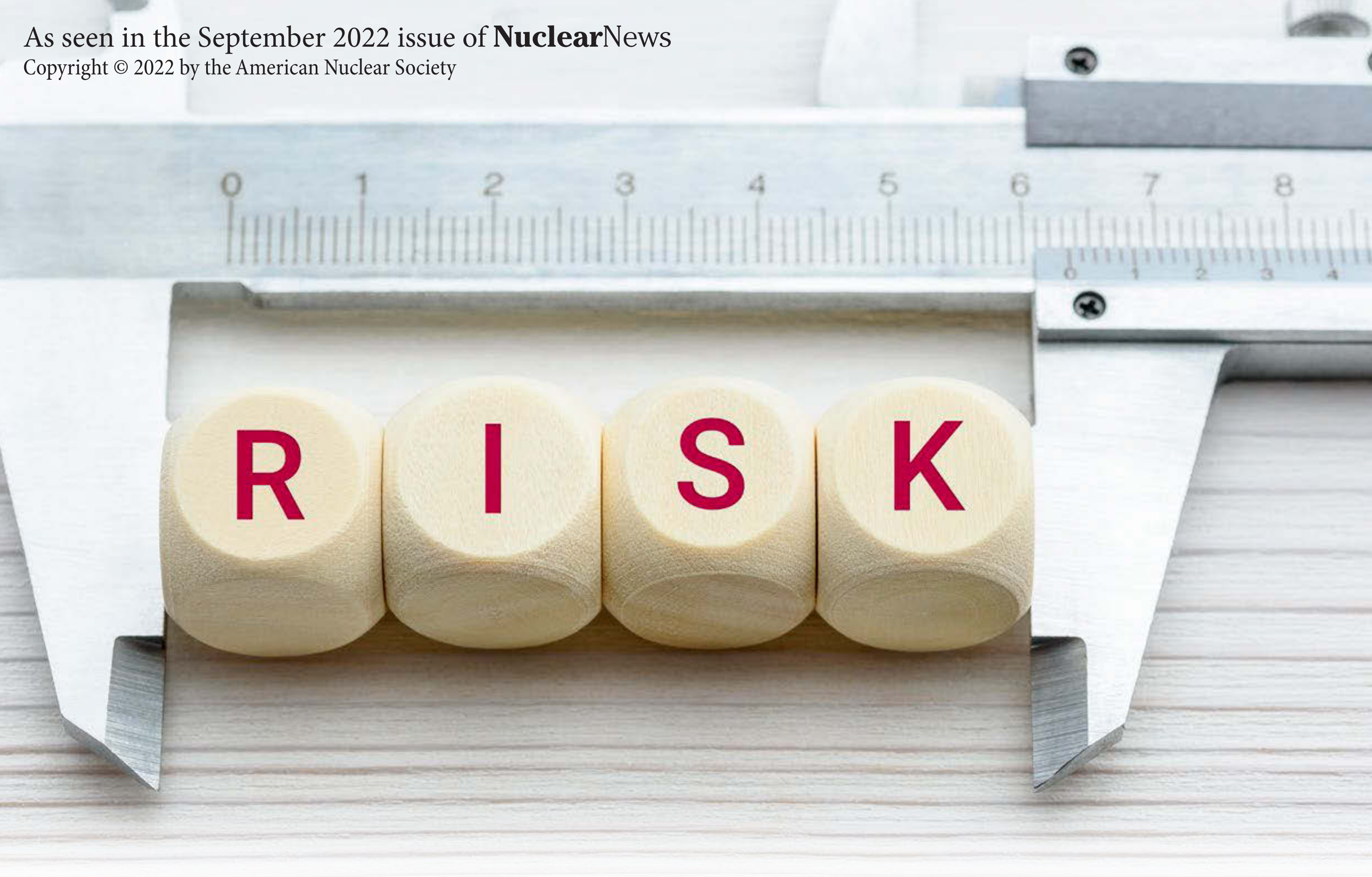
As seen in the September 2022 issue of **Nuclear**News



Maintaining RIPB in commercial LWRs:

ANS Standards Committee publishes new standard for light water reactor risk-informed, performance-based design

By Kent B. Welter

The new standard ANSI/ANS-30.3-2022, *Light Water Reactor Risk-Informed, Performance-Based Design*, has just been issued by the American Nuclear Society. Approved by the American National Standards Institute (ANSI) on July 21, 2022, the standard provides requirements for the incorporation of risk-informed, performance-based (RIPB) principles and methods into the nuclear safety design of commercial light water reactors. The process described in this standard establishes a minimum set of process requirements the designer must follow in order to meet the intent of this standard and appropriately combine deterministic, probabilistic, and performance-based methods during design development.

This standard was formally initiated in January 2018 with a draft completed by the working group in August 2019. The first step in the approval process was a preliminary review by four ANS standards committees—the Light Water Reactor & Reactor Auxiliary System Design Subcommittee; the Risk-informed, Performance-based Principles and Policy Committee (RP3C); the Subcommittee on Risk Application; and the Research and Advanced Reactors Consensus Committee. Owing to extensive comments from the preliminary review, it took 19 months to address and revise the draft to the satisfaction of commenters. The revised draft was issued to the ANS Large Light Water Reactor Consensus Committee for formal approval with concurrent public review in March 2021. Comments on the first ballot resulted in over 130 substantive changes, which required a second ballot and public review in February 2022. Consensus was finally reached without objection in July 2022 after the close of the third ballot and public review.

The main provisions of this standard provide specific process requirements and references to additional national standards for defining safety requirements; selecting licensing-basis events; performing design-basis and severe accident analysis; classifying and categorizing structures, systems, and components; establishing systematic defense-in-depth measures; evaluating defense-in-depth adequacy; and implementing a performance-based decision analysis process.

The plant designer is responsible for selecting and implementing the specific design requirements necessary for implementation of this standard, including support for defining accidents and expected operational characteristics through design analyses, models, conformance with applicable industrial codes and standards, or experience gained from similar designs. The designer is also responsible for the use of alternate or additional criteria and requirements to accommodate unique technologies, designs, or site characteristics not covered (or referenced) by this standard or related documents. The inclusion of RIPB practices also supports a greater understanding of uncertainties surrounding deterministic safety evaluations and establishing compensatory actions for risk-significant uncertainties.

Reactor design organizations can improve the quality and transparency of their design decisions by implementing the provisions specified in this standard both from a public safety perspective and cost perspective. This can only be achieved if clear RIPB goals are established early in the design process and if technical progress is frequently assessed against these goals to support effective decision-making.

The definitions in ANSI/ANS-30.3-2022 have been taken primarily from the ANS Glossary and International Atomic Energy Agency Safety Glossary. In some cases, the IAEA definition was used if a suitable definition was not available in the ANS Glossary or because it was preferred. The use of IAEA definitions in this standard helps ensure international harmonization and acknowledges the global market for new and advanced LWRs. Numerous definitions were derived from other sources but modified slightly to be more generally applicable to this standard.

This standard has technology-neutral elements but is intended for use in designing and licensing new commercial LWRs under Title 10 of the *Code of Federal Regulations* Part 50 or Part 52.

The RIPB principles and practices in this standard represent the current state of practice with respect to advanced LWR design and licensing. It was developed consistent with existing U.S. Nuclear Regulatory Commission regulations and guidance. The intent is that advanced LWR designers can use this standard in current or near-term licensing applications. NRC endorsement of this standard will be sought to align industry and the regulator on consistent use and application of the provisions. Small modular reactor designers, such as NuScale Power, have expressed great interest in obtaining NRC endorsement of this standard to support near-term licensing applications.

N. Prasad Kadambi, chair of ANS's RP3C and a member of the ANS-30.3 Working Group, said, "ANS-30.3 represents an example of how a voluntary consensus standard can bring forward for consideration by industry results from research. The research supporting the section on performance-based decision-making was done about 20 years ago and would not have seen the light of day without publication in such a standard."

This standard was prepared by the ANS-30.3 Working Group. The following members contributed to this standard:

K. B. Welter (chair), NuScale Power

D. P. Blanchard (vice chair), Applied Reliability Engineering

J. K. August, Individual

R. J. Burg, Engineering Planning & Management

D. A. Dube, Jensen Hughes (retired)

E. P. Elliot, Los Alamos Environmental Management

N. P. Kadambi, Kadambi Engineering Consultants

D. E. W. Leaver, Worley Parsons (retired)

M. Linn, Individual

G. Locklear, Kinectrics AES

P. A. Sicard, Entergy Corporation

D. J. Spellman, Xcel Engineering

D. L. Van Bossuyt, Naval Postgraduate School

R. P. White, Individual

C. Williams, NuScale Power

Kent B. Welter is chief engineer in testing and analysis at NuScale Power and chair of the ANS-30.3 Working Group.