Comments on the Nuclear Regulatory Commission's
Part 53 Preliminary Proposed Rule Language

Docket ID: NRC-2019-0062

Edwin Lyman
Director of Nuclear Power Safety
Union of Concerned Scientists
Washington, DC
August 31, 2022

General comments

The Union of Concerned Scientists (UCS) supports a focused revision of the NRC's nuclear power reactor licensing regulations to (1) improve consistency and clarity; (2) revisit the use of crude and archaic metrics of health risk, such as Part 100 dose criteria and the Quantitative Health Objectives (QHOs), that are insensitive to the disproportionate impacts of radiation exposure on disadvantaged populations; and (3) address long-standing safety and security gaps in the current regulatory "patchwork" highlighted by the Fukushima Near-Term Task Force (NTTF) in 2011. If done correctly, such an effort also would naturally result in a more logical licensing framework for new reactors that "appropriately balances defense-in-depth and risk considerations," as the NTTF put it. Essential to accomplishing such a task is a process that ensures that risk information is employed only to the extent that it can be strongly supported by a well-validated probabilistic risk assessment (PRA) that fully accounts for uncertainties, and that compensates for those uncertainties by requiring deterministic defense-in-depth measures. Regulation should be based not on unverified assumptions or happy talk or unrealistic expectations, but rather on hard facts and data and rigorous science and engineering principles—and an unwavering commitment to protection of public health and safety.

Unfortunately, the proposed Part 53 language does not embody such an approach. The Nuclear Energy Innovation and Modernization Act (NEIMA) directed the NRC to develop a "technology-inclusive" regulatory framework for advanced reactor licensing, but specified that it should include "risk-informed and performance-based techniques" only "where appropriate." UCS believes that the use of "risk-informed" techniques is only appropriate when limited to "the extent supported by the state-of the art PRA methods and data," as stated in the NRC's PRA Policy Statement. However, the NRC staff is broadly interpreting NEIMA as giving it *carte blanche* to rewrite the entire framework for licensing and oversight of all nuclear power reactors, while in the process jettisoning many requirements that do not have a direct relationship to quantitative accident risk and thus cannot be credibly risk-informed, such as the security requirements of Part 73 (which, by the way, are already largely performance-based). UCS maintains that this interpretation is "inappropriate" from both technical and public safety perspectives and hence violates the letter of NEIMA.

Even worse, in response to industry requests, the preliminary rule language contains an alternative framework (Framework B) for reactor applicants who do not want to prepare a PRA but who still wish to benefit from the regulatory relief that a risk-informed approach could provide. Although the NRC staff, to their credit, originally maintained that such a framework would necessarily be deterministic, the industry—complaining that Framework B should also be "risk-informed"—is pushing the staff to incorporate provisions in Framework B initially intended for use only by applicants under Framework A, which does require a PRA. But because there is no technically valid way to risk-inform licensing without a PRA, such a regulatory buffet ("a little from Column A, a little from Column B") undermines the very foundation of risk-informed regulation and hence is not "appropriate."

Also, in developing Part 53, the NRC staff did not undertake a long-overdue review of the technical basis for the individual dose criteria that set system objectives for so many of the NRC's regulations and policies. The NRC should have evaluated whether these criteria—some dating to the early 1960's—are still appropriate and sufficiently protect disadvantaged populations and sensitive subgroups (we think they do not). Instead, the draft language leans into the status quo even more heavily, for example elevating the deeply flawed and incomplete Quantitative Health Objectives (QHOs) from policy guidance to regulatory requirements.

UCS is also deeply disappointed that the NRC has failed to use Part 53 to reverse its misguided policy on advanced reactors dating from the 1990s, and to require that new reactors demonstrate a higher level of safety than the operating fleet licensed under the current rules. Instead, the NRC is strenuously defending the inadequate safety status quo. And even worse, the NRC is not even using the direction it received from NEIMA to fulfill the law's purpose of providing "regulatory processes necessary to allow innovation and the commercialization of advanced nuclear reactors." At industry's urging, the NRC expanded the scope of Part 53 to apply to any "commercial nuclear reactor"—and not limited to the "advanced nuclear reactor" applicants that NEIMA specified. According to NEIMA's definition, an advanced nuclear reactor is one "with significant improvements compared to commercial nuclear reactors under construction as of the date of enactment of this Act …". By failing to honor both the letter and the spirit of NEIMA in this regard, the NRC is also missing the opportunity to advance its own policy "to encourage advanced reactor designers to consider safety and security in the early stages of design" by providing incentives for them to develop safer and more secure reactors —namely, less burdensome licensing rules.

UCS strongly encourages the NRC to change course here and restore Part 53's limitation to "advanced" reactors, with stringent entry criteria to ensure that designs will only qualify for use of the rule if their safety and security improvements are likely to be effectively realized in practice. That will generally require some degree of conservatism, given the uncertainties associated with the performance of new designs with limited or no operating experience.

An alternative approach

One consequence of Part 53's broad scope and formidable complexity is that it will likely be very difficult for the public—not to mention the NRC staff itself—to clearly assess whether the Part 53 language meets the agency's stated goal that the rule should provide for "at least the same degree of protection [of public health and safety] as required for current-generation LWRs." In fact, it is unclear to UCS if the preliminary Part 53 language even supports a requirement that the level of safety is at least as high as the currently operating fleet (see the QHO discussion below).

However, development of a "technology-inclusive" rule does not require starting from scratch and rewriting the entire rule book. It's important to note that critical parts of Part 50 are already technology-inclusive: for instance, the LWR-based General Design Criteria in 10 CFR Part 50 Appendix A are not meant to be strictly applicable to non-LWRs but merely provide guidance. UCS has concluded that the NRC could fully comply with the letter and the spirit of NEIMA by terminating the effort to create an entirely new part in 10 CFR for new reactor licensing and simply adding design-specific appendices to the existing Part 50/52 rules to address only those aspects that are clearly inapplicable to designs different from the current large LWR fleet. Combined with the flexibility that the rules already offer, this approach could be effectively used to give appropriate credit to reactors with clearly improved safety features, or to apply appropriate constraints on reactors that may have safety disadvantages—with a reduced potential for weakening safety standards in areas where it is not warranted. This approach will also allow for a simpler comparison of the current rules with the revised ones, and help provide assurance that the level of safety does not decrease.

UCS believes this approach is manageable because the population of new reactor designs that the NRC is likely to receive for review in the coming years is not actually that diverse, and can be placed in a few broad categories, including:

(a) Coolants (liquid-metal, gas, molten salt)
(b) Fuels (metal, TRISO, molten salt)
(c) Sizes: very small (<20 MWe), small (<300 MWe); medium (<600 MWe)

The accident spectrum is already fairly well-characterized for many of these design categories, some of which have been studied for decades.

Each design appendix would specify all regulations in Parts 50/52 that are inapplicable; design-specific alternatives for inapplicable requirements that correspond to a safety or security function (e.g. 50.46); and a standardized set of accidents for safety review (anticipated operational occurrences, design-basis accidents, and severe accidents determined through a structured process such as the Licensing Modernization Project, with due consideration of uncertainties). The latter set should be complemented with a requirement for applicants to conduct "systematic searches for hazards, initiating events, and accident scenarios" for their specific designs that may not be contained in the standardized list, as recommended by the Advisory Committee on Reactor Safeguards (ACRS).

The role of QHOs

Part 53 does need specific, quantitative acceptance criteria to limit the risk of severe accidents, but the QHOs are not the right ones. The QHOs represent the (minimum) level of safety of the operating fleet as it was 30 years ago. In 1990, SRM-SECY-89-102 (Implementation of the Safety Goals) pointed out that at that time, operating plants met the QHOs with margin. Today's operating plant average core damage frequency is ten times lower than it was in 1990. And the recent Vogtle Level 3 PRA study found a hundred-fold margin to the latent cancer fatality QHO and a million-fold margin to the prompt fatality QHO. Thus, unless the rule includes a specific requirement to maintain a large margin to the QHOs, Part 53 applicants could have much higher core damage frequencies than the current fleet and still meet them.

The current QHOs also lack a societal risk metric that would address land contamination, one of the most significant impacts of the Fukushima accident. And safety standards based on average cancer fatality risks are inherently discriminatory and should not be incorporated into the NRC's regulations, as they can result in disproportionate impacts on Black people and other disadvantaged groups who have lower cancer survival rates than Whites. In addition, the use of cancer as the only latent health effect ignores the growing evidence of non-cancer endpoints for low-level radiation exposure (e.g. cardiovascular disease).

Thus if QHOs are to become regulatory requirements, they should

- Be decreased by at least one order of magnitude;
- Incorporate cancer incidence rather than cancer mortality;
- Consider other disease endpoints as information becomes available;
- Include land contamination (and the risk of long-term population relocation).

The lack of clear prototype requirements

The prototype requirements for new reactor licensing are of vital importance. The existing requirements in 10 CFR 50.43(e) are already too vague, and the Part 53 draft language appears to be even worse. The default option for demonstrating novel safety features that are credited in the license application should be prototype testing; the criteria for allowing alternative means to satisfy the requirement need to be sufficiently detailed to ensure that the alternative would provide the same level of assurance. In addition, there should be a structure in the rule where applicants learn early in the process whether the NRC is likely to accept alternatives to a prototype, which would give the applicant the lead time necessary for a prototype program. Otherwise, any prototype requirement would likely be meaningless because if an applicant chooses not to build one, the NRC would be hard-pressed to delay the application by many years by insisting that one is needed.