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General Comment

See attached file(s)

Attachments

Public Comment on 10 CFR Part 53 - June 2021

February 21, 2021

John Tappert
Director, Division of Rulemaking, Environmental, and Financial Support
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Comment on "Draft for the NRC's Rulemaking on, Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors" (RIN-3150-AK31; NRC-2019-0062)

Dear Mr. Tappert,

This letter and its enclosure provide the perspective of the Breakthrough Institute on the ongoing activities by the Nuclear Regulatory Commission (NRC) to develop a new Risk-Informed, Technology-Inclusive regulation, known as Part 53, under Title 10 of the Code of Federal Regulations. This correspondence is intended to engage with the NRC as a non-profit and independent stakeholder.

The Breakthrough Institute is an independent 501(c)(3) global research center that identifies and promotes technological solutions to environmental and human development challenges. We advocate appropriate regulation and licensing of advanced nuclear reactors to enable the commercialization of innovative and economically viable emerging nuclear technologies, which we believe to represent critical pathways to climate mitigation and deep decarbonization. The Breakthrough Institute does not receive funding from industry.

The timely completion of a risk-informed performance-based licensing framework is important to the successful innovation and commercialization of advanced nuclear reactors in the United States. The effort by the NRC staff to write this draft regulation on the current timeline is to be commended. We have held our comments up to this point to allow the staff time to release preliminary drafts for the majority of subparts. However, we feel adjustments are necessary to the draft rule to provide a licensing framework to meet this goal.

The Breakthrough Institute looks forward to continued participation in this rulemaking process. We appreciate the opportunity to comment on this draft of the 10 CFR Part 53 rulemaking. Further comments may be provided as revised drafts are subsequently made available from the NRC for review. If you have any questions or need additional information, please contact me at adam@thebreakthrough.org.

Sincerely,

Dr. Adam Stein
Senior Nuclear Analyst
The Breakthrough Institute

Enclosure: Attachment A - Comment on docket RIN-3150-AK31; NRC-2019-0062

Attachment A:

Comment on Draft 10 CFR Part 53 Preliminary Proposed Rule Language: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors

Preface

The Nuclear Energy Innovation and Modernization Act (NEIMA)[1] was signed into law in 2019. One of the purposes of the NEIMA is the creation of *"a program to develop the expertise and regulatory processes necessary to allow innovation and the commercialization of advanced nuclear reactors."* The NEIMA prescribes a risk-informed and performance-based regulatory approach that is technology-inclusive. The proposed rule that is the subject of this comment is intended to meet that mandate.

Four basic tenets are needed:

1. Technology-inclusive - flexibility to be applied to a variety of technologies and operational strategies
2. Safety - No reduction in safety thresholds or increase beyond established thresholds from 10 CFR Part 50 & 52
3. Performance-based - Clear, objective, and measurable risk-informed performance criteria should be specified
4. Commercially viable - Regulation should be efficient, predictable, and not overly burdensome

A simple test of being technology-inclusive is to ask if the rule in the current form would provide an effective, efficient, and commercially viable pathway for licensing three very different but already existing or proposed technologies - a modern large light water reactor, an advanced reactor technology that has never operated, and a microreactor. If the answer is no for any of these technologies then it is likely the rule will present unforeseen issues in the future for technologies that have not yet been invented.

[1] Public Law 115 439 of 2019

Safety should meet the qualitative Safety Goals[2] - Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health. Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks. It is expected that many advanced reactors will provide larger safety margins relative to existing large light-water reactors, but should not be required to do so for licensing.

Regulatory uncertainty is a major concern and often touted as a reason that advanced reactors won't be viable in the foreseeable future. This rulemaking is an effort to change the existing prescriptive model in 10 CFR Parts 50 and 52 to a risk-informed performance-based (RIPB) approach and to be technology inclusive. The move to this approach is necessarily more open ended to allow applicants to meet the performance requirements as may be logical for that technology and design. There are two themes in the comments already submitted to the NRC by other stakeholders: 1) that the rule needs to be very open to avoid unforeseen future limitations, or 2) that the rule should be more specific on performance requirements to reduce uncertainty of what will be acceptable and therefore streamline the regulatory process. It is noted that these opinions are roughly correlated to developers and industry groups for the former and license holders and utilities for the latter. This dichotomy of perspective is both important to understand and possible to satisfy in this rulemaking process.

To facilitate expeditious reviews some guidance on acceptable licensing pathways needs to be developed. The NRC cannot be expected to be experts in every conceivable approach that a developer may take to meet the requirements in the rule. However, there are valid reasons to avoid limiting potential approaches. For example, it would be beneficial for international competitiveness if applicants could take approaches favored by the IAEA or another country's regulator, so long as the approach still meets the requirements of this rulemaking.

The draft language initially referenced other parts of Title 10 extensively. Crossreferencing was reduced in the second revision of some of the draft sections. We are in favor of avoiding unnecessary references when possible, particularly to the existing licensing pathways in Part 50 & 52. Including the text in Part 53 directly provides a clearer understanding of the requirements within the context of the entirety of Part 53, allows text to be modernized where appropriate, and decouples Part 53 from other regulations that may be updated in the future, thereby increasing the ability of

[2] Federal Register 51 FR 30028

those regulations to be modernized without impacting this rule. However, we do not feel that decoupling the Part 53 draft from prior licensing frameworks is sufficient reason in and of itself to increase safety or performance requirements, making a stricter regulation than is applied to the existing fleet.

We feel that the timeline is not too aggressive, and is necessary. There is a significant amount of RIPB work leading up to this point that the NRC can leverage. Further, abandoning this effort to either reevaluate or extend the timeline will result in the regulatory bottleneck to licensing and commercial deployment of advanced reactors. However, the rule still needs to be an effective, efficient, and commercially viable pathway for licensing.

In the public meeting on 6/10/2021 it was expressed that there is a preference to shift to more subject-specific meetings to enable subject matter experts to interact more directly. This shift has the potential to make more direct progress in many areas. However, scheduling must be carefully considered to avoid overlap and allow external stakeholders and the public to engage in all meetings, and sufficient time to review relevant material.

We hope the NRC can provide clarification on some points to better understand the reason for certain decisions being made by the staff. The comments provided in this correspondence are provided based on the most recent drafts available[3]. The following is organized by rule subpart to facilitate easier reference to specific document numbers. Some topics intersect multiple subparts. In these cases, the discussion is limited to the section that seems most relevant.

Subpart A

Providing a statement of the intent of this rule in Subpart A would provide clarity on a number of comments that have come up in stakeholder meetings. It will also clearly define how and when this rule can and should be used in the future to help avoid inappropriate interpretations.

It is noted that most sections of this preliminary draft either refer to existing sections (e.g., 50.2) or indicate that the text is still being determined (e.g., “This term is under development”). Therefore we have no comments on this Subpart at this time.

[3] NRC ADAMS Accession Number ML21148A062

Subpart B

Second Tier Safety Criteria

It is unclear from the draft text if a second tier of safety criteria is necessary. It is expected that the NRC staff want to provide safety to the public. A second tier could provide the staff with a performance basis to monitor and act on a wide range of requirements that are not included in the existing licensing frameworks (Part 50 & 52), thereby potentially increasing regulatory burden. The important consideration is if the second tier of performance requirements is necessary to ensure safety to the public. It is our opinion that if the First Tier safety criteria are met during licensing then the Second Tier safety criteria, in their current form, are not necessary and therefore burdensome. Additionally, the current draft of 53.220(a) provides generalized and open-ended performance objectives, not a measurable performance criteria that can be used for a risk-informed determination of acceptability.

Further, the text is circular in function with the performance criteria in section 53.220 (b)(1) requiring the maintenance of reliability to meet section 53.240

> *"Ensure plant SSCs, personnel, and programs provide the necessary capabilities and maintain the necessary reliability to address licensing basis events in accordance with § 53.240 and provide measures for defense-in-depth in accordance with § 53.250"*,

and then in Licensing Basis Events section 53.240 the performance criteria requires

> *"The evaluation of licensing basis events must be used to confirm the adequacy of design features and programmatic controls needed to satisfy first and second tier safety criteria of this subpart and to establish related functional requirements for plant SSCs, personnel, and programs."*

This is unclear. It appears that features and controls must be adequate for licensing basis events to satisfy first and second tier safety criteria, but the second tier safety criteria performance is determined by maintaining the capabilities to address licensing basis events.

As Low As Reasonably Achievable (ALARA)

It is our opinion that ALARA should not be a performance metric for licensing. While ALARA is good practice for operation of any radiation system, it is not a clear and

defined performance metric. The draft second tier safety criteria requires dose to the public are

> *"... are as low as is reasonably achievable taking into account the state of technology, the economics of improvements in relation to the state of technology, operating experience, and the benefits to the public health and safety."*

As such it can be interpreted in various ways or change over time. For example, revisions to what is considered economic have occurred previously[4]. Similarly, operating experience will accumulate overtime as advanced reactor technologies have no commercial operating experience. If the Second Tier is removed as we suggest then there is no further justification for directly including it in this rulemaking.

Quantitative Health Objectives (QHO)

A reworded version of the QHOs from the Safety Goals are currently included in the draft in section 53.220(b)(2). The NRC staff suggested in a recent stakeholder meeting[5] that QHOs would be necessary, and the best option for, evaluating the second tier criteria. In our opinion the QHOs should be maintained as policy and should not be included in this rule. Even if a second tier of safety criteria is needed, then we feel that the QHOs are not the appropriate performance criteria to use. Several concerns lead to this conclusion.

Using the QHOs directly in the rule elevates policy goal to rule and creates a new level of performance for licensing that has not been included in other rules. Introduction of the QHOs as a licensing requirement increases burden and the level of proof needed for licensing. Existing technologies can and do already meet this policy goal as shown in multiple studies, including the State-of-the-Art Reactor Consequence Analysis (SOARCA) project[6]. While advanced reactor technologies in development are likely to be even safer than existing reactors, this argument misses the point. The addition of QHOs as a licensing requirement without it being necessary to ensure adequate protection to the public reduces the efficiency of the licensing process and increases operational burden without providing increased safety to the public.

The need to use a derived performance criteria - health outcomes instead of the dose created by the advanced nuclear plant - is another problem. The linear no-threshold

[4] NUREG-1530
[5] NRC ADAMS Accession Number ML21088A279
[6] NUREG/CR-7110 Vol. 1

(LNT) dose model has been questioned on many occasions, including an ongoing petition for rulemaking.[7] Congress has also recently funded a low-dose research program[8] and requested that the National Academies of Science Engineering and Medicine (NAESM) develop a strategic research plan for low-dose radiation, which has just started.[9] The NRC staff even investigated the appropriate dose response model to use for the SOARCA project[10], which was expected to be predominantly low-dose. The concern of a shifting criteria if the dose model is updated could be mitigated by placing the definition in Part 53, but that precludes benefitting from the ongoing research. A better approach would be to use a first-order criteria (e.g., dose) rather than a second-order (e.g., latent cancer fatalities) that relies on the first-order criteria for calculation.

The NRC indicated that QHOs as second tier safety criteria could be applied to a range of applications, including as a basis for *"...appropriate special treatment for non-safety related SSCs."*[11] The use of QHOs requires a full PRA to calculate offsite consequences.[12] Performing a full PRA for offsite consequences as a basis for non-safety features would not be consistent with a graded approach to risk-analysis, as discussed extensively in a recent stakeholder meeting.[13]

Another concern is the difficulty in directly relating health objectives to PRA. To apply the QHOs to large light-water reactors, the NRC needed to develop surrogate risk measures.[14] Core damage frequencies (CDF) of less than $1x10^{-4}$ per reactor-year has been used as a surrogate for the latent cancer fatality QHO. Large early release frequency (LERF) of less than $1x10^{-5}$ per reactor-year has been used as a surrogate for the early cancer fatality QHO. These metrics are not perfect surrogates for the QHOs, integrate additional safety margin, and are technology dependent. Alternative surrogates may be necessary for advanced reactor technologies and developing new surrogate criteria would be very difficult, especially without operational experience.

[7] Docket NRC-2015-0057 https://www.regulations.gov/docket/NRC-2015-0057

[8] Public Law 116-260

[9] https://www.nationalacademies.org/our-work/developing-a-long-term-strategy-for-low-dose-radiation-research-in-the-united-states

[10] SECY-08-0029

[11] NRC ADAMS Accession Number ML21088A279

[12] NRC Regulatory Guide 1.174

[13] NRC ADAMS Accession Number ML21146A347

[14] NUREG-1860 Appendix D

Inherent Characteristics

The use of inherent characteristics are expected to be more common in advanced reactors where inherent and passive safety are part of the design. As defined in the current draft rule an inherent characteristic is

> *"...an attribute of a design feature that has such a high degree of certainty in its performance that uncertainties need not be quantified."*

This suggests that inherent features functionally have zero risk of failure, and therefore cannot be risk-informed. Considering the extensive use of inherent characteristics in proposed advanced reactor designs, it is hard to understate the importance of thinking carefully about how inherent characteristics fit into a risk-informed approach, how to develop a basis for validating that a characteristic should be defined as inherent, and if there is functionally zero uncertainty what level of Defense in Depth is necessary. We look forward to more detailed discussion with the staff related to this topic in the future as Defense in Depth is an important concept, but how it is applied for these new designs will require additional discussion.

Defense in Depth (DID)

A prior draft of the rule required that *"no single feature"* be relied on for safety. This requirement is prescriptive and not risk-informed. However, we concur with the NRC that there should be multiple layers of protection and that no single feature should be relied upon to ensure safety. We are not implying that multiple features be used, each of which can account for the full performance of the safety requirement. Instead, the important consideration is that a single point of failure does not create a design basis event or beyond design basis event, and that a single feature is not the only feature available to mitigate an event. A typical DID approach would require multiple layers of protection even when inherent characteristics provide a system that is functionally certain to perform as expected. The methods and features available to meet this requirement should be open to innovative solutions.

Subpart C

Editorial

As an editorial consideration, is there a purpose for Subpart C to skip 53.3xx numbering to start at 53.4xx?

Analysis Requirements

Section 53.450(a) requires a "probabilistic risk assessment". It is likely that most applicants will use this approach. However, a probabilistic assessment is not the only risk-informed approach to meet performance criteria. We suggest adopting the more appropriate text used in 53.450(b). *"...PRA, other generally accepted risk-informed approach for systematically evaluating engineered systems, or combination thereof…"*

Feedback on the potential for an applicant to use a deterministic approach has been asked at several stakeholder meetings. We feel that a pathway for a deterministic only approach is out of scope of this rule and should not be specifically included. However, sufficient flexibility should be maintained in the rule to allow a deterministic approach that is risk-informed (not risk-based) and meets the performance criteria.

It is unclear why several deterministic analyses, particularly those that reference 10 CFR Part 50, are required in this section as part of a risk-informed performance-based rule. Several of the deterministic analyses referenced are inapplicable even to the current advanced reactors in development and therefore do not pass the technology-inclusive threshold. For example, 10 CFR 50.155(e), which is referenced in draft section 53.450(g), requires monitoring of the spent fuel pool. Such a pool may not exist for a plant that ships and returns the fuel inside the reactor assembly. In addition, spent fuel may be stored in a location that is significantly different than a traditional spent fuel pool (e.g. in-vessel, but outside of the core region).

Licensing Basis Events (LBE)

This definition relies on the second tier safety criteria. As we do not feel this criteria is necessary in the rule this definition of LBE should be revised.

Design Basis Accidents (DBA)

The current definition included in section 53.450(5)(e) essentially eliminates analysis of events that are mitigated by inherent characteristics. The draft requires the applicant to

> *"...identify and analyze equipment failures and human errors. The events selected as design basis accidents should be those that, if not terminated, have the potential for exceeding the safety criteria in § 53.210(b)."*

Inherent characteristics include natural characteristics such as convection or gravity that do not involve equipment or humans. Similarly, since inherent characteristics are not currently considered by the safety-related SSCs they cannot be assumed in the analysis to mitigate the event. Considering the expected use of inherent characteristics as passive safety features in advanced reactor designs this seems to be a discontinuity in considering and crediting inherent characteristics. It is also noted that the frequency of 10,000 years is not included in the definition of DBA in Subpart A.

Application of Analytical Safety Margins to Operational Flexibilities

The purpose of this section is unclear from the draft. Initially it seemed to be a system to seek relief from operational requirements (i.e., the draft mentions emergency planning). However, it could be interpreted as a potential pathway to define a margin that could be pre-defined by the applicant for use at a later stage for secondary systems (i.e., hydrogen production, district heating), without reevaluation of the license. Additionally, there is no performance criteria to define an adequate margin to allow operational flexibilities.

Seeking relief from requirements of this rule during licensing is functionally different from defining an unused margin that can be applied as needed post-licensing. Both interpretations are potentially useful for flexible regulation and design innovation. Clarification of the intended role of this section is needed.

Subpart D-J

Preliminary drafts or first revisions have not yet been released to the public. We will review these and provide comment as necessary at a later date.