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| <b>As of:</b> 7/22/15 9:32 AM<br><b>Received:</b> July 20, 2015<br><b>Status:</b> Pending_Post<br><b>Tracking No.</b> 1jz-8k36-8r3f<br><b>Comments Due:</b> September 08, 2015<br><b>Submission Type:</b> API |
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**Docket:** NRC-2015-0057

Linear No-Threshold Model and Standards for Protection Against Radiation

**Comment On:** NRC-2015-0057-0010

Linear No-Threshold Model and Standards for Protection Against Radiation; Notice of Docketing and Request for Comment

**Document:** NRC-2015-0057-DRAFT-0042

Comment on FR Doc # 2015-15441

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**Organization:** none

**Government Agency:** n/a

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## General Comment

Comment and addenda by Pia C. Jensen 20 July 2015

Re: Docket ID NRC2015 0057 10 CFR Part 20 Comment Tracking Number: 1jz-8jzp-hc8u Linear No-Threshold Model and Standards for Protection Against Radiation [Docket Nos. PRM2028, PRM2029, and PRM2030; NRC20150057]

I call on the Nuclear Regulatory Commission to reject, outright, petitioners requests to change any part of 10 CFR Part 20, Standards for Protection Against Radiation because their proposals are inconsistent with known facts, both recent and historic, and will result in greater risks to populations and ecosystems worldwide, if their requests are enacted.

Please find within my submission for this proposed rule change my comment and supporting references in Addendum A, Pro Con LNT hormesis articles and B, Nuclear Energy Enshrined in Public Law through Finance, False Science, Intimidation, Lack of Ethics and Special Appointments.

Respectfully,

Pia C. Jensen  
Salto, Uruguay

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## **Attachments**

Jensen Comment Docket ID NRC-2015-0057 LNT v Hormesis

Pro Con LNT hormesis articles

Nuclear Energy Enshrined in Public Law through Finance, False Science, Intimidation, Lack of Ethics and Special Appointments

**Docket ID NRC–2015– 0057 10 CFR Part 20 Comment Tracking Number: 1jz-8jzp-hc8u**

*Linear No-Threshold Model and Standards for Protection Against Radiation [Docket Nos. PRM–20–28, PRM–20–29, and PRM–20–30; NRC–2015–0057]*

Comment submission by Pia C. Jensen, retired researcher and former elected official (Cotati, California 1996-2000), regarding Nuclear Regulatory Commission (NRC) rule-making pursuant to 10 CFR Part 2.802 and petitioners' requests that the NRC amend 10 CFR Part 20, *Standards for Protection Against Radiation* with regards to Linear No-Threshold (LNT) hypothesis versus Hormesis.

Petitioners Marcus; Miller; and Doss et al. (Doss on behalf of Scientists for Accurate Radiation Information) address standards for evaluating and responding to radiation exposures. To be specific, they seek to change the standard from LNT to a hormesis model based on what they describe as extensive volumes of research arguing that beneficial effects "may" be derived from low dose exposures to radioactive materials and that the LNT model could result in inappropriate management of populations in the event of radiologic disasters requiring evacuation. Also proposed are the elimination of ALARA guidance (As Low As Reasonably Achievable) <sup>22</sup> from regulations and ending differential doses for pregnant women, embryos and fetuses, and children under 18 years of age <sup>50,51,52</sup>.

Prior to addressing petitioner's arguments for changing the current rule LNT model to a hormesis model, I would like to note that I have no financial or other material interest in this proposal. My motivation is simply to see that the most protective model for managing and evaluating radiation exposure risk is in place for the protection of all people (of all ages & conditions) near and far from nuclear power plants, research sites, waste depositories, and uranium and thorium mining and processing facilities. On the flipside, it is interesting to note that the petitioners are financially motivated with regard to hormesis and radiation research and development. Also of interest is that many of petitioners Marcus and Miller comments are nearly completely identical verbiage <sup>50,51</sup>.

**A. Petitioners' Selected Statements and Requests to the NRC**

**Carol S. Marcus, Ph.D., M.D., UCLA** <sup>50</sup>

1. "There has never been scientifically valid support for this LNT hypothesis since its use was recommended by the U.S. National Academy of Sciences Committee on Biological Effects of Atomic Radiation (BEAR I)/Genetics Panel in 1956."
2. "The costs of complying with these LNT-based regulations are enormous."
3. "The literature showing no effects supports a threshold concept, in which radiation below a certain level is of no concern because it causes no deleterious effects."
4. "The literature showing protective effects supports the concept of hormesis, in which low levels of potentially stressful agents, such as toxins, other chemicals, ionizing radiation, etc., protect against the deleterious effects that high levels of these stressors produce and result in beneficial effects (e.g. lower cancer rates)."

**Petitioner Dr. Carol S. Marcus recommends these changes to 10 CFR part 20** <sup>50</sup>

- (1) Worker doses should remain at present levels, with allowance of up to 100 mSv (10 rem) effective dose per year if the doses are chronic.
- (2) ALARA should be removed entirely from the regulations. The petitioner argues that “it makes no sense to decrease radiation doses that are not only harmless but may be hormetic.”
- (3) Public doses should be raised to worker doses. The petitioner notes that “these low doses may be hormetic. The petitioner goes on to ask, “why deprive the public of the benefits of low dose radiation?”
- (4) End differential doses to pregnant women, embryos and fetuses, and children under 18 years of age.

**Mark L. Miller, CHP, [Sandia National Laboratories]** <sup>51</sup>

1. “This [LNT] overly-simplimied concept assumes that all radiation absorbed doses, no matter how small, have a finite probability of causing a fatal cancer.”
2. “Use of the LNT assumption encourages regulators to ratchet down permissible worker and public radiation levels, either through actual dose limits or use of the “as low as reasonably achievable” (ALARA) principle, giving the illusion that they are making everyone safer”
3. “The literature showing protective effects supports the concept of hormesis, in which low levels of potentially stressful agents, such as toxins, other chemicals, ionizing radiation, etc., protect against the deleterious effects that high levels of these stressors produce and result in beneficial effects (e.g. lower cancer rates).”

**Petitioner Mark L. Miller recommends these changes to 10 CFR part 20** <sup>51</sup>

- (1) Worker doses should remain at present levels, with allowance of up to 100 mSv (10 rem) effective dose per year if the doses are chronic.
- (2) ALARA should be removed entirely from the regulations. The petitioner argues that “it makes no sense to decrease radiation doses that are not only harmless but may be hormetic.”
- (3) Public doses should be raised to worker doses. The petitioner notes that “these low doses may be hormetic. The petitioner states, “[l]ow-dose limits for the public perpetuates radiophobia.”

**Mohan Doss, Fox Chase Cancer Center, USA** <sup>52</sup>

1. “Whereas many publications have claimed support for the LNT model or for low-dose radiation (LDR) cancer risk, careful scrutiny has shown these claims to be

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without merit, as major deficiencies have been identified in their study design, data, analysis, and/or interpretation.”

2. “A comparison of maps of radon levels and lung cancer rates has shown repeatedly that the areas with the highest radon levels generally have lower levels of lung cancer, and the areas having the highest rates of lung cancer generally have lower radon levels.”

3. “The use of the LNT model - based regulations over the years has resulted in a tremendous increase in the staffing of the regulatory agencies and a huge financial benefit for industries and personnel that support compliance with the regulations.”

4. “One reason for the urgency of action on this petition is that any potential future accident involving release of radioactive materials in the USA would likely result in panic evacuation because of the LNT - model - based cancer fears and concerns, resulting in considerable casualties and economic damage such as have occurred in Fukushima. The recognition of a threshold dose by NRC would obviate the need for such panic evacuations, associated casualties, and economic harm.”

5. “Since the main body of evidence that has been used to justify LDR cancer concerns and the LNT model, the atomic bomb survivor data, does not support the LNT model but is more consistent with radiation hormesis, and in view of the large body of unrefuted evidence for radiation hormesis, the LNT model - based regulations have likely caused a large number of preventable cancer deaths over the years, by prohibiting the study and application of radiation hormesis to prevent cancers. The large magnitude of these preventable deaths would justify a Congressional inquiry to determine why the scientific leaderships of the regulatory agencies and advisory bodies have failed to recognize the published evidence against the LNT model and supporting radiation hormesis for such a long period of time, and what role self-interest may have played in motivating these actions by the agencies and advisory bodies.”

**Petitioner Mohan Doss et al. recommends these changes to 10 CFR part 20** <sup>52</sup>

Simply states support for changes recommended by Marcus.

**B. Response to petitioners’ statements and requests.**

Petitioners’ Marcus, Miller, Doss et al. (MMD et al.) address two radiation exposure models <sup>50,51,52</sup> without citing recently published extensive research by Klervi Leuraud, David B Richardson, Elisabeth Cardis, Robert D Daniels, Michael Gillies, Jacqueline A O’Hagan, Ghassan B Hamra, Richard Haylock, Dominique Laurier, Monika Moissonnier, Mary K Schubauer-Berigan, Isabelle Thierry-Chef, and Ausrele Kesminiene: *Ionising radiation and risk of death from leukaemia and lymphoma in radiation-monitored workers (INWORKS): an international cohort study* <sup>3</sup>. This is an important study refuting some claims made by petitioners’ MMD et al. and which, more specifically, “provides strong evidence of positive associations between protracted low-dose radiation exposure and leukaemia.” Other important studies completed since 2011 are also ignored by MMD et al.. Some of these papers are in **References** below my comments.

MMD et al. do not sufficiently address proven differences between people of varying ages, gender, status of health, or fetal susceptibility to ionising radiation. Not all people,

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especially the unborn, are created equally and do not respond equally to radiation exposures, at any dose level, internal or external. Women, children and fetuses in particular evidence greater responses to low dose ionising radiation than other members of society <sup>4,5,6,7,25,31,32,34,35,36,37</sup>.

*One possible reason why genetic effects from low dose exposures have not been observed in human studies is that mutations in the reproductive cells may produce such significant changes in the fertilized egg that the result is a nonviable organism which is spontaneously resorbed or aborted during the earliest stages of fertilization.*

~ U.S. Nuclear Regulatory Commission <sup>36</sup>

MMD et al. consider the currently used model, LNT, to be overly simplified, when in fact, their proposed model, Hormesis, is far more simplified and resembles a “one size fits all” philosophy without taking into account vastly different responses people have to radiation exposure, nor do they account for the wide variety of types of radioisotopes which people may be subjected to. In fact, MMD et al. are negligent by not discussing the fact there is no 100% effective technological or human controlled “regulators” or filters to manage radioisotope quantities (or quality) that people may be exposed to in the event of catastrophic events resulting in agency’s raising *legally allowable limits* <sup>19,46</sup>, or even during “normal” leaks from nuclear power facilities. Additionally, the US Environmental Protection Agency’s monitoring stations are either underfunded, broken, or taken offline resulting in an inability to effectively determine quantity and quality of radioactive emissions in those locations not being monitored (reference: Addendum B - Environmental Dimensions Inc., RadNet, FBO Contract). As of 1 June 2015 only 37 of 124 radiation monitoring stations were functioning. While the EPA and NRC may not be concerned that they are not fulfilling their mandates to protect populations and environments, growing public concern exists which federal regulators should sincerely take note of <sup>14,23,24,26,27,28</sup>.

MMD et al. discuss perceived beneficial effects as though their “one size fits all” proposal will result in absolute and standardized responses by all people, all the time. It is simply not possible to predict or control, en todo, full impacts of radiation exposures among vastly different populations <sup>11,15,17</sup>. In fact, serious limitations exist and “general scientific consensus is currently in favour of the LNT model as the most appropriate dose–response relationship for radiation protection purposes at low doses.” <sup>41</sup>

MMD et al. do not sufficiently address variances in types of radiation and related toxic gas exposures that people, both workers and citizens, may be subjected to in cases of employment hazards, project failure (Hanford <sup>43,44</sup>, for example), or catastrophic events such as Three Mile Island, Chernobyl <sup>42</sup>, and more recently, Fukushima with its multitude of daughter products emitting from Tokyo Electric Power Company’s facilities into the Pacific Ocean and the world’s atmosphere every day since March 2011 <sup>45,47</sup>. Even if radiation exposures could be limited to a controlled low dose, negative impacts will still occur. Petitioners’ are asking the NRC to do the impossible - approve of changes based on a myth that nuclear related events are containable with regard to the amount and type of radiation people and ecosystems are subjected to. Petitioners’ requests read like an act of desperation to curry favor for the nuclear industry.

In the body of their presentations, MMD et al. cite a few studies to support their claims, when, in fact, research done regarding the effects of ionising radiation upon the environment and carbon based life is not thorough with regards to global medical and

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ecological implications related to how radioisotopes are transported around the world. For example, multiple countries (Austria, Sweden, Finland, Norway, Slovenia, Poland, Romania, Hungary, Switzerland, Czech Republic, Italy, Bulgaria, Republic of Moldova and Greece) experienced increased rates of diseases related to the Chernobyl event in 1986 and Fukushima's releases are currently transferring around the world by jet streams, rain, ocean currents, and biotic transference via flora and fauna (bio-accumulation). Extensive documentation on radioisotope deposition and health impacts are presented by researchers, agencies, and organisations utilizing data from sources such as the Comprehensive Nuclear-Test-Ban Treaty (CTBT <http://ctbto.org/publications/>) and publications presented by Greenpeace: The Chernobyl Catastrophe Consequences on Human Health <sup>1</sup>, but are not cited by the petitioners. In fact, the vast majority of research referenced by the petitioners were published pre- 2012 and, unethically, Doss has a propensity for self-citing, including unpublished opinion [obviously not peer-reviewed] <sup>52</sup>.

MMD et al. neglect factors of bio-accumulation and bio-magnification or, bio-concentration, with regards to man made radioisotopes entering ecosystems and up-take by flora and fauna, resulting in increased radioisotope capacity to cause human health damage as the isotopes move through the food chain. Petitioners neglect important issues of bioaccumulation or bio-concentration which are factually evident as presented in studies on the impacts of radioactive releases near nuclear facilities. In particular, the Department of Energy contracted research on aquatic environment near the Savanna River site in South Carolina which demonstrates bio-concentration in local flora.<sup>33</sup> Long-term deposition in ecosystems is an important part of the equation in radiation protection, especially for hunters and those who purchase or gather commercially available and wild foods <sup>48,49</sup>.

MMD et al. reference radiation research involving mice. Pigs, aka, swine, are historically the only animal used in research to accurately determine potential biological impacts of various compounds due to their physiological similarities to humans <sup>29,30</sup>. In fact, at least one study conducted by researchers at MIT was debunked by Ian Goddard in 2012 <sup>9</sup>. Petitioners' use of mouse research is flawed because mice and humans do not share the same, critically important, biological responses to radioisotopes <sup>8,9,10</sup>.

Much of the research and studies referenced by MMD et al. conclude that more research is required to fully understand hormesis. This is important to note when considering the history of the nuclear industry in general and conflicting information representing an industry based on an incomplete science (reference: Addendum A). Claims by nuclear proponents are often made without having gone far beyond theoretical and experimental stages of nuclear energy production or medical uses involving radiation. The science is scientifically and publicly acknowledged as incomplete. Hence, populations should not be subjected to more theoretical experimentation because people with vested interests in their chosen field of employment want to relax laws intended to protect the public. Statistically significant data supporting petitioners' claims, such as can be found in meta-analysis, simply does not exist. I challenge Marcus, Miller, & Doss et al. to produce meta analysis of significant consequence that supports their claim that hormesis is substantially better than the current LNT model for protection of human and animal populations and ecosystems.

MMD et al. contend that in areas of higher radon exposure, lower incidence of lung cancer exists. This is another fine example of how the petitioners' cherry pick information from decades old research conducted by sole authors to support their claims. Since researchers cited by MMD et al. (Bernard L. Cohen and Bobby Scott) produced their

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limited research on radon, multiple studies have been produced by multiple authors <sup>38,39,40</sup>. Those studies clearly debunk Cohen and Scott's claims. Doss actually goes so far as to cite their own, unpublished research, to support their claim. On a personal note, I find petitioners' practice of citing outdated, limited, and unpublished research highly unethical and worthy of further investigation for they would like to convince the United States government to change federal rules based upon their claims, which are easily proven false.

MMD et al. focus primarily on just a few types of deleterious effects that may arise from radiation exposures, disregarding other critical biological responses such as organ damage, musculo-skeletal and connective tissue system response, brain dysfunction, respiratory disease, hormone dysfunction, infectious diseases, non-malignant conditions of the blood vascular system, autism, digestive system dysfunction, early and excess mortality, and genetic heredity of damaged DNA resulting in a wide variety of birth defects. Impacts upon flora, fauna and plant seed stock are also ignored by MMD et al. <sup>1,3,4,5,6,7,12,13,15,18,20,21,32,33,36</sup>.

Arguments in favor of hormesis appear to be strongly financially related <sup>50,51,52</sup>. With the hormesis model in place, researchers benefit and the nuclear industry in general benefits because they won't be burdened <sup>16</sup> with what petitioners consider to be excessive costs to manage known and unknown impacts of ionizing radiation during normal and catastrophic events. Changing rules intended to protect populations for economic reasons ignores the purpose of agencies charged with medical and environmental protection.

While I personally believe that no dose is safe based upon historic and ongoing effects from Chernobyl and depleted uranium exposures in Fallujah, I do believe that the LNT model is the best known model because it takes into account the differences between people and recognizes that distance of populations from nuclear facilities during releases does make a difference with regards to medical implications of exposed populations. A hormesis model, on the other hand, rejects known variations of medical consequences of exposures as well as the fact there are no effective controls for the quality or quantity of isotopes released during events.

Mothersill and Seymour contend that "previously held views about safe doses or lack of harmful effects cannot be sustained" in *Radiobiology and Environmental Security* <sup>32</sup> supporting the idea that exposing populations to radiation is complex, unpredictable and without merit. There is no thoroughly researched scientific basis for using a hormesis model.

I call on the Nuclear Regulatory Commission to reject, outright, petitioners' requests to change any part of 10 CFR Part 20, *Standards for Protection Against Radiation* because their proposals are inconsistent with known facts, both recent and historic, and will result in greater risks to populations and ecosystems worldwide, *if their requests are enacted*.

Changing the current LNT model to a hormesis standard may also expose the Nuclear Regulatory Commission to unnecessary legal challenges at the expense of tax payers for neglecting their federal mandate to protect public health and safety and the environment (<http://www.nrc.gov/reading-rm/doc-collections/nuregs/brochures/br0256/>). Petitioners' sense of urgency does not constitute valid reasoning for changing the current rule. But, it does evidence their desire to fast-track changes so their collective may avoid deeper scrutiny of nuclear industry practices and performance in general. It appears they just want industry to be left "off the hook" in the case of emergencies and worker exposures. For



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example, in 2012 it was reported that south eastern United States experienced “**anomalously high**” depositions of radioiodine (I-131) and polonium ( $^{210}\text{Po}/^{210}\text{Pb}$ ) after Fukushima’s massive explosions as reported in Depositional fluxes and residence time of atmospheric radioiodine (I-131) from the Fukushima accident<sup>2</sup>. Full impacts of TEPCO’s disastrous events will not be completely understood for at least another 10-40 years. No rushing of nuclear proponents’ desires ought be made because the physics of nuclear incidents are not yet well known and outcomes take time to manifest. Acting hastily on behalf of nuclear proponents will likely expose the NRC to harsh scrutiny, judgement, and credibility challenges worldwide.

Lastly, petitioners note that conflicts of interest<sup>10</sup> may exist with NRC practices. This is one point on which we concur, though for different reasons. I recommend that the U.S. Government Accountability Office (<http://www.gao.gov/>), POGO: Project On Government Oversight (<http://www.pogo.org/>), and Transparency International - The Global Anti-Corruption Coalition Against Corruption (<https://www.transparency.org>) conduct deep audits of relationships between the NRC and nuclear promoting entities such as the Organisation for Economic Cooperation & Development, the International Atomic Energy Agency, the Nuclear Energy Institute, and even General Electric Corporation’s CEO, Jeffrey Immelt for apparent undue influence upon federal decision-making with regards to nuclear energy, radiation monitoring, and oversight and guidance (reference: Addendum B).

Perhaps the petitioners’ would like to plunge the world back into a 1950s mindset, but, it is obvious that the rest of the world, those with no vested interest in nuclear energy, would prefer to advance, safely.

Note: Additional related references in **Addendum A and Addendum B** submitted to compliment my comments.

Sincerely,

Pia C. Jensen  
Salto, Uruguay

*Many uncertainties remain. In particular there are still very few estimates of non-cancer mortalities attributed to Chernobyl, while long latency periods for development of cancers (in some cases greater than 40 years) inevitably mean that new cases are likely to emerge well into the future.*

~ The Chernobyl Catastrophe Consequences on Human Health

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**Addendum A:** *List of news found via google searches regarding radiation exposures (LNT v Hormesis)* <https://drive.google.com/file/d/0B7PbzAzkdGjNUGdQcFZ4NVg0YjQ/view?usp=sharing>

**Addendum B:** *Nuclear Energy Enshrined in Public Law through Finance, False Science, Intimidation, Lack of Ethics and Special Appointments* <https://drive.google.com/file/d/0B7PbzAzkdGjNUvYvYhZQl9vUHc/view?usp=sharing>

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