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PublicComment-Report

November 11, 2015

U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001,

ATTN: Rulemakings and Adjudications Staff.

To whom it may concern:

I am writing in support of the proposed rule change requesting that the NRC amend its "Standards for Protection Against Radiation" regulations and change the basis of those regulations from the Linear No-Threshold (LNT) model of radiation protection to the radiation hormesis model. I have specifically addressed the call for reevaluating acceptance of an old model that produces negative images and implications of health risks derived by unscientific extrapolations of harmful effects of low doses. In my discussion I have concluded why the LNT model should be replaced and included reasons supporting the change to the hormesis model. There is considerable evidence that conflicts with the LNT model for low doses. Regulatory authorities need to examine the scientific evidence and communicate the real health effects of nuclear radiation.

Sincerely,

Aprille Darang

Introduction

The U.S. Nuclear Regulatory Commission is requesting public comment in regards to petitions requesting the commission change the basis of its "Standards for Protection Against Radiation" regulations from the linear no-threshold (LNT) model of radiation protection to the radiation hormesis model. According to the LNT model, there is no dose threshold at which radiation damage does not occur. It assumes that the health damage caused by ionizing radiation is directly proportional to the dose of radiation, at all dose levels. In contrast, the radiation hormesis model theorizes that low-dose radiation is essentially safe and beneficial to health by stimulating adaptive protection mechanisms in the human body.

I am in favor of amending the commission's regulation standards by replacing the LNT model of radiation risk to the radiation hormesis model. The NRC, including the EPA have been guided by the LNT model's precautionary principle, assuming the worse can be hazardous to your health unless you can prove otherwise. There is considerable evidence that conflicts with the LNT model for low doses. This includes data from atomic bomb survivors, fundamental research and experiments that support actual observed health effects of observed low doses of radiation. LNT based regulations may not be the best way to protect and promote public health because these regulations ignore the fact that biological mechanisms of natural radiation protection may reduce damages caused by small doses of radiation. Regulatory authorities need to examine the scientific evidence and communicate the real health effects of nuclear radiation. These petitions address the issue of reevaluating acceptance of an old model that produces negative images and implications of health risks derived by unscientific extrapolations

of harmful effects of low doses. The radiation hormesis model reorients what is true about radiation, citing how health benefits instead of risks can and do occur at low levels of exposure.

Discussion

For regulatory agencies the LNT model determines there is no safe level of exposure when dealing with carcinogens and radiation. Extrapolation of data from epidemiological studies rooted in uncertainty is the main challenge facing environmental risk assessment (Calabrese, 2004). Over the past 20 years Dr. Edward Calabrese has carried out extensive research in the field of hormesis. The concept of the hormesis model would introduce important implications for toxicology, risk assessment, and medicine. Adoption of the hermetic model in environmental risk assessment would replace the outdated LNT model and its basis of assumptions. Calabrese argues that "the assumption of a linear relationship between dose and response completely ignores the fact that our bodies and our cells have developed mechanisms to detoxify harmful chemicals and exposure to radiation- in fact, low doses may even trigger responses that are beneficial". The public needs to be aware that the LNT predictions are scientifically questionable and should be replaced with a verifiable dose-response model, such as the hormesis hypothesis that can actually be tested with the available data (Calabrese, 2014).

The appropriateness of the use of the linear no-threshold model for calculating carcinogenic effects raises doubts from updated reports of Hiroshima-Nagasaki survivor data. Analysis of these reports were found to be unsupported by the LNT model, but shows evidence for a radiation hormesis model. Restrictive functional forms that were used to fit the data in

the recent updated report on the atomic bomb survivor cancer mortality data may have resulted in the conclusion of zero threshold dose for carcinogenic effects of radiation (Doss, 2013). It was concluded in the 1950-2020 Life Span Study on the cancer mortality of the atomic bomb survivors that, "the effects of the radiation exposure are grossly overstated and do not reflect the real risks to members of the public," (Cuttler & Pollycove 2009). Less than 1 percent of the survivors died from cancer after 40 years, in contrast to the uninformed expected range of 10-30 percent of survivors.

The dominant paradigm of the LNT hypothesis has prevented the use of radiation hormesis to be investigated in humans. In a clinical study, non-Hodgkin's lymphoma patients were given low dose radiation treatments between standard therapy treatments that resulted in reduced metastases and improved survival rates (Doss, 2013). Enabling prospective study of radiation hormesis for cancer prevention would require advisory bodies that have supported the use of the LNT model to review their recommendations in light of new evidence observed in atomic bomb survivors. Evidence for the phenomenon of radiation hormesis can be achieved through success in clinical trials that would reduce and eliminate the public's carcinogenic concerns regarding low dose radiation.

Rejection of radiation hormesis is prompted by lack of sufficient evidence to produce major changes in protection standards. According to the LNT model there is no threshold at which radiation damage occurs. Although there are biophysical processes that disprove the LNT model is incorrect at small doses. Experimental and epidemiological evidence for radiation hormesis include stimulated adaptive protection mechanisms in the human body and free radical detoxification from responses of low dose. It has been observed that there is a strong

negative correlation between background radiation level and deaths caused by cancer. One study found that the adjusted cancer mortality rate in the Gulf coast states with low Radon levels is 1.26 times higher than in the Rocky Mountain states that have 3.2 times higher natural background Radon levels (Jolly & Meyer, 2009). Other biological studies have shown that significantly lower incidence of DNA damage than the control human lymphocytes were observed in lymphocytes from individuals living in high background radiation areas irradiated with a 1.5 Gy challenge dose (Jolly, 2009).

Nuclear power has been a controversial energy option due to concerns regarding health risks and environmental damage associated with radiation and radioactive waste. There is epidemiological evidence for radiation hormesis as a plausible explanation for reduction in cancer risks among worker populations exposed to radiation. Little evidence linking low doses of external ionizing radiation and chronic lymphocytic leukemia mortality was observed in the largest nuclear cohort study to date. No excess of death from leukemia or thyroid cancer was found among the 954 Canadian military personnel exposed to low-dose ionizing radiation during clean-up operations for a nuclear reactor in Ontario (Vaiserman, 2010). Another study showed much lower cancer mortality rates were found in 45,468 Canadian nuclear power industry workers than in the general population. Furthermore, radiation workers in the United Kingdom also observed a negative association between radiation exposure and mortality from leukemia and multiple myeloma. In one recent study, lung cancer incidence was found to be significantly lower in U.S. states where nuclear testing occurred or where uranium was mined (Lehrer & Rosenzweig, 2015). Results observed that more background radiation exposure was associated with less lung cancer. In regards to the workers at risk in the U.S., power plants

have been designed with the latest technology and monitored by comprehensive procedures. Reactor safety remains a top priority. Even so, ionizing radiation exposure risk and precautionary radiation regulations need to be revised.

Conclusion

The increasing number of research challenging the illogical LNT approach adds to the body of evidence suggesting that the LNT model of radiation carcinogenicity in cancers and other deleterious effects might not be correct. The studies support that at certain low levels radiation exposure may do more good for human cells rather than harm. In fact, low dose radiation may prevent tissue damage, aid in genetic repair, and other benefits. Evidence includes the phenomenon of radiation hormesis in atomic bomb survivor data, toxicology assessments, and in background environmental and work exposure. In addition, radiation hormesis has been observed as a method of reducing, preventing, and treating cancers.

The assumption that all radiation levels are dangerous based on the Linear No Threshold model is misleading given the scientific literature and current research. While effects of high doses of radiation are clear, the science is less clear when it comes to low dose radiation. Although research on low dose radiation is difficult, there has been an increasing understanding of its health effects and benefits. The play-it-safe approach when considering low dose radiation by regulatory agencies is questionable and allowing its continued basis for "Standards for Protection Against Radiation" regulations needs to be reexamined. Expert radiologist Jaworowski (2008) advises "The 'precautionary principle', reducing the exposures ever lower and at any cost, proved not to be 'cautionary' at all. It has led to unacceptable societal

penalties... The time has come to change the lithified LNT paradigm and to base radiological safety and protection on modern knowledge and the realities of the natural radiation environment". These are fundamental claims that can only be supported with the acceptation of the radiation hormesis model and replacement of the LNT model of radiation.

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