

From: [Cindy Folkers](#)
To: [RulemakingComments Resource](#)
Subject: [External_Sender] Beyond Nuclear comments on PRM-50-123; NRC-2020-0155
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Attachments: [Annex A Studies of radiation damage.pdf](#)
[Beyond Nuclear comments PRM-50-123.pdf](#)

Attached please find comments on Docket No. PRM-50-123; NRC-2020-0155 Public Protective Actions During a General Emergency from Beyond Nuclear and accompanying annex A.

Thank you.

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November 16, 2020

COMMENTS ON Docket No. PRM-50-123; NRC-2020-0155
Public Protective Actions During a General Emergency
Submitted by email to Rulemaking.Comments@nrc.gov
NUCLEAR REGULATORY COMMISSION
10 CFR Part 50

Thank you for the opportunity to comment.

Beyond Nuclear is providing comments regarding Petition for Rulemaking 50-123 (PRM-50-123) as currently docketed before the US Nuclear Regulatory Commission (NRC) that argue that the petition should not be accepted for review by the agency.

Mr. Thomas McKenna's petition, at its core, contends that evacuation is one action that would "result in more excess deaths than the radiation exposure [it was] intended to prevent." Therefore, petitioner seeks to have the U.S. Nuclear Regulatory Commission "amend, as needed, its requirements (10 CFR 50.47, Appendix E to Part 50), implementation guidance and supporting analysis, materials and activities such that protective actions implemented during a General Emergency at a nuclear power plant will most likely do more good than harm when both the possible physical health effects of radiation exposure and protective actions are taken into consideration."

Petitioner McKenna's argument seeks to significantly diminish public protection from the established deleterious effects from radiation exposure and diminish the longstanding philosophical foundation of nuclear power oversight known as "Defense-In-Depth." The outcome would be to significantly diminish the nuclear industry's liability for the precipitating accident and what can be extremely prolonged, complicated dislocation and recovery cost. Mr. McKenna focuses his attack on the last line of defense for public safety and health, that being, offsite emergency planning and preparedness to include evacuation. The fundamental idea of evacuation as part of emergency preparedness in event of a severe nuclear accident is to prepare the public to put as much distance between downwind populations and the radioactivity as is reasonably and quickly achievable. The result is recognized in the public's perception as offsite emergency planning. As such, emergency preparedness is fundamentally a part of the federal and state licensing agreement to operate nuclear power stations.

As has been established in NRC regulations and guidance since 1978, the last line of defense for public safety is the "evacuation planning zone" (EPZ), currently established as within a ten-mile radius. Contrary to what Mr. McKenna is proposing, as demonstrated by the severe accidents at Chernobyl and Fukushima, evacuation planning and preparedness should be expanded, not diminished. Furthermore,

according to an NRC and EPA task force in NUREG-0396, *Planning Basis for Development of State and local Response Plans in Support of Light Water Nuclear Power Plants* (1978), “Emergency planning is not based on quantified probabilities of incident or accident.” [p.11] The NRC task force further concluded, “radiological emergency planning is not based on probabilities, but public perceptions of the problem and what could be done to protect public health and safety.” [p. 11] The report described that while severe nuclear accidents could be “comparable in some senses in severe natural and manmade disasters which would trigger an ultimate protective measure such as evacuation, do require specialized planning considerations.” [p.26]

Instead, Mr. McKenna seeks to eliminate evacuation readiness under the guise of saving lives from federal and state mass relocation actions and associated risks and stresses. The petitioner surmises that it is better-- rather than evacuate populations from the deleterious effects of radiological exposure--to increase the population exposure (men, women, pregnant women, children and infants). To the contrary, federal and state emergency planners and the nuclear industry should be required to expand public education and readiness to radiological threats much the same way the public schools exercise fire drills to increase the student body response effectiveness to real threats.

It is as disingenuous to suggest that civil society eliminate evacuation preparedness from natural disaster because relocation/dislocation can induce the same physical and stress consequences as do population relocation and dislocation from radiological accidents. Forest fires have disrupted and relocated entire communities albeit on significantly smaller scale. Radiological dislocation of large populations disrupts homes, entire communities and economies. Mass dislocation by a nuclear accident will significantly extend and deepen the population trauma experience. However, while governments bear responsibility to aid and assist its citizens in response to natural disaster, nuclear disaster should require that industry liability bear more, not less, responsibility to its victims. The Japanese dislocation traumatization following Fukushima Daiichi demonstrates the physical and psychological effects of extended relocation and economic hardship, but also by the traumatization of government / industry to forcibly relocate those same populations back into still contaminated communities and environments or lose their disaster relief assistance.

SOARCA needs serious adjustment before using it to assess deaths from nuclear emergencies

However, petitioner relies on assumptions in the *State-of-the-Art Reactor Consequence Analyses (SOARCA) Report* for estimation of deaths from a General Emergency. At the time SOARCA was released, concerns were raised by reactor communities for several reasons that have not been resolved; some of these reasons are recognized by the petitioner himself. Some outstanding concerns, from public

comments on SOARCA, are summarized with detailed explanations found in the original submitted comments^{1,2}:

1. NRC assumes design and vent failures at the Fukushima Daiichi Mark I reactors will not be a problem at current reactors
2. NRC assumes a severe accident probability that is too low
3. NRC assumes that resources are available in a timely manner to mitigate a severe accident
4. Risk coefficients are based on old health consequence studies
5. Computer simulations used by SOARCA would have failed to predict all of the real-world nuclear power catastrophes occurring thus far

All of these shortcomings would need to be corrected before any comparison between deaths from evacuation and shelter-in-place are made using SOARCA modeling and assumptions.

A serious meltdown with release of radiation and widespread contamination has occurred every seven years on average. That's pretty probable.

Petitioner assumes that severe consequences are improbable and therefore uses exposure scenarios that choose less severe impacts. But the actual occurrence of severe accidents from meltdowns has been a single core meltdown about every seven years. Therefore, calculating exposures for severe consequences is absolutely warranted. Additionally, there were three cores that melted down at FDNPP indicating that civilian nuclear sites with multiple cores carry greater probability of multiple core failure.

When Japanese regulators allowed Oi to restart, they really believed that the chance of a meltdown was about one in a million. If you take a million and divide it by the 400 nuclear power plants in the world, you come up with the probability of a nuclear accident of about once every 2,500 years. But what has history shown us? History has shown us we had a meltdown at Three-Mile Island, we've had a meltdown at Chernobyl, and we've had three melt-downs at Daiichi, in 35 years... So the question is, should we believe history, or should we believe [regulators?]³

No government agency had predicted reactor meltdowns every seven years. Four of these were U.S. designs. Three were in the same complex, boding ill for the probability of meltdown at SMR sites.

For small modular reactors, unsupported claims of inherent safety, like a claim of NuScale passive cooling (shown to lead to a fatal design flaw with normal operation), have lead industry to push for

placing SMRs in riskier situations such as locations in densely populated urban areas, elimination of personnel, containment, and safety systems. But SMRs are *not* inherently safer. SMR core damage risk per module due to operator error is higher for some designs than most light-water reactors; and SMRs can release highly dangerous amounts of radioactivity with some designs releasing huge amounts of cesium 137 and xenon. For the NuScale SMR, there can be up to twelve reactor modules on a single site and while each one carries less radioactivity, common cause failures and acts of sabotage could lead to multiple meltdowns or irradiated fuel pool failures, obviating any safety and dose reduction from smaller single cores.

Since thyroid cancer is the most recognize health impact from nuclear meltdowns, it needs to be assessed in the context of this petition, as do thyroid diseases that are not cancer.

Petitioner further recognizes that thyroid cancers are not addressed in this petition in part because the latest NRC study of NPP emergencies (NRC 2013a) does not provide estimates of thyroid cancer rates and subsequent health effects. Children's thyroids are particularly susceptible to radiation, with cancers often appearing as soon as one year after exposure.⁴ By the reckoning of several radiation committees, industry and government, thyroid cancer is the largest health risk. Failure to account for this risk is NOT alright when considering replacing evacuation with shelter-in-place.⁵

Despite claims that any thyroid cancer increases in those exposed as children at the time of the FDNPP meltdown and release are due to overdiagnosis, clinical details of thyroid examinations show most thyroid cancer cases were not innocuous. The cancers had invaded nearby tissues such as lymph nodes, lungs, trachea, and nerves — indicating that thyroid removal was recommended for the purpose of avoiding death by metastatic cancer and therefore not merely a result of overdiagnosis. The ratio of female to male cancers was nearly 2 to 1.^{6,7}

Current research has found that thyroid cancers in members of the TMI community carry a biological mark specific to radiation exposure⁸, are more aggressive and appear earlier, than thyroid cancers outside of the TMI community. Although research is ongoing, these studies reveal that radiation from TMI may be implicated⁹ in thyroid disease, demonstrating why non-cancer impacts are an important consideration in deciding between evacuation and shelter-in-place.

Radiation affects women, children, and pregnancy disproportionately. Any consideration of shelter-in-place replacing evacuation MUST include a thorough assessment of this impact and focus on protection.

Further, petitioner mentions limitations including SOARCA's failure to consider all important early radiation-induced health effects (e.g. to the embryo/fetus). Early human life stages (pregnancy and childhood) and females are especially susceptible to damage from radiation. Paying special attention to the impact on reproductive health is important for two reasons:

1. the vulnerability of pregnancy and childhood can not only lead to health impacts during these stages, but exposures during these stages can cause diseases years later when the person is an adult; and
2. this lifetime risk from early developmental exposure is all but ignored in radiation exposure standards in the US. All childhood cancers start to increase at exposures not much more than *natural* annual doses.

Among childhood cancers, leukemia and central nervous system cancer risks predominate. There appears to be a strong impact of radioactive contamination on individual fitness in current and future generations, with potentially significant population-level consequences, even beyond the area contaminated with radioactive material. Radioactivity is also associated with negative, subclinical health impacts such as impaired neural development and lower I.Q. Radiation appears to act along the estrogen pathway, hinting that, in addition to a carcinogen, radioactivity may be an endocrine disruptor. Estrogen plays key roles in healthy pregnancy and puberty and is greater in women than men. For summary and references on fetal and female health impacts, see Annex A: *Studies of radiation damage*, included in an additional email attachment as part of these comments. Annex A can also be found at <http://static1.1.sqspcdn.com/static/f/356082/27892589/1545158757637/study+references+handbook+health+chapter.pdf?token=UWBBZx6uXtKvIEAYjmTquF%2FHH3E%3D>

While petitioner recognizes that the non-cancer, non-mortality impacts of radiation exposure are uncertain, petitioner uses only cancer and other deaths, not cancer incidence or other health impacts, to argue against evacuation. But death shouldn't be the only health impact considered. Radiation's impact extend far beyond death and an adequate comparison of health impacts cannot be made without incorporating ALL health impacts into a determination on whether or not to evacuate. See attached Annex A for summary and references on non-cancer, non-mortality health impacts and recent research on the impacts of inhabiting contaminated areas for generations.¹⁰

Limitations and uncertainties are too abundant to recommend risky shelter-in-place, instead of evacuation, in the event of a General Emergency at nuclear facilities.

Finally, petitioner recognizes that non-radiation related early and later death estimates for dislocation due to the FDNPP meltdowns are uncertain, including “[r]eliability of the estimate of the excess early deaths

among the public...[r]eliability of the estimates of the excess late deaths following dislocation due to medical conditions...”

There is not enough evidence to claim evacuation is ultimately worse than shelter-in-place. The limitations recognized by even the petitioner SHOULD be enough to reject his petition. Add to that the empirical data that we do have in studies of catastrophic accident impacts, and it is clear we should be preparing for an organized evacuation in a larger geographic area than even currently planned. Any adjustment to any General Emergency guidelines or recommendations should protect for both uncertainties and limitations recognized by petitioner and others, and the disproportionate impacts indicated in the empirical data. Therefore, Beyond Nuclear asks that NRC deny petitioner’s request.

References

¹ Lampert M. 2012. *COMMENTS DOCKET ID NRC-2012-0022 STATE-OF-THE-ART-REACTOR CONSEQUENCE ANALYSES (SOARCA) REPORT DRAFT FOR COMMENT*. Pilgrim Watch. February 28.

² Portzline S. 2012. *COMMENTS DOCKET ID NRC-2012-0022 STATE-OF-THE-ART-REACTOR CONSEQUENCE ANALYSES (SOARCA) REPORT DRAFT FOR COMMENT*. Three Mile Island Alert. February 28.

³ Gundersen A. 2012. *Lessons from Fukushima: A Lecture by Arnie Gundersen*. Fairewinds Energy Education. September 3.

⁴ Howard, J. 2012. Revised 2013, 2014, 2015. Minimum Latency & Types or Categories of Cancer. *9.11 Monitoring and Treatment*. World Trade Center Health Program.

⁵ Crane P. 2012. *Comment On: NRC-2012-0022-0005 State-of-the-Art Reactor Consequence Analyses Reports*. Thyroid Cancer Survivors' Association support group, Seattle, Washington. February 24.

⁶ Hiranuma, Y. 2016. Clinicopathological Findings of Fukushima Thyroid Cancer Cases: October 2016. Fukushima Voice version 2e. Retrieved from <https://fukushimavoice-eng2.blogspot.com/2016/10/clinicopathological-findings-of.html> Accessed 3 March 2019.

⁷ Hiranuma, Y. 2018. Fukushima Thyroid Examination Fact Sheet: 2017. *KAGAKU* Oct. 88 (10).

⁸ Goldenberg, D., Russo, M., Houser, K., Crist, H., Derr, J. B., Walter, V., Warrick, J. I., Sheldon, K. E., Broach, J., & Bann, D. V. 2017. Altered molecular profile in thyroid cancers from patients affected by the Three Mile Island nuclear accident. *The Laryngoscope*, 127 Suppl 3, S1–S9. <https://doi.org/10.1002/lary.26687>

⁹ Solovey M. 2017. Possible correlation shown between TMI nuclear accident and thyroid cancers. Penn State News. May 31. Retrieved from <https://news.psu.edu/story/469874/2017/05/31/research/possible-correlation-shown-between-tmi-nuclear-accident-and-thyroid> accessed November 10, 2020.

¹⁰ Korsakov, A.V., E.V. Geger, D.G.Lagerev, L.I. Pugach, and T.A. Mousseau 2020. De novo congenital malformation frequencies in children from the Bryansk region following the Chernobyl disaster (2000–2017). *Heliyon*, 6(8): e04616.



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Studies of radiation damage

Studies of background radiation (including natural and man-made)

- All childhood cancers¹ start to increase² at exposures not much more than natural annual doses.
- Among childhood cancers, leukemia and central nervous system cancer risks³ predominate.
- There appears to be a strong impact⁴ of radioactive contamination on individual fitness in current and future generations, with potentially significant population-level consequences, even beyond the area contaminated with radioactive material.
- Radioactivity is also associated with negative, subclinical health impacts such as impaired⁵ neural development and lower I.Q.⁶
- Radiation can increase resistance⁷ of bacteria to antibiotics.
- Radioactivity appears to act along the estrogen pathway⁸, hinting that, in addition to a carcinogen, radioactivity may be an endocrine disruptor. Estrogen plays key roles in healthy pregnancy and puberty and is greater in women than men.

Uranium studies

- Uranium in drinking water—at levels allowed by the Environmental Protection Agency—disrupts⁹ the estrogen pathway.
- Birth defects¹⁰ and abnormal¹¹ pregnancy development, including low birth weight, are associated with ingestion of uranium.
- The incidence¹² of reproductive or gonadal cancer in New Mexico Native American children and teenagers is 8-fold greater than that in non-Native Americans of the same ages. New Mexico has been home to hundreds of uranium mines, all of which are now abandoned (although threats of new mines remain). These mines have left behind tailings and other radioactive wastes that have contaminated soil, air and water and which continue to harm health.

Operating reactor/fuel facility studies

- The National Academy of Sciences says childhood leukemia is a sentinel indicator¹³ for radiation exposure in a community.
- When data around normally operating nuclear facilities is examined worldwide, we find increases¹⁴ in childhood leukemia. Over 60 studies indicate this.

Catastrophe studies¹⁵

- Children in Chernobyl-contaminated areas have suffered reduced respiratory¹⁶ capacity as recently as 2010. The more radioactive cesium in their body, the greater the effect.



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- Exposure to radioactivity is associated with chronic fatigue immune dysfunction syndrome (CFIDS¹⁷)
- Cardiovascular defects¹⁸ are still surfacing from radioactivity due to the ongoing Chernobyl catastrophe.
- Birth defects (blastopathies¹⁹) and other health disturbances are found among not only those who were adults at the time of the Chernobyl disaster, but their children who were in utero at the time and, most disturbingly, their later offspring.
- Thyroid cancers in the TMI area appear to bear a radiation-specific biological marker²⁰, occur earlier and seem to be more aggressive.²¹ Thyroid cancers continued increasing²² years after Chernobyl began. Thyroid cancers have been observed in children since the Fukushima nuclear disaster in Japan but studies²³ at Fukushima suffer from poor methodology and lack of transparency, putting in serious jeopardy any independent analysis.
- Research²⁴ indicates that forest matter in the contaminated areas around Chernobyl is taking years or even decades longer to decay²⁵ than it should.
- Monkeys in Fukushima-contaminated areas²⁶ are born with fewer blood components, including white blood cells, now that their environment is radioactively contaminated from the reactor explosions of 2011. Having a diminished number of white blood cells, which fight disease, can lead to a compromised²⁷ immune system.
- Negative impacts²⁸ on animals such as smaller brains and lower sperm counts, to name just two, are also occurring at Chernobyl and Fukushima.

¹ Background Radiation & Cancer in Children. Video
https://www.youtube.com/watch?annotation_id=annotation_3426295427&feature=iv&src_vid=5xYRvnCBZOM&v=XTijlRsXTSE

² A record-based case-control study of natural background radiation and the incidence of childhood leukaemia and other cancers in Great Britain during 1980–2006. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3998763/>

³ Background Ionizing Radiation and the Risk of Childhood Cancer: A Census-Based Nationwide Cohort Study
<https://ehp.niehs.nih.gov/1408548/>

⁴ Strong effects of ionizing radiation from Chernobyl on mutation rates. <https://www.nature.com/articles/srep08363>

⁵ CHERNOBYL'S SUBCLINICAL LEGACY: PRENATAL EXPOSURE TO RADIOACTIVE FALLOUT AND SCHOOL OUTCOMES IN SWEDEN. <http://www.columbia.edu/~le93/Chernobyl.pdf>

⁶ The Chernobyl accident and cognitive functioning: a study of Norwegian adolescents exposed in utero.
<http://www.ncbi.nlm.nih.gov/pubmed/21038158>

⁷ Sensitivity to Antibiotics of Bacteria Exposed to Gamma Radiation Emitted from Hot Soils of the High Background Radiation Areas of Ramsar, Northern Iran. <http://www.theijoem.com/ijoem/index.php/ijoem/article/view/958>

⁸ Interaction between ionizing radiation and estrogen: What we are missing? [http://www.medical-hypotheses.com/article/S0306-9877\(11\)00413-0/abstract](http://www.medical-hypotheses.com/article/S0306-9877(11)00413-0/abstract)



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- ⁹ On Cancer's Trail <http://www2.nau.edu/gradcol/enews/2008September/Research.html>
- ¹⁰ On Cancer's Trail <http://www2.nau.edu/gradcol/enews/2008September/Research.html>
- ¹¹ Embryo Toxic Effects of Depleted Uranium on the Morphology of the Mouse Fetus. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3985252/>
- ¹² On Cancer's Trail <http://www2.nau.edu/gradcol/enews/2008September/Research.html>
- ¹³ Analysis of Cancer risks in Populations Near Nuclear Facilities Phase I. 2012. P 190. http://www.nap.edu/catalog.php?record_id=13388
- ¹⁴ Hypothesis to explain childhood cancer near nuclear power plants. <https://www.ncbi.nlm.nih.gov/pubmed/20662426>
- ¹⁵ For a comprehensive assessment of Chernobyl impacts, see The Other Report on Chernobyl (TORCH) An independent evaluation of the health-related effects of the Chernobyl nuclear disaster. March 31, 2016. Ian Fairlie. For Chernobyl studies previously unavailable in the West, see: Chernobyl: Consequences of the Catastrophe for People and the Environment. Yablokov and Nesterenko. 2009.
- ¹⁶ Reduced lung function in children associated with cesium-137 body burden. <https://www.ncbi.nlm.nih.gov/pubmed/26072943>
- ¹⁷ National CFIDS Foundation — Ionizing Radiation and CFIDS/ME. Medical Research Papers and Highlights <http://www.ncf-net.org/radiation.htm>
- ¹⁸ Exiled scientist: 'Chernobyl is not finished, it has only just begun' <https://www.usatoday.com/story/news/world/2016/04/17/nuclear-exile-chernobyl-30th-anniversary/82896510/>
- ¹⁹ Impacts of disaster-related radiation exposure on child development. <https://vimeo.com/210658909>
- ²⁰ http://www.pennlive.com/news/2017/05/hershey_researcher_believes_ne.html
- ²¹ <http://nuclearhotseat.com/2018/04/11/three-mile-island-nuclear-meltdown-at-39-wtf-actually-happened-to-us-nh-355/>
- ²² <https://www.mskcc.org/blog/study-reveals-genetic-causes-thyroid-increase-after-chernobyl>
- ²³ Fukushima Thyroid Examination Fact Sheet: September 2017 https://www.iwanami.co.jp/kagaku/eKagaku_201709_Hiranuma-rev.pdf
- ²⁴ Highly reduced mass loss rates and increased litter layer in radioactively contaminated areas. <http://www.ncbi.nlm.nih.gov/pubmed/24590204>
- ²⁵ Decay takes a holiday: the wickedness beneath the "Chernobyl wild paradise" myth and the rotten implications for ecosystems and radiation science <http://www.beyondnuclear.org/russia-ussr/2014/4/18/decay-takes-a-holiday-the-wickedness-beneath-the-chernobyl-w.html>
- ²⁶ Three Ways Radiation Has Changed The Monkeys Of Fukushima <https://www.forbes.com/sites/jeffmcmahon/2017/10/30/three-ways-radiation-has-changed-the-monkeys-of-fukushima-a-warning-for-humans/>
- ²⁷ Low white blood cell count <https://www.mayoclinic.org/symptoms/low-white-blood-cell-count/basics/when-to-see-doctor/sym-20050615>
- ²⁸ Anomalies in wildlife and the ecosystem around Chernobyl and Fukushima. <https://vimeo.com/211662517>