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Standards Committee

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Respondent: American Nuclear Society (ANS) Standards Board on behalf of the ANS Standards Committee
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Title: ANS Standards Board Response to Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors [NRC-2019-0062]
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The U.S. Nuclear Regulatory Commission (NRC) solicited comments on ''Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors'' proposed rule (also known as ''part 53'') which would revise the NRC's regulations by adding a risk-informed, performance-based, and technology-inclusive regulatory framework for commercial nuclear plants in response to the Nuclear Energy Innovation and Modernization Act.

The American Nuclear Society (ANS) Standards Committee develops voluntary consensus standards to be certified by the American National Standards Institute (ANSI) as American National Standards. The standards developed and maintained by the ANS Standards Committee address the design, analysis, and operation of components, systems, and facilities related to the application of nuclear science and technology.

Comments on Part 53 Proposed Rule, Docket ID NRC-2019-0062

The ANS Standards Board thanks the NRC for the opportunity to comment on the 10 CFR Part 53 proposed rule. The ANS Standards Board has identified two areas of concern.

1. Departure from endorsed voluntary consensus standard ANSI/ANS-8.1-2014 (R2023)

The ANS Standards Board takes exception with wording in the proposed rule which does not follow the promulgated voluntary consensus standard ANSI/ANS-8.1-2014 (R2023), *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*.

The section of the proposed rule of concern is § 53.620(d) which is discussed in the Federal Register notice accompanying the proposed rule (see Federal Register / Vol. 89, No. 211 / Thursday, October 31, 2024, p. 86932). The background discussion for subpart E states:

> *The most significant change proposed for MLs in part 53 as compared to MLs under part 52 relates to § 53.620(d) in subpart E and the associated licensing provisions in subpart H. These provisions would allow and establish requirements for the loading of fuel into a manufactured reactor at the*

manufacturing site for subsequent transport to a commercial nuclear facility that will operate pursuant to a COL. The first requirement in the proposed § 53.620(d) would establish limitations on when a license under part 70 would authorize the loading of fuel into a reactor manufactured under an ML. The proposed regulation would require the manufactured reactor to include at least two independent physical mechanisms that will each prevent criticality should conditions most favorable to critical operation be introduced (e.g., optimum neutron moderation and reflection). This requirement would contribute to the NRC's longstanding practice of requiring defense in depth for preventing accidents in any facility dealing with SNM, including requirements in § 70.64 for certain part 70 licensees to adhere to the "double contingency principle."

The additional requirement in the proposed rule for part 70 licensees loading fuel into a reactor "to include at least two independent physical mechanisms that will each prevent criticality should conditions most favorable to critical operation be introduced (e.g., optimum neutron moderation and reflection)" is beyond what the current part 70 requires.

The ANS Standards Board similarly takes issue with the following statement:

> *This requirement would contribute to the NRC's longstanding practice of requiring defense in depth for preventing accidents in any facility dealing with SNM, including requirements in § 70.64 for certain part 70 licensees to adhere to the "double contingency principle."*

This statement is not accurate. What the proposed rule calls for is not consistent with the process analysis requirement and the double contingency principle as put forth in ANSI/ANS-8.1-2014 (R2023). The proposed rule is also not performance based as mandated by the Nuclear Energy Innovation and Modernization Act of 2019 (NEIMA) and the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act of 2024.

The process analysis requirement and the double contingency principle are the foundations of criticality safety for all part 70 facilities.

The process analysis requirement in ANSI/ANS-8.1-2014 (R2023), Section 4.1.2, states:

> *Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions.*

The double contingency principle [Section 4.2.2 in ANSI/ANS-8.1-2014 (R2023)] is a recommended technical practice used to meet the process analysis requirement with the concept of defense in depth and states:

> *Process designs should incorporate sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible.*

A part 70 fuel facility must demonstrate how they meet 10 CFR 70.61(d), which states:

> *In addition to complying with paragraphs (b) and (c) of this section, the risk of nuclear criticality accidents must be limited by assuring that under normal and credible abnormal conditions, all nuclear processes are subcritical, including use of an approved margin of subcriticality for safety. Preventive controls and measures must be the primary means of protection against nuclear criticality accidents.*

Accordingly, 10 CFR 70.61(d) is the ANS-8.1 process analysis requirement with the addition of "including use of an approved margin of subcriticality for safety."

The part 70 fuel facility also must demonstrate compliance with 10 CFR 70.64(a)(9), which states:

> *Criticality control. The design must provide for criticality control including adherence to the double contingency principle.*
>
> *Before a new operation with fissionable material is begun, or before an existing operation is changed, it shall be determined that the entire process will be subcritical under both normal and credible abnormal conditions.*

Although endorsement is not necessary for Federal use,[1] the NRC has endorsed ANSI/ANS-8.1-2014 (R2023) in Regulatory Guide 3.71, Rev. 3. While the endorsement takes exception to some items in the standard, it does not take exception to the performance process analysis requirement or the double contingency recommendation. OMB Circular A-119 states:[2]

> *...all Federal agencies must use voluntary consensus standards in lieu of government-unique standards in their procurement and regulatory activities, except where inconsistent with law or otherwise impractical.*

In this case, the NRC is proposing a new regulation with additional requirements above and beyond what it endorsed in the voluntary consensus standard ANSI/ANS-8.1-2014 (R2023) without justification. In reviewing license applications under part 70, the NRC staff applies the following guidance in NUREG-1520, Rev. 2:[3]

[1] OMB Circular A-119: Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, Microsoft Word - Revised Circular A-119 as of 1.22.2016 for posting
[2] Federal Register/Vol. 63, No. 33/Thursday, February 19, 1998/Notices.
[3] "Standard Review Plan for Fuel Cycle Facilities License Applications," NUREG-1520, Rev. 2.

e. Acceptance Criteria for Purely Qualitative Methods

A purely qualitative method of defining "unlikely" and "highly unlikely" is acceptable if it incorporates all of the applicable reliability and availability qualities to an appropriate degree. For example, one statement of applicable qualities is double-contingency protection, the quality of a process design that incorporates sufficient factors of safety to require at least two unlikely, independent, and concurrent changes in process conditions before a criticality accident is possible. (p. 3-30)

The guidance in NUREG-1520 references regulatory requirements in Section 5.4.1, excerpted below:

5.4.1 Regulatory Requirements

Acceptance criteria are based on meeting the relevant requirements of the following regulations:

6. The requirements for new facilities or new processes at existing facilities requiring a license amendment under 10 CFR 70.72, "Facility Changes and Change Process," are stated in 10 CFR 70.64, "Requirements for New Facilities or New Processes at Existing Facilities," and include adherence to the double contingency principle. (p 5-4)

The guidance in NUREG-1520 also includes the following provisions for reviewing criticality safety evaluations:

5.4.3.1.7.2 Criticality Safety Evaluations (CSEs)

2. The applicant commits to providing the technical basis that demonstrates (a) subcriticality under normal and credible abnormal conditions and (b) compliance with the double contingency principle in the CSEs. (p 5-15)

The language in ANSI/ANS-8.1-2014 (R2023) is embedded in the regulations and the criticality safety programs of every part 70 facility.

The additional requirement in the proposed rule for part 70 licensees loading fuel into a reactor "to include at least two independent physical mechanisms that will each prevent criticality should conditions most favorable to critical operation be introduced (e.g., optimum neutron moderation and reflection)" adds an additional, prescriptive level of control in addition to and beyond the current part 70 requirement for reasonable assurance of adequate protection.

As described by the proposed rule, a part 70 facility would have to demonstrate that three unlikely, independent, and concurrent failures, assuming the reactor is not normally immersed in optimally

moderated and reflected, must occur before criticality is possible. The process upsets which would have to happen are:

1. An upset must occur that creates conditions that are most favorable to criticality (e.g., optimum neutron moderation and reflection)
2. Loss of one physical mechanism that prevents criticality
3. Loss of the second physical mechanism that prevents criticality

If the situation of optimum neutron moderation and reflection are normal conditions (conditions which are consistent with normal operations), then having two independent controls which are unlikely to fail and are independent of each other would meet the double contingency principle, but the double contingency principle does not require two physical mechanisms in order to satisfy the recommendation.

Additionally, the prescriptive requirement of two physical mechanisms is not consistent with a performance-based approach called for in NEIMA and the ADVANCE Act. The ANSI/ANS-8 series of standards are written as performance based in that they provide requirements and recommendations without prescriptively stating how they must be satisfied. By making prescriptive requirements, the NRC places additional burdens on the part 70 applicant or licensee by not allowing other non-physical methods of control that would meet the existing regulation in part 70.

The requirement for two physical mechanisms is not consistent with what is required by ANSI/ANS-8.1-2014 (R2023) and beyond what is required by part 70 for reasonable assurance of adequate protection. The ANS Standards Board requests that the NRC revises the rule to require the operations covered by § 53.620(d) follow the ANSI/ANS-8 series of standards and particularly ANSI/ANS-8.1-2014 (R2023) for ensuring criticality safety at part 70 facilities.

2. Lack of clarity on an apparent new requirement for prior NRC approval of consensus codes and standards

The ANS Standards Board is also seeking NRC clarification for the following statement in § 53.440b (Design requirement) which states:

> *The design features required by § 53.400 must, wherever applicable, be designed using generally accepted consensus codes and standards that have been endorsed or otherwise found acceptable by the U.S. Nuclear Regulatory Commission (NRC).*

The ANS Standards Board calls attention to two aspects of this statement that are potentially problematic with respect to the utility and application of volunteer consensus standards and consistency with established law and policy per the Nuclear Technology Transfer and Advancement Act of 1985 (NTTAA) and OMB Circular A-119:

- The phrasing “generally accepted consensus codes and standards” is different from that in Section 12(d)(1) of the NTTAA and OMB Circular A-119, which refer to and establish preference for “volunteer consensus standards.” If this is a deliberate departure from law and federal policy, more context and justification would be helpful. If this discrepancy is not intentional, then the text should be revised appropriately for clarity.
- The statement can be interpreted to mean that use of codes and standards require prior review, acceptance, or endorsement by the NRC; this prior approval burden could discourage the use of new, revised, or previously unapproved codes and standards. Standards development organizations will continue to revise and develop new codes and standards that may be useful to an applicant’s submittal but would not meet this prior approval requirement. If the interpretation is correct, more context and justification would be helpful. If the interpretation is not correct, the text should be revised appropriately for clarity.