

Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs)

TRIAL USE AND PILOT APPLICATION

Publication of this standard for trial use has been approved by The American Society of Mechanical Engineers and the American Nuclear Society. Distribution of this standard for trial use and comment shall not continue beyond 36 months from the date of publication, unless this period is extended by action of the Joint Committee on Nuclear Risk Management. It is expected that following this 36-month period, this draft standard, revised as necessary, will be submitted to the American National Standards Institute (ANSI) for approval as an American National Standard. A public review in accordance with established ANSI procedures is required at the end of the trial-use period and before a standard for trial use may be submitted to ANSI for approval as an American National Standard. This trial-use standard is not an American National Standard.

Comments and suggestions for revision should be submitted to:

Secretary, Joint Committee on Nuclear Risk Management
The American Society of Mechanical Engineers
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New York, NY 10016-5990



**The American Society of
Mechanical Engineers**



ANS

Date of Issuance: January 5, 2015

**NOTE: The original trial use period of 24 months was extended to 36 months
by the Joint Committee on Nuclear Risk Management.**

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The American Society of Mechanical Engineers
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Published by

**American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60526 USA**



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Printed in the United States of America

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(This Foreword is not a part ASME/ANS RA-1.2-2014, “Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactor (LWRs)”.)

FOREWORD

The American Society of Mechanical Engineers (ASME) Board on Nuclear Codes and Standards (BNCS) and the American Nuclear Society (ANS) Standards Board mutually agreed in 2004 to form the Nuclear Risk Management Coordinating Committee (NRMCC). The NRMCC was chartered to coordinate and harmonize standards activities related to probabilistic risk assessment (PRA) between ASME and ANS. A key activity resulting from the NRMCC was the development of PRA standards structured around the levels of PRA (i.e., Level 1, Level 2, and Level 3) to be jointly issued by ASME and ANS. In 2011, ASME and ANS decided to combine their respective PRA standards committees to form the ASME/ANS Joint Committee on Nuclear Risk Management (JCNRM).

The Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs) was initiated by the ANS Risk Informed Standards Committee (RISC) in 2005 and is currently within the responsibility of the JCNRM Subcommittee on Standards Development. The Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs) was developed to provide requirements for the evaluation of containment performance and radiological releases to the environment. The radiological releases considered result from postulated accidents that cause fuel damage. The requirements of this standard apply to the evaluation of risk informed applications that use radionuclide release information or as input to the determination of inputs for Level 3 PRA evaluations (e.g., ex-plant consequences). This standard addresses sequences initiated by internal or external events during all modes of operation for operating and evolutionary commercial light water reactor (LWR) nuclear plants. This standard is used in conjunction with the ASME/ANS PRA Standard RA-Sa-2009. Specifically, the applicable requirements of the ASME/ANS PRA Standard RA-Sa-2009 are also applicable to those comparable parts of the Level 2 Analysis. In addition, the Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs) is structured to provide the requirements for all of the hazards defined in ASME/ANS PRA Standard RA-Sa-2009 and analyzed with a Level 1 PRA. The original draft of this standard was developed in 2011 and has undergone several revisions prior to the current ballot.

This standard sets forth the criteria for the technical adequacy of a Level 2 analysis to support risk-informed decisions for commercial nuclear power plants. Supporting requirements are provided for determining the chronology and physical processes governing core damage progression, containment response, and radiological release to the environment as part of PRAs and related analysis methodologies. This standard establishes the requirements to characterize the fission product release frequencies for various containment performance outcomes.

Significant input has been received from the JCNRM, specifically the JCNRM Subcommittee on Standards Development (SC-SD). In addition, an SC-SD consensus ballot readiness review team provided a valuable assessment of the proposed Level 2 PRA Standard prior to its submittal for ballot.

Publication for Trial Use

The technical requirements in this standard are based on source material from the existing ASME/ANS PRA standard ASME/ANS RA-Sa-2009 as well as the draft PRA standard under development by JCNRM for Level 3 PRA. Although RA-Sa-2009 was revised in 2013 in ASME/ANS RA-Sb-2013

(Addendum B), the changes in Addendum B are not fully addressed in this Level 2 PRA trial use standard. JCNRM has approved the use of draft ANS standards with a requirement to follow up with changes to reflect changes in the supporting standards. Such changes could necessitate a need for revisions to this standard. The use of source material from not-yet-approved PRA standards and several other considerations have shaped the decision to issue this standard for trial use. It is expected that changes that may be required to account for changes to the supporting standards will be accomplished as part of the effort to upgrade this trial-use standard to the requirements of the American National Standards Institute.

This standard is intended to be used together with other PRA standards that cover different aspects of PRA. Specifically, this standard is intended to be used directly with ASME/ANS RA-Sa-2009, “Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications.” ASME/ANS RA-Sa-2009 includes Level 1 PRA and large early release frequency (LERF) for internal events at-power, external events, internal flood, and internal fire.

The Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs) cross references supporting requirements related to Systems, Data, Success Criteria, and Human Reliability Analysis to those technical elements of ASME/ANS RA-Sa-2009. This is consistent with the approach used in the LE element in Section 2-2.8 of ASME/ANS RA-Sa-2009 and in other sections of ASME/ANS RA-Sa-2009.

The format for this standard was developed in 2005 when no “standard” format was available. Therefore, it is not consistent with some other published PRA Standards regarding chapter numbers. Following Trial Use, the format of the section numbering will be reevaluated.

This standard is issued for Trial Use. Feedback is requested regarding the standard in all areas including the following general areas:

- Ease of use
- Clarity of technical supporting requirements (SR)
- Difficulty in the incorporation of interface requirements
- Difficulties in interpretation related to:
 - Different hazards
 - Different Plant Operating States
- Ability to evaluate significance when multiple release categories are involved
- Adequacy of references to PRA elements in other standards (e.g., Human Reliability, Systems, and Data)

Specific areas for which feedback is requested are:

- The availability of a realistic HRA technique to be used to satisfy SR PT-D2 for Capability Category II
- The minimum requirements for a peer review team (number of members, total study duration, total on-site presence) – Section 5.4.4
- A review of the ER HLR and SRs to ensure that the requirements are sufficiently clear and not duplicative.
- For SR L1-B2, is greater specification on the treatment of failure to run duration needed to assess the operation of mitigation equipment during accident progression?

PREPARATION OF TECHNICAL INQUIRIES TO THE JOINT COMMITTEE ON NUCLEAR RISK MANAGEMENT

INTRODUCTION

NOTE FOR TRIAL USE: The text of this section describes the technical inquiry process for approved standards. However, during the trial use period, users are encouraged to provide feedback, ask questions, and interact with the Severe Accident Progression and Radiological Release (Level 2) PRA Standard for Nuclear Power Plant Applications for Light Water Reactors (LWRs) project team. Such feedback may be provided via the Secretary of the Joint Committee on Nuclear Risk Management, as noted below.

The ASME/ANS Joint Committee on Nuclear Risk Management (JCNRM) will consider written requests for the interpretation and revision of risk management standards and the development of new requirements as dictated by technological development. JCNRM's activities in this latter regard are strictly limited to interpretations of the requirements or to the consideration of revisions to the requirements on the basis of new data or technology. As a matter of published policy, The American Society of Mechanical Engineers (ASME) does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity, and, accordingly, inquiries requiring such consideration will be returned. Moreover, ASME does not act as a consultant on specific engineering problems or on the general application or understanding of the standard's requirements. If, based on the inquiry information submitted, it is the opinion of the JCNRM that the inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

To be considered, inquiries will require sufficient information for JCNRM to fully understand the request.

INQUIRY FORMAT

Inquiries shall be limited strictly to interpretations of the requirements or to the consideration of revisions to the present requirements on the basis of new data or technology. Inquiries shall be submitted in the following format:

- (a) *Scope.* The inquiry shall involve a single requirement or closely related requirements. An inquiry letter concerning unrelated subjects will be returned;
- (b) *Background.* State the purpose of the inquiry, which would be either to obtain an interpretation of the standard's requirement or to propose consideration of a revision to the present requirements. Concisely provide the information needed for JCNRM's understanding of the inquiry (with sketches as necessary), being sure to include references to the applicable standard edition, addenda, part, appendix, paragraph, figure, or table;
- (c) *Inquiry Structure.* The inquiry shall be stated in a condensed and precise question format, omitting superfluous background information and, where appropriate, composed in such a way that "yes" or "no" (perhaps with provisos) would be an acceptable reply. This inquiry statement should be technically and editorially correct;
- (d) *Proposed Reply.* State what it is believed that the standard requires. If, in the inquirer's opinion, a revision to the standard is needed, recommended wording shall be provided;
- (e) *Typewritten/Handwritten.* The inquiry shall be submitted in typewritten form; however, legible, handwritten inquiries will be considered;
- (f) *Inquirer Information.* The inquiry shall include the name, telephone number, and mailing address of the inquirer;

- (g) *Submission.* The inquiry shall be submitted to the following address: Secretary, Joint Committee on Nuclear Risk Management, The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

USER RESPONSIBILITY

Users of this standard are cautioned that they are responsible for all technical assumptions inherent in the use of PRA models, computer programs, and analysis performed to meet the requirements of this standard.

CORRESPONDENCE

Suggestions for improvements to the standard or inclusion of additional topics shall be sent to the following address: Secretary, Joint Committee on Nuclear Risk Management, The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

COMMITTEE ROSTERS

CONTRIBUTORS TO THE SEVERE ACCIDENT PROGRESSION AND RADIOLOGICAL RELEASE (LEVEL 2) PRA STANDARD FOR NUCLEAR POWER PLANT APPLICATIONS FOR LIGHT WATER REACTORS (LWRs)

(The following is a roster of the Joint Committee on Nuclear Risk Management at the time of the approval of this standard.)

This standard was processed and approved for release for trial use and pilot application by the ANS/ASME Joint Committee on Nuclear Risk Management in accordance with procedures approved by ASME and ANS. At the time it approved this standard, the JCNRM had the following members:

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ASME/ANS RA-S-1.2-2014 (formerly ANS/ASME-58.24 of the Standards Committee of the American Nuclear Society) was responsible for development of this standard. It had the following membership when first formulated:

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