waste Isolation Means Zero Release of Radioactivity