ASME/ANS RA-S-1.1–2022

Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications

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CONTENTS

FOREWORD

The American Society of Mechanical Engineers (ASME) Board on Nuclear Codes and Standards (BNCS) and American Nuclear Society (ANS) Standards Board have formed a Joint Committee on Nuclear Risk Management (JCNRM) to develop and maintain probabilistic risk assessment (PRA) standards. The JCNRM operates under procedures accredited by the American National Standards Institute (ANSI) as meeting the criteria of consensus procedures for American National Standards. The JCNRM holds two formal meetings per year, and users are invited to participate. Additional information about the JCNRM can be found on its committee page at https://cstools.asme.org/.

In 2002, ASME issued an initial PRA standard, the scope of which was Level 1 and large early release frequency for internal events at-power for light water reactor (LWR) nuclear power plants. In 2003 and 2007, ANS issued two other PRA standards, the scopes of which were external hazards and internal fires at-power for LWR nuclear power plants. In 2008, the three standards were combined into one standard, ASME/ANS RA-S–2008, under the joint auspices of ASME and ANS. A revision, ASME/ANS RA-Sa-2009 [Addendum (a)], was issued in 2009. The JCNRM came into existence after Addendum (a) was issued. A second revision was issued in 2013, ASME/ANS RA-Sb–2013 [Addendum (b)]. This revision was reaffirmed in 2018. A Case was issued in 2017, ASME/ANS RA-S CASE 1, which was an alternative to Part 5 (Seismic PRA). This was then reissued in 2019, ASME/ANS RA-S CASE 1-1, with only minor corrections.

ASME/ANS RA-S-1.1-2022 is a new edition of the Level 1 PRA Standard that supersedes all previous revisions. The JCNRM is responsible for ensuring that this Standard is maintained and revised, as necessary. This responsibility includes appropriate coordination with and linkage to other standards under development for related risk-informed applications.

ASME/ANS RA-S-1.1-2022 is a substantial revision of ASME/ANS RA-Sb-2013. The following major modifications are among those performed:

- A number of changes have been implemented to strengthen the consistency among technical elements that are cross-cutting through different hazards. These changes required, for example, revisiting Supporting Requirements (SRs) associated with screening, uncertainty, human reliability analysis, and documentation. The screening criteria are now consolidated into a single set of screening criteria in Part 1.
- Back references from Part to Part (e.g., from Part 4 to Part 2) have been made more consistent, deliberate, and explicit in each Part to facilitate the peer review process.
- Significant lessons learned have been gathered in the past few years on hazard PRAs such as high-winds PRAs and external flooding PRAs that previously had less opportunity for being piloted. Such lessons learned have been incorporated in clarifications of the intent of the SRs for Part 7 and Part 8.
- Capability Category III has been removed across the board on the basis that Capability Category II already envisions refined analysis and realism implemented for the risk-significant elements. Going beyond this, while not discouraged, is not something that needs to be codified in a standard that is supposed to identify the minimum requirements for a technically adequate analysis.
- The new edition of this Standard includes a new section in Part 1. Section 1-7 states requirements to assess the technical adequacy of newly developed methods to be used in the plant PRA.
- In previous addenda, Nonmandatory Appendix (NMA) 1-A provided examples of "PRA maintenance" and "PRA upgrades." These subjects are now being addressed by the Pressurized Water Reactor Owners Group (PWROG). The new NMA 1-A provides meanings for the action verbs used in SRs. It is provided as an aid to interpret the intent of the SRs, especially for users for whom English is not the first language.
- Key operating definitions such as the definitions of "PRA upgrade" and "PRA maintenance" have been changed. These definitions now agree with the ones presented in PWROG-19027-NP

(Rev. 2), "Newly Developed Method Requirements and Peer Review," and endorsed by the U.S. Nuclear Regulatory Commission via Regulatory Guide 1.200 (Rev. 3), "Acceptability of Probabilistic Risk Assessment Results for Risk-Informed Activities." Other definitions have been revisited for clarity.

- Notes and commentaries have been revised to ensure content is still up to date and, for the most part, are removed from the body of this Standard and located in NMAs associated with the individual Parts. This relocation emphasizes the concept that notes and commentaries do not represent formal requirements of this Standard and are provided for information. References are also removed from individual SRs and moved to notes as one way to meet the SRs.
- All peer review requirements have been consolidated into one section in Part 1 to remove inconsistencies and duplicated information from different Parts.
- The clarification regarding the scope of walkdowns documented in JCNRM Inquiry 20-2435 for Addendum B has been included in the NMAs for all walkdown SRs in this Standard. (Inquiry 20-2435 available at https://cstools.asme.org/csconnect/CommitteePages.cfm?Committee=100186782&Action=40886)
- Finally, Part 10 on the Seismic Margin Assessment has been withdrawn from the Standard and is therefore removed.

The current edition of this Standard has a significantly larger number of SRs, even though some have been removed. However, the intent of the overall Standard remains consistent with the previous versions.

This publication, the 2022 edition of the "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," was approved by the ASME BNCS and the ANS Standards Board. ASME/ANS RA-S-1.1-2022 was approved by ANSI on May 11, 2022.

CORRESPONDENCE WITH THE ASME/ANS JOINT COMMITTEE ON NUCLEAR RISK MANAGEMENT

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, ASME/ANS Joint Committee on Nuclear Risk Management, The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions to the Standard are made periodically to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Interpretations. Upon request, the ASME/ANS JCNRM Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can be rendered only in response to a written request sent to the Secretary of JCNRM.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the inquirer will receive an automatic e-mail confirming receipt.

If the inquirer is unable to use the online form, they may mail the request to the Secretary of JCNRM at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the inquirer submit their request in the following format:

Subject	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a “yes” or “no” reply is acceptable.
Proposed Reply(ies)	Provide a proposed reply(ies) in the form of “yes” or “no,” with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The inquirer may also include any plans or drawings that are necessary to explain the question; however, these materials should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Furthermore, persons aggrieved by an

interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The JCNRM regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of JCNRM.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

JCNRM Cases may be issued periodically and are available under the "JCNRM CASES" tab in the lefthand column at https://go.asme.org/JCNRMcommittee.

ACKNOWLEDGMENTS

The ANS/ASME JCNRM is animated by the passion of more than 200 professionals in the industry, from four continents and spanning the extensive interdisciplinary breadth needed for the development of multihazard, full-scope, comprehensive risk assessments. Their dedication and support continue to sustain the primary role that risk information has in the safe and efficient design, operation, and regulation of nuclear power plants. The members of the JCNRM Subcommittee on Standard Maintenance and the reporting working groups have dedicated significant time to the refinement of this Standard.

A particular debt of gratitude is owed by the JCNRM to Paul Amico, Andrea Maioli, and Ian Wall, who have been instrumental in leading and coordinating the combined effort needed to update and edit this edition of the Standard, navigating the schedule and challenges of a volunteer organization while maintaining the highest technical rigor.

A number of people have supported the JCNRM for numerous years but retired before seeing the completion of this Standard, for which they provided instrumental help. We acknowledge the efforts of these people and especially the work of Gareth Perry, former Subcommittee on Standard Maintenance vice cochair.

We also remember dear friends and significant contributors to this Standard and to the risk-informed technology community that have passed. In memoriam, we acknowledge Mary Drouin, Barry Sloane, and Rupert Weston.

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Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications

(The following is a roster of the Committee at the time of the approval of this Standard.)

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