Comments
on Issues Associated with
Potential Revisions to 10 CFR 20 Radiation Protection Regulations
and
10 CFR 50 Appendix I Design Basis Objectives for Radiation Protection for Nuclear Plants
75 FR 59160

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Introduction

At the heart of what should be the Nuclear Regulatory Commission's prime mission is protection of the public and nuclear workers from exposure to radiation. Unfortunately, current NRC radiation protection regulations allow exposures at levels so high that its own official excess risk estimates associated with the permissible radiation doses generally exceed by orders of magnitude allowable risks for any other carcinogen. The NRC's radiation protection standards are desperately in need of being markedly tightened.

However, NRC staff is considering changes to NRC radiation regulations that do not enhance protections and instead, in a number of cases, would further erode those protections. Moreover, it is doing so in close cooperation with the industry it is supposed to be regulating, while freezing out the public.

Objections to Freezing Out the Public

The NRC held three public workshops on revising radiation protection regulations, centered on roundtable panel participants selected by NRC. Initially, NRC said, "NRC is selecting roundtable panel participants *to represent the diversity of stakeholders for these issues*, including the various uses of radioactive materials licensed by the NRC." [1] However, in fact, the panels did not include even a single participant representing public interest stakeholders.[2] Every single panelist was either a licensee or regulator.

The NRC workshop summaries are candid about this bias. Despite the commitment made in the public meeting notice, quoted above, for a "diversity of stakeholders," NRC staff conceded that instead "The roundtable panel members were pre-selected to represent the diversity of stakeholders *for the various uses of radioactive materials licensed by the NRC."* One could not have a better example of NRC's myopic view of stakeholders affected by its decisions: NRC appears to believe it exists to represent the interests of radioactive materials users, not to protect those affected by radiation from those uses. NRC has long been viewed by scholars and the public as a classic "captured regulatory agency." This experience does little to counter that widespread perception.

That bias towards hearing only from the regulated community and its push against improved public radiation protections is made clear in the summaries NRC staff prepared of the

[1] "Public Meeting Notice-Workshop Series on Potential Changes to the U.S. Nuclear Regulatory Commission's Radiation Protection Regulations," October 4, 2010. See also Federal Register announcement at 75 FR 59161-2.

[2] We understand that one public interest representative may have been invited but was unable to participate. Even had he been able to be present, one invitation to a member of the public interest community out of approximately 60 panelists from the licensee and regulator communities is indicative of the hopelessly one-sided nature of the NRC's views as to which stakeholders it listens to.

three Workshops. In each one, using virtually identical language, NRC staff indicated that the panelists opposed even a modest tightening of occupational exposure limits or protections for pregnant women in 10 CFR 20, but supported weakening the design objectives in 10 CFR 50 Appendix I. Given the nature of the "pre-selected" panels to exclude all representatives of NGOs working to improve protection of the public, such a result is not surprising.

Don Cool of the NRC staff had promised Diane D'Arrigo last year to notify her of the workshops. He didn't do so. In a telephone conversation on 31 January 2011, Mr. Cool conceded that he had failed to provide the promised notification.[3]

The associated Federal Rregister notice did solicit public written comments, but in practical effect made such comments essentially impossible. For example, the notice requests comments related to the use of ICRP reports 2, 26, 60, and 103. However, NRC fails to make those very reports publicly available. ICRP charges astronomical prices for copies of these recommendations. It would cost a member of the public on the order of $1000 to obtain just those four ICRP reports that form the basis of the request for comments issued by NRC; $241 alone for ICRP 103.

NRC violates the fundamental requirements of the Administrative Procedure Act and other laws by engaging in rulemaking by setting up sessions to hear only from one side, freezing the public out; and by soliciting comments on documents that are for all intents and purposes kept from the general public.

Additionally, the Federal Register notice directs the public to Regulations.gov for documents related to the notice, and to the ADAMS database, but most of the relevant documents are apparently not posted on either place. For example, Regulations.gov appears to contain only four documents – the Federal Register notice, the Staff Requirements Memo, SECY-08-0197, and a 2009 Federal Register notice. The FR notice also refers the readers to http://www.nrc.gov/about-nrc/regulatory/rulemaking/opt-revise.html for relevant documents. But that URL takes you to an NRC website notice saying, "Page not found." To find panelist and participant lists, transcripts, and meeting summaries for the DC and LA workshops, NRC staff had to direct us to places not identified at all in the Federal Register notice.

In short, NRC set up meetings with only one side of the stakeholder spectrum—licensees, who have a vested interested in further relaxed regulations. NGOs who represent the public interest and are in favor of more robust public protections were excluded from the panels. The primary documents for which comment was requested – ICRP recommendations – are not available to members of the public unless they can spare $1000. The other relevant documents about the meetings were also not publicly available. This all creates the appearance of a captured regulatory agency attempting to undertake actions that it knows cannot withstand public scrutiny, so the public is frozen out.

[3] In part because of this, and the failure for even the most elementary of the documents in question to be available where NRC said they would be, Mr. Cool said that we could submit comments a few days after the nominal cutoff.

The Core Issues

Despite frequently insisting upon what it terms "risk-informed decision-making" or "risk-based regulation," the NRC has historically declined to set radiation protection limits based on risk, using dose or "effective dose" instead. Were the risk of cancer associated with NRC's permissible radiation levels explained in plain English, using the U.S. government's own official risk figures[4], the following would be revealed:

1. **NRC's Primary Dose Limits for the Public Would Yield An Excess Cancer in Every 156 People Exposed.**

10 CFR 20's primary permissible radiation dose level for members of the public, 100 millirem per year over one's lifetime, is officially equated to a risk of cancer of producing approximately 6.4 cancers per thousand people exposed, above and beyond the number of cancers that would have occurred without the exposure. In other words, one out every 156 people getting the NRC's "acceptable" radiation dose over their lifetimes would get a cancer from it. Using the recent National Academy of Sciences BEIR VII study, prepared at the request of the NRC, the risk would be 8.6 per thousand, or *approaching one cancer per hundred people exposed.*[5]

2. **This is 100-10,000 Times Higher Cancer Risk Than Permitted for Any Other Carcinogen.**

By contrast, all other carcinogens are generally regulated in a "legally allowable" risk range of one in a million to one in ten thousand getting cancer (i.e., cancer incidence) from the exposure. In other words, NRC allows public exposures to radiation at risk levels one hundred to ten thousand times higher than the federal government permits for any other carcinogen. EPA has previously opposed NRC's radiation standards for this reason, asking why radiation should be treated as a "privileged pollutant," permitted to expose people to cancer risks at levels far above that allowed for any other pollutant.

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[4] Federal Guidance Report 13 sets the dose-risk relationship as 8.46×10^{-4} cancers per person-rem. The National Academy of Sciences Biological Effects of Ionizing Radiation report (BEIR-7), which post-dates FGR 13, says the latest scientific evidence indicates radiation is even more dangerous than previously presumed and sets the effect size at 1.14×10^{-3} cancers per person-rem.

[5] Given the dramatic underestimate of true dose resulting from the discounting of cancers when using the effective dose equivalent, as discussed below, the true risk is even higher, considerably so.

3. **NRC Permits Even Higher Doses To The Public**.Under 10 CFR 20.1301(d), licensees or license applicants can request to be allowed to expose individuals to up to 500 millirem per year, five times the dose permitted under the primary standard, which already is far outside the acceptable risk range.[6]

4. NRC Permits Workers To Receive 5 Rem—An Official Cancer Risk of 1 in 4, Completely Unacceptable

NRC's regulations allow the nuclear industry to expose its workers to 5 rem (5000 millirem) per year, each year they work. That is the equivalent of about one thousand chest X-rays annually. 5 rems per year over a 50-year career would be 250 Rem, or about a 1 in 4 risk of an excess cancer using the official risk estimates.[7] Put differently, about a quarter of one's workforce would, by NRC's own official risk estimates, get a cancer from their work if exposed at NRC's "acceptable" radiation exposure level each year they worked, never exceeding the permissible dose. This is far higher than the legally permissible risks from other occupational exposures, which are generally regulated at a 1 in 1000 risk level (10^{-3}), i.e., two orders of magnitude lower.[8]

Now, NRC may argue that nuclear workers rarely get the full 5 rem a year. If so, it should have no problem radically reducing the permissible exposure, but to date has refused to do so. Furthermore, *licensee representatives at the recent workshops considering reducing the occupational limits objected, saying they routinely expose workers to those levels and claiming they can not do otherwise.* Even if workers were to receive only a fraction of 5 rem a year, that would still entail an unacceptable risk. 1 Rem a year, for example, would mean 1 in 20 workers would get cancer from their employment, quite unacceptable.

But finally, regulations setting "legally allowable" exposures to radiation should indeed be based on what is publicly and morally acceptable. It is fundamentally unacceptable to have radiation standards set so high that it is deemed permissible to cause a cancer in a quarter of your workforce. And the NRC and industry have never disclosed this to the public or workers. If 100 workers begin work at a nuclear facility, they should be told, in plain English, that if they get the allowable radiation exposure each year they work, while never going over the legal limit, the official government estimate is that roughly a quarter of them will get a cancer from that exposure, over and above the number that would have gotten cancer without such exposure.

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[6] See also 10 CFR 20.1403.

[7] Age at exposure would change somewhat the risk factor from the FGR13 and BEIR VII values used here, but wouldn't change the basic conclusion. BEIR VII's effect size would estimate a 1 in 3 risk of cancer not taking into account age.

[8] See, e.g., Tran, Nga et al., *Chemical And Radiation Environmental Risk Management at the Crossroads: Case Studies,* Environmental Law Institute, October 2001, report funded by U.S. EPA Office of Radiation and Indoor Air, Radiation Protection Division, p.51.

5. **NRC Ignores EPA and National Academy of Sciences Radiation Protection Guidance, Relying Instead on Recommendations from a Private Organization (ICRP) Heavily Skewed to Radically Weak Radiation Protection Standards**

The EPA is statutorily tasked with providing the fundamental guidance on radiation protection for the federal government. It is EPA that issues the Federal Guidance Reports on radiation, sets Protective Action Guides (PAGs) for responding to nuclear releases (other than terrorist events), establishes Maximum Concentration Limits (MCLs) for radioactivity in water pursuant to the Safe Drinking Water, etc.

EPA in turn, and all other agencies, are to base their radiation protection standards and guidance on the recommendations of the National Academy of Sciences BEIR committee findings. Every decade or so, EPA, NRC and other agencies ask the NAS to update its radiation risk estimates based on the most recent science.

Virtually every time NAS convenes the BEIR committee, the new science has led to increases in its estimates of the dangers of "low dose" ionizing radiation. In 2006, NAS published BEIR VII, its most recent study, finding ionizing radiation produces about a third more cancers per unit dose than previously presumed. EPA is now working to update its radiation guidance and standards to reflect the findings of BEIR VII.

Not NRC. Instead of relying on the National Academy of Sciences study that it had itself requested and helped fund, NRC ignores the National Academy of Sciences. And instead of relying on its sister agency, EPA, tasked with establishing radiation guidance for the federal family, NRC is ignoring EPA.

Ignoring both NAS and EPA, NRC now proposes instead to rely on a private organization, ICRP, with a long history of pushing for relaxed radiation protection standards. For example, ICRP has formally recommended that no long-term cleanup be required after a radiological release until annual doses exceed an astonishing 10 rem, which over thirty years would produce cancer in a third of the public exposed, according to the National Academy of Sciences. ICRP has recommended no intervention ever occur when long-term doses are less than 1 rem per year, a risk of one in thirty. Between 1 and 10 rem, cleanup would be discretionary.

Any organization that makes such frankly and deeply disturbing recommendations should not be taken seriously. It certainly cannot qualify as a "radiation protection" organization. It is just a private organization pushing for dramatically unprotective radiation protection standards.

Yet NRC is here proposing to ignore the National Academy of Sciences and EPA, and rely instead on this private organization with its deeply troubling agenda.[9] *NRC is using the*

[9] We do not imply endorsement of the EPA and BEIR VII approaches. There are aspects of both we find troubling. The best scientific evidence suggests substantially higher risk coefficients than either uses. Oak Ridge, Hanford, Santa Susana, and the multi-nation IARC nuclear worker

ICRP as a federal advisory committee, yet ICRP does not comply with the Federal Advisory Committee Act (FACA) requirements about avoiding conflicts of interest, assuring balance, etc. Indeed, many of its members would likely fail to meet the FACA legal standards.

6. **ICRP Recommends "Discounting" Radiation-Induced Cancers, Jacking Up Permissible Radioactive Concentrations**

The fundamental goal of radiation protection should be the prevention of radiation-induced cancers and other health effects. At the core of ICRP recommendations is an assertion that a cancer should not be counted as a cancer, but as a fraction of a cancer. ICRP recommends that a bladder, colon, kidney, or thyroid cancer, for example, should not count as one cancer, but should be "discounted" by factors including lethality, number of years of life lost for fatal cancers, and a subjective assessment of the relative degree of pain and suffering for different cancers. By so doing, ICRP then recommends increasing the permissible radiation exposure because it asserts that getting a cancer isn't so bad—some people survive it, after painful treatment, and some who die from it, do so later in life. Therefore, ICRP claims, industry ought to be permitted to cause a larger number of cancers from its radiation releases. ICRP thus estimates "detriments" rather than cancers, by discounting the cancers, and proposes the use of "effective dose equivalent" (EDE) or "effective dose" (ED) instead of actual dose, creating a fiction that the "effective" dose is far less than the real dose because the cancers it produces should be pretended to be effectively far fewer than really produced because some people survive some of the cancers or get them later in life. These wholly subjective recommendations raise profound ethical questions and deeply taint the organization that makes them. The NRC should have no part of such morally questionable recommendations.

Yet NRC has adopted them hook, line, and sinker, while ignoring the guidance it should follow from EPA and NAS. NRC should abandon ICRP's "effective dose" or "effective dose equivalent"—which should really be called "fictional dose," as they have the regulator pretend that an actual dose is markedly lower than it really is, by these morally questionable discounting or "weighting" factors related to the suffering from the kind of cancer they produce.

The difference between the true dose and the fictional dose "equivalent" employed by NRC and ICRP is often quite large. The difference varies, radionuclide by radionuclide. Comparing the true dose with the supposed effective dose equivalent for some key radionuclides, EPA has estimated that a regulation limiting doses to 25 millirem whole body, 75 millirem thyroid, and 25 millirem to any other critical organ [e.g., 40 CFR 190/.10(a), EPA's fuel cycle rule, applicable to NRC licensees] is roughly equivalent to a limit of 10 millirem effective dose

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studies, to name just a few, all suggest a considerably higher risk from the same unit of radiation than currently assumed by EPA and BEIR VII. However, at minimum, NRC should rely on its sister agency charged with this task, rather than a private organization with an agenda, and once it has asked the National Academy of Sciences to prepare updated risk figures, should not ignore them.

equivalent.[10] In other words, the effective dose equivalent is not equivalent at all, but understates the true whole body and organ doses by a substantial factor. A 100 millirem EDE limit, for example, such as the current 10 CFR 20, thus is really roughly the equivalent of a limit of 250 millirem whole body, 750 millirem to the thyroid and 250 millirem to any other critical organ—a grossly unacceptable amount.[11]

This helps explain, when NRC changed 10 CFR 20 twenty years ago to supposedly reduce permissible exposures from 500 millirem per year to 100 millirem per year for members of the public—a five-fold supposed reduction—the permissible concentrations for 2/3 of the radionuclides actually went up! This kind of shell game is deeply disturbing: the NRC announced at the time, in light of all the new evidence, including the NAS's BEIR V study, that radiation was more dangerous than previously thought[12], that it was reducing permissible radiation exposures by a factor of five. And then, by switching to "effective dose equivalent" (what we call a fictional dose") from actual dose, it instead actually increased permissible exposures for 2/3 of the radionuclides. This must be reversed.

EPA—whose guidance is supposed to drive regulations at all other agencies—generally does not use "effective dose" or "effective dose equivalent" for precisely these reasons. It doesn't use "detriment," as proposed by ICRP, but counts instead cancer incidence, not discounting the cancers.[13] And it doesn't use dose, but uses risk. Dose misleads, particularly EDE or ED, masking the true risk, and the risk associated with each radionuclide varies. It is risk that matters, and it is risk that NRC avoids disclosing and using for its regulatory decisions regarding radiation.

In sum, NRC should abandon the change it made when it last amended 10 CFR 20 of switching from true dose to a fictional dose; should abandon any reliance on "weighting" factors that discount the true risk by not counting a cancer as a cancer but only as a fraction of a "detriment"; and should come into the modern era by regulating by disclosed risk, and keeping permissible risk within the acceptable risk range employed for all other carcinogens.

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[10] "Comparison of Critical Organ and EDE Radiation Dose Rate Limits for Situations Involving Contaminated Land," Office of Radiation and Indoor Air; April 1997

[11] Even this rough EPA comparison for EDE understates the true difference. As is discussed above, when NRC changed 10 CFR 20 to supposedly reduce permissible exposures from 500 millirem per year to 100 millirem per year for members of the public, permissible concentrations for 2/3 of the radionuclides increased, showing that for those radionuclides, effective dose understates true dose—and thus risk-- by more than a factor of five.

[12] BEIR V found ionizing radiation three times more likely to produce solid cancers and four times more likely to produce leukemias than previously assumed. BEIR VII subsequently found the risk of inducing cancer from low-dose radiation a third higher than found by BEIR VII.

[13] The only exception at present is skin cancer, which EPA is currently analyzing how to address.

7. NRC Should Bring Its Regulations Into Conformance With EPA's Most Protective Standards

10 CFR 20.13012(e) in passing mentions that fuel cycle licensees must comply with EPA's radiation regulations found at 40 CFR 190. HOWEVER, every other passage of 10 CFR 20, and its various tables, is at variance with those EPA limits and extraordinarily higher. There is no excuse for this.

As indicated above, 40 CFR 190, which NRC concedes its fuel cycle licensees must comply with, is set at the equivalent of approximately 10 millirem per year EDE for the public. Yet NRC's 10 CFR 20 is set at an order of magnitude less protective level – 100 millirem per year EDE. Every concentration limit, for example, for the public in 10 CFR 20 Appendix B, is based on a combined 10 millirem per year limit. Licensees report against the Appendix B levels, NRC inspectors inspect against it. But those limits are vastly higher than the limit required by 40 CFR 190, which NRC admits its licensees must comply with. This must be fixed. 10 CFR 20 values must all be lowered to bring them into accord with 40 CFR 190.

10 CFR 20 Appendix B includes tables for allowable concentrations of different radionuclides in air and water.[14] These limits generally vastly exceed EPA limits. There is no justification for this.

Additionally, EPA sets permissible concentrations of radionuclides in water. These are the Maximum Concentration Limits (MCLs), established by the Safe Drinking Water Act. These levels are generally also used for discharges, for example, under NPDES permits. Yet 10 CFR 20 lists "permissible" concentration of radionuclides in water that greatly in excess of the MCLs.

A few examples:

The MCL for I-131 is 3 pCi/L; NRC's limit is 1000 pCi/L, 333 times higher.
The MCL for I-129 is 1 pCi/L; NRC's limit is 200 pCi/L, 200 times higher.
The MCL for tritium is 20,000 pCi/L; NRC's limit is 1,000,000, 50 times higher.
The MCL for strontium-90 is 60 pCi/L; NRC's limit is 500, nearly 10 times higher.

This is not to say we think EPA's limits are always protective. For example, for tritium, levels of tritium in streams are at about 10 pCi/L, so EPA's limits are 2000 times what we normally find. New evidence shows that the low-energy beta from tritium is far more harmful than what is currently assumed. Tritium also can damage DNA in a unique way: when it is incorporated into a DNA molecule, replacing regular hydrogen, and then decays to helium, it can break the DNA bond. But all said, there simply is no good reason for NRC to set levels of contaminants in water that exceed EPA's MCLs.

[14] Limits are also included for releases into sewers, which drain into surface water bodies and groundwater. NRC's permissible concentrations for these releases are ten-fold higher than the already non-protective permissible water concentrations.

8. Public Continues to Oppose Any Effort to Deregulate Radioactive Wastes

Although the Federal Register notice did not list for discussion at these meetings the concept of legally deregulating, clearing or declaring as "below regulatory concern" (BRC) some man-made radioactive materials and wastes from radioactive controls, the ICRP 103 recommendations do include these highly objectionable provisions that the United States public has clearly rejected. We encourage NRC to keep this OUT of the U.S. regulations.

Key Recommendations

1. NRC should abandon the fictional doses employed by use of "effective dose equivalent" and "effective dose" and not discount the true dose by such morally questionable factors as subjective views of the relative pain and suffering of different cancers.

2. NRC should, in plain English, disclose the full potential risk, using at minimum the most recent National Academy of Sciences BEIR VII risk factors for cancer incidence from ionizing radiation exposure. It should not instead rely on ICRP.

3. NRC radiation regulations should be, at minimum, based on a risk to the public in the standard legally allowable cancer incidence risk range of one in a million to one in ten thousand required of all other carcinogens.[15]

4. Permissible exposures to workers should be reduced by 1-2 orders of magnitude at least. Risks in the 10^{-1} range, as is currently the situation with NRC's regulations for worker exposure, are just grossly unacceptable. The proposal to keep the 5 Rem/year limit, but require a 10-year average of no more than 2 Rem/year, is a tiny step in the right direction but grossly inadequate; that would still be a risk of about 1 cancer per 10 workers exposed.

5. Uncertainty must be expressly taken into account and radiation protection standards established based on significant conservatisms. That is not the case at present. ICRP, for example, builds essentially no conservatisms into its recommendations but does include significant non-conservatisms. For example, even though NAS calculated that the "central estimate" for DDREF was 1.5, ICRP decided it would like to stick with a DDREF of 2.0 (DDREF is a fudge factor to reduce the risk estimates, not really defensible in light of the conclusion of both entities that the best evidence suggests a Linear No-Threshold dose-response relationship. Significant evidence suggests instead a supra linear relationship at low doses, and conservatism would suggest, for example, using that assumption.) For example, ICRP recommends now reducing its estimate of genetic defects from radiation six fold—for no scientific reason suggesting less risk, just that it wants to stop counting the genetic effects after

[15] We do not necessarily endorse the risk range of 10^{-6} to 10^{-4} as sufficiently protective, nor, as indicated above, the BEIR VII dose-risk relationship, given the significant evidence that radiation is more dangerous than assumed therein. However, given how far away NRC is from regulations that meet the risk range, even using the BEIR VII size effect, we urge that *as a minimum* NRC revise its regulations to keep exposures within that risk range using the BEIR VII values.

the second generation. There needs to be an explicit treatment of uncertainty at each step in the calculations, and conservatism built in to treat that uncertainty in the context of radiation protection, where one needs to err on the side of protection.

6. At minimum, 10 CFR 20 should be revised to lower permissible exposures and concentrations to comply with EPA requirements such as 40 CFR 190 and making the permissible water concentrations, including releases to sewage, at least as stringent as the MCLs.

7. 10 CFR 50 Appendix I should not be revised to change from dose to the fiction of "effective dose" that discounts cancers, risks, and true dose. The proposal put forward by NRC staff would significantly further weaken already weak regulations. And Appendix I should finally start being enforced. If licensees when operating violate their design objectives, they should be fined.

8. There should be no use of dose "constraints," which are not enforceable limits. There is no enforcement action taken if one violates a constraint. Radiation protection limits should be precisely that—limits.

9. Protect the Most Vulnerable. NRC regulations are based on the least sensitive subpopulation. Infants, for example, are more radiosensitive than adults; women more radiosensitive than males. The regulations should be altered to be based on protecting the most sensitive subpopulation.

10. Lastly, since NRC staff held three meetings solely with licensees and regulators, freezing out the public and viewing as stakeholders primarily those users of radioactive materials with an interest in preventing enhanced radiation protections for the public and workers, NRC should arrange for us to be able to make an in-person presentation of our concerns about and recommendations for improvement of NRC radiation protection regulations to the NRC Commissioners.

In summary, NRC should come into the modern era of protection of the public and workers. The time is long past when radiation should be treated as a "privileged pollutant," allowed to produce cancers at levels allowed for no other carcinogen. It is frankly unacceptable to declare that an "acceptable" dose for workers is so high that it would produce a cancer in a quarter of them, or for members of the public, it is acceptable for the nuclear industry to expose the public to radiation levels so high that one in a hundred of them would be permitted to get cancer from the industry's releases.[16] If nuclear is "clean energy," as its advocates have tried to claim, then NRC's radiation regulations would appear to put a lie to that claim, saying the industry cannot run without regulatory limits so high as to be unacceptable to any thinking person.

NRC should markedly tighten its radiation regulations, so that risks are at minimum in the range considered acceptable by other agencies for all other carcinogens and factor in the potential presence of other carcinogens and stressors. Or it should declare nuclear power so dangerous

[16] The actual risk levels are far higher when one takes into account NRC's reliance on the fictional "effective dose" rather than the real dose, the former discounting the true dose and risk by a substantial, arbitrary factor.

that it cannot operate without exposing workers and the public to cancer risks considered unacceptable for all other industries and contaminants.