

ASME/ANS RA-S-1.1–2024
(Revision of ASME/ANS RA-S-1.1–2022)

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

AN AMERICAN NATIONAL STANDARD



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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/>.

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.

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.

In 2022, ASME/ANS RA-S-1.1-2022 was released and superseded all previous revisions.

ASME/ANS RA-S-1.1-2022 represented a substantial revision of ASME/ANS RA-Sb-2013. The 2022 edition had a significantly larger number of SRs, even though some were removed. However, the intent of the overall Standard remained consistent with the previous version. The following major modifications were among those performed:

- A number of changes were 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](#)) were made more consistent, deliberate, and explicit in each Part to facilitate the peer review process.
- Significant lessons learned were 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 were incorporated in clarifications of the intent of the SRs for [Part 7](#) and [Part 8](#).
- Capability Category III was 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 2022 edition of this Standard included 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 2022 [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” were 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, ANSI/ANS RA-S-1.1-2024, presents only minimal editorial modifications and reference corrections from the 2022 edition and further enhances the internal consistency of this Standard. Expanded requirements are only provided for [HR-H2](#) and [HR-G3](#).

This publication, the 2024 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-1.1-2024 was approved by ANSI on February 29, 2024.

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In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

This Standard is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number, the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

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(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

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(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Standard and the paragraph, figure, or table number

(4) the editions of the Standard to which the proposed case applies

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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 Working Group on Level 1 LWR have dedicated significant time to the refinement of this Standard.



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PART 1

GENERAL REQUIREMENTS FOR

A LEVEL 1 PRA, INCLUDING

LARGE EARLY RELEASE

FREQUENCY

Section 1-1

Introduction

1-1.1 OBJECTIVE

This Standard states the requirements for probabilistic risk assessments (PRAs) used to support risk-informed decisions for commercial light water reactor (LWR) nuclear power plants while at-power.

1-1.2 SCOPE AND APPLICABILITY

This Standard states requirements for a Level 1 PRA of internal and external hazards while at-power for the evaluation of core damage frequency (CDF). In addition, this Standard states requirements for a limited Level 2 PRA sufficient to evaluate large early release frequency (LERF). The only hazards explicitly excluded from the scope are accidents resulting from purposeful human-induced security threats (e.g., sabotage, terrorism). These requirements are written for operating LWR power plants (i.e., plants with designs and features similar to the plants operating when this Standard was published). They may be used for LWR plants under design or construction or for advanced LWRs, but revised or additional requirements may be needed.

1-1.2.1 Treatment of Hazard Groups

This Standard states specific requirements for the following hazard groups:

- (a) Internal Events ([Part 2](#))
- (b) Internal Floods ([Part 3](#))

- (c) Internal Fires ([Part 4](#))
- (d) Seismic Events ([Part 5](#))
- (e) High Winds ([Part 7](#))
- (f) External Floods ([Part 8](#))
- (g) Other Hazards ([Part 9](#))

Many of the technical requirements in [Part 2](#) are fundamental requirements for performing a PRA for any hazard group and are therefore relevant to [Part 3](#), [Part 4](#), [Part 5](#), [Part 6](#) (for external hazard screening), [Part 7](#), [Part 8](#), and [Part 9](#) of this Standard. They are included by reference in those requirements that address the development of the plant response to the damage states created by the hazard groups addressed in [Part 3](#), [Part 4](#), [Part 5](#), [Part 6](#), [Part 7](#), [Part 8](#), and [Part 9](#). Their specific allocation to [Part 2](#) is partially a historical artifact of the way this PRA Standard was developed, with the at-power internal-events (including internal floods) requirements being developed first, and those of the remaining hazard groups being developed later. However, it is also a reflection of the fact that a fundamental understanding of the plant response to a reasonably complete set of initiating events (as defined in [Section 1-2.2](#)) provides the foundation for modeling the impact of various hazards on the plant. Thus, even though [Part 2](#) is given a title associated with the internal-events hazard group, it is understood that the requirements in this Part are applicable to all the hazard groups within the scope of the PRA.

(The text presented in [blue font](#) in this Standard comprises hyperlinks to enable efficient access to referenced sections and elements, requirements, notes, references, etc., including hyperlinks to and from HLRs and SRs in the requirements section and appendix.)

1-1.2.2 Hazards and Initiating Events

In using this Standard, it is necessary to understand the relationship among “hazard group,” “hazard,” “hazard event,” and “initiating event,” which are defined in [Section 1-2.2](#).

In general, there is a range of hazard events associated with any given hazard, and, for analysis purposes, the range can be divided into bins characterized by their severity. Hazard events of different severity can result in different initiating events.

Consider the internal-events hazard group, as this group provides the fundamental understanding of plant response. As noted above, this hazard group includes several hazards, such as transients and loss of coolant accidents (LOCAs), which can be considered as generic hazards.

For transients, different transient events, such as reactor trip and loss of feedwater, can be identified in terms of the different demands they place on critical safety functions; these demands characterize the events’ severity.

For LOCAs, the LOCA events applicable to the plant design might be the large LOCA, medium LOCA, small LOCA, and so forth. The small LOCA leading to plant trip on low pressure or low level is a specific binning within the range of the generic type of hazard associated with LOCAs.

Because the internal-events hazard group serves as the fundamental basis for the plant model, the terms “hazard events” and “initiating events” are synonymous, and this structure forms the primary consideration for the remaining hazard groups.

For the remaining hazard groups, the terms “hazard event” and “initiating event” are not synonymous. Rather, a hazard event is identified as the cause of an initiating event by virtue of the effect it has on the plant. The assessment of the effect on the plant defines the reason for the plant trip as well as any additional failures and provides the starting point for the analysis of the plant response. Therefore, in keeping with the definition of “initiating event,” for the occurrence of a given hazard event, the initiating event (or events, as more than one outcome may be possible) is (are) a perturbation of the steady-state operation of the plant that challenges plant control and safety systems whose failure could potentially lead to core damage.

For example, consider the earthquake hazard group, which involves only one hazard, that is, earthquakes are the hazard and also the hazard group. This hazard (earthquakes) can be defined in terms of a range of seismic (hazard) events (e.g., 0.1g, 0.3g, 0.5g, >0.75g) and their associated spectral shapes and time histories. The assessment of the potential initiating events resulting from each hazard event is made based on an assessment of the impact of the seismic hazard event on the plant. So, for example, for a 0.1g seismic event, the assessment

may be that the likelihood of any physical damage resulting in an automatic trip is very small; for 0.3g and 0.5g seismic events, the most likely effect may be damage to the switchyard or the transmission system, with a very small likelihood of any seismic induced failures that could result in any other initiating event; and for a >0.75g seismic event, in addition to a loss of off-site power (LOOP), there may be a high likelihood of failure of vessel or piping anchorage causing an induced LOCA. Based on such an assessment

(a) A manual scram may be the only credible initiating event for the 0.1g seismic hazard event.

(b) A LOOP would be assumed to be a hazard, whereas a grid-related LOOP would be an initiating event for the 0.3g and 0.5g seismic hazard events.

(c) In addition to a grid-related LOOP, a LOCA would be included as a hazard, whereas a small break LOCA would be an initiating event for very large (>0.75g) earthquakes.

When multiple initiating events are possible, each will have a conditional probability of occurrence which, when combined with the hazard event frequency, provides the corresponding initiating event frequency.

It is even possible that a hazard event would not result in an initiating event (i.e., there would be no perturbation of the plant operation). For example, a plant may automatically trip (initiating event), may be manually tripped (initiating event), or may continue (no initiating event) to operate through a hurricane event. These examples highlight why the distinction between “hazard event” and “initiating event” is important and must be maintained.

1-1.3 STRUCTURE FOR PRA REQUIREMENTS

1-1.3.1 PRA Technical Elements

The technical requirements for the PRA model are organized by their respective PRA technical elements. The PRA technical elements define the scope of the analysis for each Part of this Standard. This Standard specifies technical requirements for the PRA technical elements listed in [Table 1-1.3-1](#).

1-1.3.2 High-Level Requirements

A set of objectives and High Level Requirements (HLRs) is provided for each PRA technical element in the Technical Requirements section of each respective Part of this Standard. The HLRs set forth the minimum requirements for a technically acceptable baseline PRA, independent of a PRA application. All HLRs are written by using “shall.” The HLRs are defined in general terms and present the overarching context for the derivation of more detailed Supporting Requirements (SRs). The general terms used for HLRs represent not only the diversity of approaches that have been used to develop the existing PRAs but also the need to accommodate future technological innovations.

1-1.3.3 Supporting Requirements

A set of SRs is stated for each HLR (that is included for each PRA technical element) in the Technical Requirements section of each respective Part of this Standard. All SRs are written by using “action verbs” rather than “shall.” The meaning of each action verb used in this Standard is stated in [Nonmandatory Appendix \(NMA\) 1-A](#).

This Standard is intended for a wide range of PRA applications that require a corresponding range of PRA capabilities. PRA applications vary with respect to which risk metrics are employed, which decision criteria are used, the extent of reliance on the PRA results in supporting a decision, and the degree of resolution required for the factors that determine the risk significance of the subject of the decision. In developing the different portions of the PRA model, it is recognized that not every item (e.g., system model) will require the same level of detail, the same degree of plant specificity, or the same degree of realism.

Although the capabilities required for each portion of the PRA to support a PRA application fall on a continuum, two levels are defined and labeled Capability Category I (CC-I) and Capability Category II (CC-II), so that requirements can be developed and presented in a manageable way. [Table 1-1.3-2](#) describes, for three principal attributes of PRA, the bases for defining the Capability Category. This table was used to develop the SRs for each HLR.

The delineation of the Capability Categories within the SRs is generally that the degree of scope and level of detail, the degree of plant specificity, and the degree of realism (i.e., the depth of the analysis) increase from CC-I to CC-II. As the Capability Category increases, the depth of the analysis required also increases. In other cases, increasing the depth of analysis may result in a decrease in the risk, such as when a conservative assumption is refined to be more realistic (e.g., changing from conservative success criteria to more realistic success criteria).

The boundary between these Capability Categories can be defined in only a general sense. When a comparison is made between the capabilities of any given PRA and the SRs of this Standard, it is expected that the capabilities of a PRA’s elements or portions of the PRA within each of the elements will not necessarily all fall within the same Capability Category, but rather will be distributed among both Capability Categories.

There may be PRA technical elements, or portions of the PRA within the elements, that fail to meet the SRs for either of these Capability Categories. CC-I requirements should result in a model that is capable of identifying the most risk-significant CDF/LERF accident sequences at a functional or systemic level. CC-II will provide a realistic assessment of CDF/LERF. Furthermore, the SRs have been written so that, within a Capability Category, the interfaces between portions of the PRA are

consistent (e.g., requirements for event trees are consistent with the definition of initiating event groups).

When a specific PRA application is undertaken, judgment is needed to determine which Capability Category is needed for each portion of the PRA and, thus, which SRs apply to the PRA applications.

For each SR, the minimum requirements necessary to meet CC-I and CC-II are defined. Some SRs apply to only one Capability Category and some extend across both Capability Categories. When an SR spans both Capability Categories, it applies equally to each Capability Category. When necessary, the differentiation between Capability Categories is made in other associated SRs.

The Technical Requirements section of each respective Part of this Standard also specifies the required documentation to ensure traceability of the analysis.

The SRs specify what to do rather than how to do it, and, in that sense, specific methods for satisfying the requirements are not prescribed. Nevertheless, certain established methods were contemplated during the development of these requirements. Alternative methods and approaches or newly developed methods for meeting the requirements of this Standard may be used if they provide results that are equivalent or superior to the methods usually used and if they meet the HLRs and SRs presented in this Standard. Requirements for newly developed methods are provided in [Section 1-7](#). The requirements for the documentation of any particular method used are established in documentation HLRs for each technical element of each Part, and requirements for peer review are described in [Section 1-6](#). In addition, any example in the SR body or any NMA or note is not to be considered the only way to address a supporting requirement.

1-1.4 APPLICABILITY OF PRA TECHNICAL ELEMENTS

The use of a PRA and the Capability Categories that are required to be met for each of the PRA technical elements will differ among PRA applications. [Section 1-3](#) describes the activities to determine whether a PRA has the capability to support a specific PRA application of risk-informed decision-making (RIDM). Two different PRA Capability Categories are described in [Section 1-1.3](#). PRA capabilities are evaluated for each associated SR, rather than by specifying a Capability Category for specific parts or the whole PRA.

1-1.5 PRA CONFIGURATION CONTROL PROGRAM

[Section 1-5](#) states requirements for configuration control of a PRA (i.e., maintaining and upgrading a plant-specific PRA) such that the PRA represents the as-built, as-operated facility to a degree sufficient to support the PRA application for which it is used.

Table 1-1.3-1 PRA Technical Elements Addressed by This Standard

Hazard Type	Hazard Group	PRA Technical Elements
Internal Hazards	Internal Events	Initiating Events Analysis (IE) Accident Sequence Analysis (AS) Success Criteria (SC) Systems Analysis (SY) Human Reliability Analysis (HR) Data Analysis (DA) Quantification (QU) LERF Analysis (LE)
	Internal Floods	Internal Flood Plant Partitioning (IFPP) Internal Flood Source Identification and Characterization (IFSO) Internal Flood Scenario Development (IFSN) Internal Flood-Initiating Event Analysis (IFEV) Internal Flood PRA Plant Response Model (IFPR) Internal Flood Human Reliability Analysis (IFHR) Internal Flood Risk Characterization (IFQU)
	Internal Fires	Internal Fire Plant Boundary Definition and Partitioning (PP) Internal Fire-Initiating Events and Equipment Selection (ES) Internal Fire Cable Selection and Location (CS) Internal Fire Qualitative Screening (QLS) Internal Fire Plant Response Model (PRM) Internal Fire Scenario Selection and Analysis (FSS) Internal Fire Ignition Frequency (IGN) Internal Fire Circuit Failure Analysis (CF) Internal Fire Human Reliability Analysis (FHR) Internal Fire Risk Quantification (FQ)
External Hazards	Seismic Events	Seismic Hazard Analysis (SHA) Seismic Fragility Analysis (SFR) Seismic Plant Response Analysis (SPR)
	High Winds	Wind Hazard Analysis (WHA) Wind Fragility Analysis (WFR) Wind Plant Response Analysis (WPR)
	External Floods	External Flood Hazard Analysis (XFHA) External Flood Fragility Analysis (XFFR) External Flood Plant Response Analysis (XFPR)
Other Hazards (internal or external)	See Note (1)	“X” Hazard Analysis (XHA) “X” Hazard Fragility Analysis (XFR) “X” Hazard Plant Response Analysis (XPR) “X” Screening and Conservative Analysis (EXT)

NOTE:

- (1) For any other hazard group “X,” the approach for performing a PRA for the hazard group shall meet requirements [HLR-XHA](#), [HLR-XFR](#), and [HLR-XPR](#) in [Part 9](#). Each hazard for which a unique approach is developed shall constitute its own hazard group. Hazards that share a common approach, methods, and data shall be analyzed as a single hazard group. Examples of such hazard groups include biological events and external fires.

Table 1-1.3-2 Bases for PRA Capability Categories

Attributes of PRA	Capability Category I	Capability Category II
1. Scope and Level of Detail: The degree to which the scope and level of detail of the plant design, operation, and maintenance are modeled	Resolution and specificity are sufficient to identify the relative importance of the contributors at the hazard group, initiating event group, and functional or systemic accident sequence level, including associated human failure events (HFEs) [Notes (1) and (2)].	Resolution and specificity are sufficient to identify the relative importance of the risk-significant contributors at the hazard group, initiating event group, functional and systemic accident sequence, and basic event level, including associated HFEs, and for hazards other than internal events, at the hazard scenario level. [Notes (1) and (2)].
2. Plant Specificity: The degree to which plant-specific information is incorporated in modeling the as-built, as-operated plant	Use of generic data/models is acceptable except for the need to account for unique design and operational features of the plant that have bearing on the assessment of CDF/LERF.	Plant-specific data/models are used for the risk-significant contributors to the extent feasible
3. Realism: The degree to which realism is incorporated in modeling the expected response of the plant	Departures from realism may have a moderate impact on the conclusions and risk insights as supported by state of the practice [Note (3)].	Departures from realism will have a small impact on the conclusions and risk insights as supported by state of the practice [Note (3)].

NOTES:

- (1) The hazard scenarios are the events in the PRA logic model that capture the frequency of the initiating hazard and represent the impact of the hazard on the plant, taking into account those protective measures that are in place to prevent damage from the hazard. The plant specificity and realism attributes will be used to ensure that the hazard scenarios are evaluated in a manner consistent with the other contributors, subject to the limitations imposed by the differences in treatments of each hazard.
- (2) The definitions for CC-I and CC-II are not meant to imply that the scope and level of detail include identification of all components and human actions but rather that they include only those needed for the function of the system being modeled to the extent that function is important to assessing plant risk as defined in the context of this Standard.
- (3) Differentiation between moderate and small is determined by the extent to which the impact on the conclusions and risk insights could affect a decision under consideration. This differentiation recognizes that the PRA would generally not be the sole input to a decision. A moderate impact implies that the impact (of the departure from realism) is of sufficient size that it is likely that a decision could be affected; a small impact implies that it is unlikely that a decision could be affected.

1-1.6 PEER REVIEW REQUIREMENTS

Section 1-6 states the general requirements for a peer review to determine if the methods and its implementation in the PRA meet the requirements of the Technical Requirements section of each respective Part of this Standard.

1-1.7 ADDRESSING MULTIPLE HAZARD GROUPS

The technical requirements to determine the technical adequacy of a PRA for different hazard groups to support PRA applications are presented in [Part 2](#), [Part 3](#), [Part 4](#), [Part 5](#), [Part 7](#), [Part 8](#), and [Part 9](#). The approaches to modeling the plant damage resulting from different hazard groups vary in terms of the degree of realism and the level of detail achievable. For example, there are uncertainties that are unique to the modeling of the different hazards and their effect on the plant, and the assumptions made in dealing with these uncertainties can lead to varying degrees of conservatism in the estimates of risk. Furthermore, because the analyses can be resource intensive, it is normal to use screening approaches to limit the number of detailed scenarios to be evaluated and the number of mitigating systems credited while still achieving an acceptable evaluation of risk.

For many PRA applications, it is necessary to include the combined impact on risk from those hazard groups for which it cannot be demonstrated that the impact on the decision being made is not risk insignificant. This combination can be done by using a single model that combines the PRA models for the different hazard groups or by combining the results from separate models. In either case, when combining the results from the different hazard groups, it is essential to account for the differences in levels of conservatism and levels of detail so that the conclusions drawn from the results are not overly biased or distorted. To support this objective, this Standard is structured so that requirements for the analysis of the PRA results, including identification of risk-significant contributors, identification and characterization of sources of uncertainty, and identification of assumptions, are included in each Part separately.

In some cases, the requirements for developing a PRA model in [Part 3](#), [Part 4](#), [Part 5](#), [Part 7](#), [Part 8](#), and [Part 9](#) refer back to the requirements of [Part 2](#). The requirements of [Part 2](#) should be applied to the extent needed, given the context of the modeling of each hazard group. In each Part, many of the requirements that differentiate between Capability Categories, either directly or by incorporating the requirements of [Part 2](#), do so on the basis of the analysis of risk-significant contributors and risk-significant accident sequences/cutsets for the hazard group being addressed. Because, as discussed above, there are differences in the way the PRA models for each specific hazard group are developed, the requirements

are best analyzed separately in a self-contained manner for each hazard. In other words, these requirements are identified with respect to the CDF and LERF for each hazard group separately. While there is a need in some PRA applications to assess the risk significance with respect to the total CDF or LERF, this assessment has to be done with a full understanding of the differences in conservatism and level of detail introduced by the modeling approaches for the different hazard groups, as well as within each hazard group.

Additionally, from a practical standpoint, PRA models are generally developed on a hazard group basis [e.g., a fire PRA, a seismic PRA, a high wind PRA (HWPPRA)]. While they may be integrated into a single model with multiple hazards, the development is done on a hazard group basis. In CC-II, this Standard strives to ensure that the more risk-significant contributors to each hazard group are understood and analyzed with an equivalent level of resolution across applicable SRs, plant specificity, and realism, so as to not skew the results for that hazard group. The definitions in [Section 1-2.2](#) also acknowledge that there may be cases where the proposed quantitative assessment process is inappropriate (e.g., the hazard group risk is very low or bounding methods are used).

To summarize, the definitions in [Section 1-2.2](#) that use the term “risk significant” simply help to define how much realism is necessary to meet CC-II of some SRs. They are *not* intended to be definitions of what is risk significant in a particular PRA application. Indeed, in the context of a specific PRA application, they may be either too loose or too restrictive, depending on what is being evaluated. In the context of this Standard, the decisions on applying these definitions and/or defining what is risk significant for a decision would be addressed in the Risk Assessment Application Process (see [Section 1-3](#)).

1-1.8 SCREENING CRITERIA

This Section discusses the underlying rationale for the criteria to be used in this Standard when screening out items from consideration when constructing the PRA model. Screening is an inherent part of constructing a PRA model. It is a tool used to simplify the PRA model while retaining important contributors to risk. As such, the underlying screening process is to ensure that items that are screened out do not impact the results and insights provided by the PRA model.

Hazards, initiating events, accident sequences, plant areas, plant structures, systems failure modes, or components failure modes and HFEs can each be subjected to the screening process as the PRA model is constructed.

[Table 1-1.8-1](#) specifies the general criteria (both quantitative and qualitative) that shall be used in considering whether any of the above items can be screened

out from consideration in the construction of the PRA. These general criteria are referenced, as needed, in the individual Parts and should be applied only as directed from the SRs in the Part. Because of significant design differences and associated risk profiles, the general criteria in [Table 1-1.8-1](#) are not applicable to advanced LWRs. In addition to these general criteria, the individual Parts may also include supplemental Part-specific criteria that should be employed in completing the screening activity.

Note that although a hazard (or hazard group) may be screened out from being developed per the requirement of the applicable Part of this Standard, the screened out hazard (or hazard group) may still need to be considered in the RIDM for a specific application.

In the context of hazards that are associated with a range of severities (rather than a single discrete event), the “initiating event frequency” refers to the frequency with which a specified site “impact threshold” is exceeded (i.e., exceedance frequency). Impact threshold is the hazard severity at which a plant transient may occur. The screening criteria to be applied to each item for each hazard are specified in [Part 2](#), [Part 3](#), [Part 4](#), [Part 5](#), [Part 7](#), [Part 8](#), and [Part 9](#) SRs. Screening is permitted only within the hazard under consideration. These screening criteria are to be used only when specified in an SR. Use of alternative screening criteria to those in this Section may be allowed with documented justification if the referencing SR specifically states that alternative screening criteria are permitted. Otherwise, the criteria in [Table 1-1.8-1](#) are to be used as written.

1-1.9 UNDERSTANDING RISK SIGNIFICANCE

One of the main outcomes of a state-of-practice PRA is the possibility to identify risk-significant contributors based on quantitative criteria (i.e., an item under consideration that contributes above a certain percentage to the overall risk).

The requirements provided in this Standard are aimed at ensuring that the analysis maintains an appropriate level of completeness such that even at CC-I it is possible to identify risk-significant contributors.

Depending on the intended application of the PRA, risk-significant elements can then be used to inform design and/or plant operation improvements or to inform appropriate focus on maintenance or regulatory activities. Risk-significant items are prime targets for analysis refinements aimed at enhancing the realism of the associated insights.

Generally, identifying the elements of the model (e.g., cutsets, sequences, scenarios) that contribute 95% of the hazard risk is sufficient to capture the significant contributors. Assuring that these contributors are represented in a realistic way and allowing the remaining 5% contribution to be evaluated in a simplified, less realistic fashion will not affect decision-making. Beyond consideration of the elements that represent combinations of basic events, an individual basic event could be sufficiently important by itself to the risk profile. A practical approach to address this condition can be an assessment of the relative importance of the individual basic event via thresholds such as an individual contribution of 1% to total hazard risk (i.e., CDF or LERF), a Fussell-Vesely (FV) importance of 0.005, or a Risk Achievement Worth (RAW) of 2.

In line with the above, [Table 1-1.9-1](#) specifies the quantitative criteria generally to be used in determining risk significance for the various modeling items (contributors). If these quantitative criteria are not used, justification for any alternative quantitative criteria shall be documented. The documentation shall describe how the alternative quantitative criteria meet the intent of the criteria in [Table 1-1.9-1](#). These alternative quantitative criteria shall be peer reviewed for their appropriateness and ability to adequately determine risk significance such that the integrity of the PRA model is maintained. Once the potential risk-significant

Table 1-1.8-1 Generic Screening Criteria

Index No. SCR	Screening Metric	Screening Criteria
SCR-1	Hazard or hazard groups	Mean CDF less than $1.0\text{E-}6$ per reactor-year and mean LERF less than $1.0\text{E-}7$ per reactor-year, as estimated using a demonstrably conservative analysis for each hazard or hazard group
SCR-2	Relative (individual contributors)	(a) Less than 1% contribution to the aggregate probability or frequency of the items subject to screening, as defined in the referencing SR and the total contribution of the screened out items not exceeding 5% of the group of items subject to screening as defined in the referencing SR, or (b) contributing $<1.0\text{E-}8$ per reactor-year to CDF and $<1.0\text{E-}9$ per reactor-year to LERF and the total contribution of the screened out items not exceeding 5% of the group of items subject to screening as defined in the referencing SR
SCR-3	Deterministic	Demonstratively conservative assessments that the element screened out does not impact the plant or is subsumed into a more frequent or more impactful event

contributors are identified along with the specific technical requirements, the next major step is to apply the needed refinements into the modeling inputs.

Risk significance is often used in the iteration process to build a PRA model. Thus, initial simplifying assumptions that may impact multiple portions of the PRA model may need to be reviewed and modified as needed to increase the PRA model realism. This type of iteration is performed until the PRA model represents a realistic risk profile of the plant to the extent practical according to the state of practice. Consequently, the focus should be on increasing the realism of those elements of the PRA that have the potential to significantly impact the model results.

The determination of risk significance is extremely important to the ultimate level of effort required to finalize the PRA. Therefore, the numerical thresholds used to identify risk-significant items should be considered in the context of the resolution of the quantification process and the relative risk contribution of the various hazards included. In some cases, it will be necessary to consider different numerical thresholds or to demonstrate that distortions in importance measures will not alter the risk insights and risk ranking of the PRA model.

Table 1-1.9-1 describes how risk significance is determined for the different types of modeling items (contributors).

Table 1-1.9-1 Risk Significance Determination

Item	Criteria for Risk Significance Determination [Note (1)]
Risk-significant accident progression sequence	One of the set of accident sequences contributing to LERF resulting from the analysis of a specific hazard group that, when rank-ordered by decreasing frequency, sum to a specified percentage of the LERF or that individually contribute more than a specified percentage of LERF for that hazard group. The summed percentage of 95% and the individual percentage of 1% of the applicable hazard group are generally used.
Risk-significant accident sequence	One of the set of accident sequences resulting from the analysis of a specific hazard group, defined at the functional or systematic level, that, when rank-ordered by decreasing frequency, sum to a specified percentage of the CDF for that hazard group or that individually contribute more than a specified percentage of CDF. The summed percentage of 95% and the individual percentage of 1% of the applicable hazard group are generally used.
Risk-significant basic event	A basic event that contributes significantly to the computed risks for a specific hazard group. This contribution generally includes any basic event that has an FV importance greater than 0.005 or a RAW importance greater than 2.
Risk-significant containment challenge	A containment challenge that results in a containment failure mode that is represented in a risk-significant accident progression sequence.
Risk-significant contributor	A basic event; structure, system, or component (SSC); piece of equipment; HFE; scenario; and so on that contributes to a significant sequence or cutset or contributes significantly to the computed risks for a significant sequence or cutset-specific hazard group.
Risk-significant cutset	A cutset is one element of an accident sequence resulting from the analysis of a specific hazard group that, when rank-ordered by decreasing frequency, sums to a specified percentage of the CDF (or LERF) for that hazard group or that individually contributes more than a specified percentage of CDF (or LERF). The summed percentage of 95% and the individual percentage of 1% of the applicable hazard group are generally used. Cutset significance may also be measured relative to overall CDF (or LERF) or relative to an individual accident sequence CDF (or LERF) of the applicable hazard group.

NOTE:

- (1) If these criteria are not used, justification for any alternative criteria shall be documented. The documentation shall describe how the alternative criteria meet the intent of the stated criteria in this table. These alternative criteria shall be peer reviewed for their appropriateness and ability to adequately determine risk significance such that the integrity of the PRA model is maintained.

Section 1-2

Acronyms and Definitions

The following definitions are provided to ensure a uniform understanding of acronyms and terms as they are specifically used in this Standard.

1-2.1 ACRONYMS

AC: alternating current

ADS: automatic depressurization system

AEF: Annual Exceedance Frequency

ANS: American Nuclear Society

AOPs: abnormal operating procedures

APC: atmospheric pressure change

ASCE: American Society of Civil Engineers

ASTM: American Society for Testing and Materials

ATWS: anticipated transient without scram

BOP: balance of plant

BWR: boiling water reactor

CC-I and CC-II: Capability Categories I and II

CCDP: conditional core damage probability

CCF: common cause failure

CDF: core damage frequency

CLERP: conditional large early release probability

DC: direct current

DOE: US Department of Energy

DW: drywell

ECCS: emergency core cooling system

EOPs: emergency operating procedures

EPRI: Electric Power Research Institute

FMEA: failure modes and effects analysis

FSAR: Final Safety Analysis Report

FV: Fussell-Vesely importance measure

GMC: ground motion characterization

GMPE: Ground Motion Prediction Equation

GRS: Ground Response Spectra

HEP: human error probability

HFE: human failure event

HLR: High Level Requirement

HPME: high pressure melt ejection

HRA: human reliability analysis

HROI: Hazard Range of Interest

HVAC: heating, ventilation, and air conditioning

HW: high wind

HWEL: High Wind Equipment List

HWPPRA: high wind PRA

HWTL: high-wind target list

IE: initiating event

IFPRA: internal flooding PRA

IPE: individual plant examination

ISLOCA: interfacing systems loss of coolant accident

ISRS: in-structure response spectra

LERF: large early release frequency

LIP: local intense precipitation

LLNL: Lawrence Livermore National Laboratory

LOCA: loss of coolant accident

LOOP: loss of off-site power (also referred to as “LOSP”)

LWR: light water reactor

MCC: motor control center

MCR: main control room

MSO: multiple spurious operation

NEI: Nuclear Energy Institute

NMA: Nonmandatory Appendix

NFPA: National Fire Protection Association

NPP: nuclear power plant

NPSH: net positive suction head

NRC: Nuclear Regulatory Commission

NSSS: nuclear steam supply system

NUREG: NRC report

PAU: physical analysis unit

PDS: plant damage state

PFHA: probabilistic flood hazard analysis

PGA: peak ground acceleration

PRA: probabilistic risk assessment

PSHA: probabilistic seismic hazard analysis

PWHA: probabilistic wind hazard analysis

PWR: pressurized water reactor
 RAW: Risk Achievement Worth
 RCS: reactor coolant system
 RE: Reference Earthquake
 RES: Office of Nuclear Regulatory Research (of the NRC)
 RIDM: risk-informed decision-making
 RPV: reactor pressure vessel
 Sa: spectral acceleration
 SBO: station blackout
 SCDF: seismic core damage frequency
 SEL: seismic equipment list
 SGTR: steam generator tube rupture
 SLERF: seismic large early release frequency
 SLCS: standby liquid control system
 SPRA: seismic probabilistic risk assessment
 SR: Supporting Requirement
 SSC(s): structure(s), system(s), and component(s)
 SSHAC: Senior Seismic Hazard Analysis Committee
 SSI: soil-structure interaction
 THERP: Technique for Human Error Rate Prediction (see NUREG/CR-1278 [1-1])
 TS: Technical Specifications
 UHS: uniform hazard response spectrum
 V/H: vertical-to-horizontal (ratio)
 XFEL: external flood equipment list
 XFPRA: external flood PRA

1-2.2 DEFINITIONS

accepted method: a method that the regulatory body has used or accepted for the specific risk-informed application for which it is proposed.

accident class: a grouping of severe accidents with similar characteristics (e.g., accidents initiated by a transient with a loss of decay heat removal, LOCAs, station blackout accidents, and containment bypass accidents).

accident progression sequence: a unique combination of events that clearly delineate the chronological and physical progression of core damage, containment response, and fission product release to the environment.

accident sequence: a representation in terms of an initiating event followed by a sequence of failures or successes of events (e.g., system, function, or operator performance) that can lead to undesired consequences, with a specified end state (e.g., core damage or large early release).

accident sequence analysis: the process to determine the combinations of initiating events, safety functions, and

system failures and successes that may lead to core damage or large early release.

adversely affect: to impact plant equipment items leading to equipment failure (e.g., in the context of a fire PRA, a fire that includes spurious operation of devices).

aleatory uncertainty: the uncertainty inherent in a non-deterministic (stochastic, random) phenomenon. Aleatory uncertainty is represented by modeling the phenomenon in terms of a probabilistic model. In principle, aleatory uncertainty cannot be reduced by the accumulation of more data or additional information (aleatory uncertainty is sometimes called “randomness”).

as-built, as-operated: a conceptual term that represents the degree to which the PRA matches the current plant design, plant procedures, and plant performance data, relative to a specific point in time. (NOTE: At the design certification stage, the plant is neither built nor operated. For these situations, the intent of the PRA model is to represent the “as-designed, as-to-be-built, and as-to-be-operated” plant.)

associated effects: characteristics of the flood event that are not captured solely by flood elevation (height). Associated effects include factors such as wind waves and runup effects; hydrostatic loading; hydrodynamic loading, including debris and water velocities; effects caused by sediment deposition and erosion; clogging due to debris; concurrent site conditions, including adverse weather conditions; and groundwater ingress.

assumption: a judgment that is made in the development of the PRA model either for modeling convenience or because of lack of information or state of knowledge. An assumption is a source of model uncertainty:

(a) An example of assumption used for modeling convenience is limiting the number of individual modeled components under the assumption that the consequence of any individual combination of components is the same.

(b) An example of assumption made for lack of information is assuming component failure due to failure of heating, ventilation, and air conditioning (HVAC) in the absence of detailed room heat-up calculations.

atmospheric pressure change: atmospheric pressure change loads result from the variation in the atmospheric pressure field as a vortex moves over a structure. Atmospheric pressure change loads are considered in tornado design and depend on the amount of venting or leakage of the structure as a translating tornado interacts with the structure.

at-power: those plant operating states characterized by the reactor being critical and producing power, with automatic actuation of critical safety systems not blocked and with essential support systems aligned in their normal power operation configuration.

availability: the complement of unavailability.

baseline PRA: a PRA that has been developed consistent with the Technical Requirements of this Standard independent of an application.

basic event: an event in a fault-tree model that requires no further development because the appropriate limit of resolution has been reached.

cable: referring solely to “electric cables,” a construction comprising one or more insulated electrical conductors (generally copper or aluminum). A cable may or may not have other physical features such as an outer protective jacket, a protective armor (e.g., spiral wound or braided), shield wraps, and/or an uninsulated ground conductor or drain wire. Cables are used to connect points in a common electrical circuit and may be used to transmit power, control signals, indications, or instrument signals.

cable failure mode: the behavior of an electrical cable on fire-induced failure that may include intracable shorting, intercable shorting, and/or shorts between a conductor and an external ground (see also *hot short*).

capability category: see [Table 1-1.3-2](#).

circuit failure mode: the manner in which a conductor fault is manifested in the circuit. Circuit failure modes include loss of motive power, loss of control, loss of or false indication, open circuit conditions (e.g., a blown fuse or open circuit protective device), and spurious operation.

cliff edge effect: an instance of a sudden large variation in plant conditions in response to a small variation in an input (e.g., change in flood height, grid perturbation based on voltage or frequency exceeding a breaker trip set point).

coexistent hazard: hazard that is a secondary hazard to and/or concurrent with another hazard.

common cause failure: a failure of two or more components during a short period of time as a result of a single shared cause.

community distribution: for any specific expert judgment, the distribution of expert judgments of the entire relevant (informed) technical community of experts knowledgeable about the given issue.

component: an item in a nuclear power plant, such as a vessel, pump, valve, or circuit breaker.

composite variability: the composite variability includes the randomness uncertainty (β_R) and the modeling and data uncertainty (β_U). The logarithmic standard deviation of composite variability, β_C , is expressed as $(\beta_R^2 + \beta_U^2)^{1/2}$.

concurrent hazard: a hazard that occurs simultaneously with the occurrence of another hazard as a result of a common cause [e.g., high winds (HWs) concurrent with storm surge event caused by a hurricane or a moderate wind event concurrent with a large rainfall event].

conservative: use of information (e.g., assumptions) such that the assessed outcome is meant to be less favorable than the expected outcome.

containment bypass: a direct or indirect flow path that may allow the release of radioactive material directly to the environment bypassing the containment.

containment challenge: severe accident conditions (e.g., plant thermal hydraulic conditions or phenomena) that may result in compromising containment integrity. These conditions or phenomena can be compared with containment capability to determine whether a containment failure mode results.

containment failure: loss of integrity of the containment pressure boundary from a core damage accident that results in unacceptable leakage of radionuclides to the environment.

containment failure mode: the manner in which a containment radionuclide release pathway is created. It encompasses both those structural failures of containment induced by containment challenges when they exceed containment capability and the failure modes of containment induced by HFEs, isolation failures, or bypass events such as interfacing systems LOCA (ISLOCA).

containment performance: a measure of the response of a nuclear plant containment to severe accident conditions.

consensus method/model: a method or model that the regulatory body has used or accepted for the specific risk-informed application for which it is proposed.

core damage: uncovering and heat-up of the reactor core to the point at which prolonged oxidation and severe fuel damage are anticipated and involving enough of the core, if released, to result in off-site public health effects.

core damage frequency: expected number of core damage events per unit of time.

damage criteria: those characteristics of the fire-induced environmental effects that will be taken as indicative of the fire-induced failure of a damage target or set of damage targets.

damage target: see *target*.

damage threshold: the values corresponding to the damage criteria that will be taken as indicative of the onset of fire-induced failure of a damage target or set of damage targets.

demonstrably conservative: use of input information or assumptions that provides high confidence that the assessed outcome is as conservative as it is portrayed to be.

dependency: requirement that is external to an item and upon which its function depends and that is associated with dependent events that are determined by, influenced by, or correlated to other events or occurrences.

distribution system: piping, raceway, duct, or tubing that carries or conducts fluids, electricity, or signals from one point to another.

electrical overcurrent protective device: an active or passive device designed to prevent current flow from exceeding a predetermined level by breaking the circuit when the predetermined level is exceeded (e.g., fuse or circuit breaker).

end state: the set of conditions at the end of an accident sequence that characterizes the impact of the sequence

on the plant or the environment. In most PRAs, end states typically include success states (i.e., those states with negligible impact), plant damage states for Level 1 sequences, and release categories for LERF sequences.

epistemic uncertainty: the uncertainty attributable to incomplete knowledge about a phenomenon that affects our ability to model it. Epistemic uncertainty is represented by ranges of values for parameters, a range of viable models, the level of model detail, multiple expert interpretations, and statistical confidence. In principle, epistemic uncertainty can be reduced by the accumulation of additional information. This definition is used in the context of seismic hazard and fragility.

equipment: a term used to broadly cover the various components in a nuclear power plant. Equipment includes electrical and mechanical components (e.g., pumps, control and power switches, integrated circuit components, valves, motors, fans) and instrumentation and indication components (e.g., status indicator lights, meters, strip chart recorders, sensors). “Equipment,” as used in this Standard, *excludes* electrical cables.

equipment qualification: the generation and maintenance of data and documentation to demonstrate that equipment is capable of operating under the conditions of a qualification test or under test and analysis.

evaluator expert: an expert who is capable of evaluating the relative credibility of multiple alternative hypotheses and who is expected to evaluate all potential hypotheses and bases of inputs from proponents and resource experts to provide both evaluator input and other experts’ representation of the community distribution.

event tree: a logic diagram that begins with an initiating event or condition and progresses through a series of branches that represent expected system or operator performance that either succeeds or fails and arrives at either a successful or failed end state.

expert elicitation: a formal, highly structured, and documented process whereby expert judgments, usually of multiple experts, are obtained.

expert judgment: information provided by a technical expert, in the expert’s area of expertise, based on opinion or on an interpretation based on reasoning that includes evaluations of theories, models, or experiments.

exposed structural steel: structural steel elements that are not protected by a passive fire-barrier feature (e.g., fire-retardant coating) with a minimum fire-resistance rating of 1 hr.

external flood hazard mechanism (flooding mechanism): the physical processes by which a natural or manmade flood-forcing phenomenon can lead to overflow or accumulation of water on or near a site.

external hazard: a hazard originating outside a nuclear power plant that directly or indirectly causes an initiating event and may cause safety system failures or operator errors that may lead to core damage or large early release. Hazards such as earthquakes, tornadoes, and floods from sources outside the plant and fires from

sources outside the plant are considered external hazards. (See also *internal event*.) By historical convention, LOOP not caused by another external hazard is considered to be an internal event.

facilitator/integrator: a single entity (individual, team, company, etc.) that is responsible for aggregating the judgments and community distributions of a panel of experts to develop the composite distribution of the informed technical community (herein called “the community distribution”).

failure mechanism: any of the processes that result in failure modes, including chemical, electrical, mechanical, physical, thermal, and human error.

failure mode: a specific functional manifestation of a failure (i.e., the means by which an observer can determine that a failure has occurred) by precluding the successful operation of a piece of equipment, a component, or a system (e.g., fails to start, fails to run, leaks). (NOTE: In the context of fire PRA, *spurious operation* is also considered a failure mode above and beyond failures that preclude successful operation.)

failure modes and effects analysis: a process for identifying failure modes of specific components and evaluating their effects on other components, subsystems, and systems.

failure probability: the likelihood that an SSC will fail to operate on demand or fail to operate for a specific mission time.

failure rate: expected number of failures per unit time, evaluated, for example, by the ratio of the number of failures in a population of components to the total time observed for that population.

fault tree: a deductive logic diagram that depicts how a particular undesired event can occur as a logical combination of other undesired events.

figure of merit: the quantitative value, obtained from a PRA, used to evaluate the results of a PRA application (e.g., CDF or LERF).

fire analysis tool: as used in this Standard, “fire analysis tool” is broadly defined as any method used to estimate or calculate one or more physical fire effects (e.g., temperature, heat flux, time to failure of a damage target, rate of flame spread over a fuel package, heat release rate for a burning material, smoke density) based on a predefined set of input parameter values, as defined by the fire scenario being analyzed. Fire analysis tools include, but are not limited to, computerized compartment fire models, closed-form analytical formulations, empirical correlations such as those provided in a handbook, and lookup tables that relate input parameters to a predicted output.

fire area: a portion of a building or plant that is separated from other areas by rated fire barriers adequate for the fire hazard. (NOTE: A rated fire barrier is a fire barrier with a fire-resistance rating.)

fire barrier: a continuous vertical or horizontal construction assembly designed and constructed to limit the

spread of heat and fire and to restrict the movement of smoke.

*fire compartment*¹: a subdivision of a building or plant that is a well-defined enclosed room, not necessarily bounded by rated fire barriers. A fire compartment generally falls within a fire area and is bounded by noncombustible barriers where heat and products of combustion from a fire within the enclosure will be substantially confined. Boundaries of a fire compartment may have open equipment hatches, stairways, doorways, or unsealed penetrations. This term is defined specifically for fire risk analysis and maps plant fire areas and/or zones, defined by the plant and based on fire protection systems design and/or operations considerations, into compartments defined by fire damage potential. For example, the control room or certain areas within the turbine building may be defined as a fire compartment.

fire-induced initiating event: that initiating event assigned to occur in the fire PRA plant response model for a given fire scenario.

fire modeling: as used in this Standard, “fire modeling” refers to the process of exercising a fire analysis tool including the specification and verification of input parameter values, performance of any required supporting calculations, actual application of the fire analysis tool itself, and the interpretation of the fire analysis tool outputs and results.

fire protection program: the integrated effort involving equipment, procedures, and personnel used in carrying out all activities of fire protection. It includes system and facility design, fire prevention, fire detection, annunciation, confinement, suppression, administrative controls, fire brigade organization, inspection and maintenance, training, quality assurance, and testing.

fire-resistance rating: the time, in minutes or hours, that materials or assemblies have withstood a fire exposure as established in accordance with an approved test procedure appropriate for the structure, building material, or component under consideration.

fire scenario: a set of elements that describes a fire event. The elements usually include a physical analysis unit, a source fire location and characteristics, detection and suppression features to be included, damage targets, and intervening combustibles.

fire scenario selection: the process of defining a fire scenario to be analyzed in the fire PRA that will represent the behavior and consequences of fires involving one or more fire ignition sources. Fire scenario selection includes the identification of a fire ignition source (or set of fire ignition sources); secondary combustibles and fire spread paths; fire damage targets, detection and suppression systems and features to be credited; and

other factors that will influence the extent and timing of fire damage.

fire suppression system: generally refers to permanently installed fire protection systems provided for the express purpose of suppressing fires. Fire suppression systems may be either automatically or manually actuated. However, once activated, the system should perform its design function with little or no manual intervention.

fire wrap: a localized protective covering designed to protect cables, cable raceways, or other equipment from fire-induced damage. Fire wraps generally provide protection against thermal damage.

flood area: an area within a plant that is defined for the purpose of performing a flood assessment PRA. Flood areas are normally defined in terms of one or more of the following: building types; location within a building or the site; and the physical barriers that delay, restrict, or prevent the propagation of floods to adjacent areas. Flood areas refer to areas of buildings or of the site that may be flooded due to internal or external flooding sources.

flood event duration (external flooding): defines the period of time that a flood hazard affects the site. Flood event duration typically begins with conditions being met for entry into a flood procedure or notification of an impending flood and ends when flood waters have receded from the site. It typically includes warning time (if available) and period of inundation and recession.

flood hazard (external flooding): those hydrometeorological, geoseismic, or structural failure phenomena (or combination thereof) that may produce flooding at or near nuclear power plant site.

flood-induced accident sequence: an accident sequence that includes a flood-induced initiating event and the potential for undesired consequences, with a specified end state (e.g., core damage).

flood-induced failure mechanism: the failure mechanism of an SSC induced by a flood. Possible SSC failure mechanisms include, but are not limited to, shorting out of electrical connections, blockage of air intakes, and structural damage from flood loads. In the context of external flooding, flood-induced failure mechanisms may include additional factors such as blockage of sumps (e.g., due to debris) and overtopping of barriers.

flood-induced initiating event: an initiating event that is caused by a flood either directly (e.g., loss of system function caused by diversion of flow associated with the flood) or indirectly (e.g., plant shutdown caused by the loss of function of one or more flood-damaged SSCs). In the context of external flooding, flood-induced initiating events also include initiating events due to damage of SSCs from the floodwaters.

flood initiating area (internal flooding): the area from which the flood originates.

flood propagation path: a physical pathway that would allow the progression of a flood within and among different flood areas. In the context of external flooding,

¹ It is noted that the term “fire compartment” is used in other contexts, such as general fire protection engineering, and that the term’s meaning as used here may differ from that implied in an alternative context. However, the term also has a long history of use in fire PRA and is used in this Standard based on that history of common fire PRA practice.

flood propagation paths may begin with floods that originate from a source external to the plant.

flood rate: the flow rate of water or steam across the breach or opening in the pressure boundary of the flood source during the flood event. In the context of external flooding, the flood rate may also include the rate of flow of external flood water into a flood area. Depending on the context, the flood rate may be a time-dependent rate, a maximum rate, or an average rate over the duration of the flood.

flood response SSCs (external flooding): SSCs that may be used to maintain key safety functions during conditions that might occur during an external flood scenario, including SSCs that are indirectly related to maintenance of key safety functions (e.g., barriers that protect SSCs from floodwaters or other related effects).

flood scenario: a description of an event that results in a flood-induced initiating event. The factors included in the definition of a flood scenario are flood area; flood source; flood rate; flood propagation path; impact on plant SSCs; human actions included in flood initiation, mitigation, and termination; and means of detection (sensors, alarms, indications, etc.).

flood source: an inventory of water or steam normally contained within a system, tank, component, reservoir, river, lake, or ocean that provides the potential for flooding-induced failure of SSCs in the event the flood source container or pressure or retention boundary is breached.

flood volume: the total flood volume of water released from the source from flood initiation to termination or to a specific point in time during a flood scenario; unless specified as the localized volume in specific flood areas for scenarios that involve multiple flood areas, flood volume is normally used to calculate the nominal flood height, which is associated with the submergence failure cause. Water-spray volumes are generally different from flood volumes, but spray water may accumulate and contribute to flood volumes.

fragility: fragility of an SSC is the conditional probability of its failure at a given hazard input level. The input could be earthquake motion, wind speed, or flood level. The fragility model used in seismic PRA is known as a double lognormal model with three parameters, which are the median acceleration capacity, the logarithmic standard deviation of the aleatory (randomness) uncertainty in capacity, and the logarithmic standard deviation of the modeling and data uncertainty in the median capacity.

frontline system: a system (safety or nonsafety) that is capable of directly performing one of the accident-mitigating functions (e.g., core or containment cooling, coolant makeup, reactivity control, or reactor vessel pressure control) modeled in the PRA.

Fussell-Vesely: for a specified basic event, FV importance is the fractional contribution to the total of a selected figure of merit for all accident sequences containing that basic event. For PRA quantification methods that

include nonminimal cutsets and success probabilities, the FV importance measure is calculated by determining the fractional reduction in the total figure of merit brought about by setting the probability of the basic event to zero.

ground acceleration: acceleration at the ground surface produced by seismic waves, typically expressed in units of g , the acceleration of gravity at the Earth's surface.

harsh environment: an abnormal environment (e.g., high or low temperature, humidity, corrosive conditions) expected as a result of postulated accident conditions appropriate for the design basis or beyond design basis accidents.

hazard: a phenomenon that challenges the safe operation of a facility. A hazard is a subset of a hazard group and a superset of hazard events. Hazards in the internal events hazard group include LOCAs and LOOPs. In some cases, a hazard group may consist of only one hazard (e.g., the seismic hazard), in which case the hazard and the hazard group are considered to be synonymous.

hazard analysis: the process to determine an estimate of the expected frequency of exceedance (over some specified time interval) of various levels of some characteristic measure of the intensity of a hazard (e.g., peak ground acceleration to characterize ground shaking from an earthquake). The time period of interest is typically 1 yr, in which case the estimate is called the annual frequency of exceedance.

hazard event: an event brought about by the occurrence of the specified hazard. A hazard event is described in terms of the specific levels of severity of impact that a hazard can have on the plant. For example, an internal flood event would be expressed in terms of the specific flood source and its local impact, such as the resulting water levels in affected plant areas or the extent of the area subjected to spray; a seismic event would be expressed in terms of spectral acceleration and associated spectral shape; a transient event would be expressed in terms of the plant systems affected by the event.

hazard group: a group of hazards that result in similar effects on or challenges to a facility. A hazard group is a subset of a hazard type and a superset of hazards. The hazards in a given hazard group may be assessed using a common approach, methods, and likelihood data for characterizing the effect on the plant. Examples of hazard groups include internal events, internal flood, seismic, and HW. In some cases, a hazard group may only consist of one hazard (e.g., the seismic hazard), in which case the hazard group and the hazard are considered to be synonymous.

hazard type: a hazard type is a superset of hazard groups. Internal hazards include hazard groups such as internal events and internal fire and external hazards include hazard groups such as the seismic hazard and external flooding.

high energy arcing fault: electrical arc that leads to a rapid release of electrical energy in the form of heat, vaporized copper, and mechanical force.

high energy line: a pipe or piping system component is classified as high energy if it contains water or steam at maximum operating temperature exceeding 200°F or maximum operating pressure exceeding 275 psig.

high energy line break: a break or breach in a high energy line.

high-hazard fire source: a fire source that can lead to fires of a particularly severe and challenging nature. High-hazard fire sources would include, but are not limited to, catastrophic failure of an oil-filled transformer, an unconfined release of flammable or combustible liquid, leaks from a pressurized system containing flammable or combustible liquids, and significant releases or leakage of hydrogen or other flammable gases.

high winds: tornadoes, hurricanes (or cyclones or typhoons as they are known outside the United States), extratropical (thunderstorm) winds, and other wind phenomena depending on the site location.

high wind equipment list: the SSCs whose performance may be impaired as a consequence of the HW hazard.

hot short: individual conductors of the same or different cables coming in contact with each other where at least one of the conductors involved in the shorting is energized, resulting in an impressed voltage or current on the circuit being analyzed.

human error: any human action that exceeds some limit of acceptability, including inaction where required, excluding malevolent behavior.

human error probability: a measure of the likelihood that plant personnel will fail to initiate the correct, required, or specified action or response in a given situation or, by commission, performs the wrong action. The HEP is the probability of the HFE.

human failure event: a basic event that represents a failure or unavailability of a component, system, or function that is caused by human inaction or an inappropriate action.

human reliability analysis: a structured approach used to identify potential HFEs and to systematically estimate the probability of those events using data, models, or expert judgment.

human response action: a post-initiator operator action, following a cue or symptom of an event, taken to satisfy the procedural requirements for control of a function or system.

ignition frequency: frequency of fire occurrence generally expressed as fire ignitions per reactor-year.

ignition source: piece of equipment or activity that causes fire.

initiating event: a perturbation to the steady-state operation of the plant that challenges plant control and safety systems whose failure could potentially lead to

core damage. An initiating event is defined in terms of the change in plant status that results in a condition requiring a reactor trip (e.g., loss of main feedwater system, small LOCA) or a manual trip prompted by conditions other than those in the normal shutdown procedure when the plant is at-power. An initiating event may result from human causes, equipment failure from causes internal to the plant (e.g., hardware faults, floods, or fires) or external to the plant (e.g., earthquakes or HWs), or combinations thereof.

initiator: see *initiating event*.

insights: information that provides an understanding and explanation of what is and is not important to the analysis.

integrator: a single entity (individual, team, company, etc.) that is ultimately responsible for developing the composite representation of the informed technical community (herein called “the community distribution”). This integration sometimes involves informal methods such as deriving information relevant to an issue from the open literature or through informal discussions with experts and sometimes involves more formal methods.

intensity: a measure of the impact of a hazard.

intercable (as in “*intercable conductor-to-conductor short circuit*”): electrical interactions (shorting) between the conductors of two (or more) separate electrical cables (see also *intracable*).

interfacing systems LOCA (ISLOCA): a LOCA when a breach occurs in a system that interfaces with the reactor coolant system (RCS), where isolation between the breached system and the RCS fails. An ISLOCA is usually characterized by the overpressurization of a low-pressure system when subjected to RCS pressure and can result in containment bypass.

internal event: a hazard group that encompasses events other than floods or fires that result from or involve mechanical, electrical, structural, or human failures from causes originating within a nuclear power plant or losses of off-site power (except when caused by another hazard) that directly or indirectly cause an initiating event and may cause safety system failures or operator errors that may lead to core damage.

intracable (as in “*intracable conductor-to-conductor short circuit*”): electrical interactions (shorting) between the conductors of one multiconductor electrical cable (see also *intercable*).

key safety functions: the minimum set of safety functions that must be maintained to prevent core damage and large early release. These include reactivity control, reactor pressure control, reactor coolant inventory control, decay heat removal, and containment integrity in appropriate combinations to prevent core damage and large early release.

large early release: a large release occurring before the effective implementation of off-site emergency response

and protective actions and there is the potential for early health effects.

large early release frequency (LERF): expected number of large early releases per unit of time.

large release: the release of airborne fission products to the environment such that there are significant off-site impacts. Large release and significant off-site impacts may be defined in terms of quantities of fission products released to the environment, status of fission product barriers and scrubbing, or dose levels at specific distances from the release, depending on the specific analysis objectives and regulatory requirements.

LERF analysis: evaluation of containment response to severe accident challenges and quantification of the mechanisms, amounts, and probabilities of subsequent radioactive material releases from the containment.

level 1 analysis: identification and quantification of the sequences of events leading to the onset of core damage.

level of detail: the degree to which (i.e., amount of) information is discretized and included in the model or analysis.

licensee-controlled area: areas of the plant site that are directly controlled by the nuclear power plant licensee.

local intense precipitation: a locally heavy rainfall event that is typically defined by specifying three parameters: rainfall depth, rainfall duration, and spatial extent (area). LIP is typically associated small-scale events over geographic areas on the order of 1 to 10 square-miles and by an assumption that the rainfall rate is aerially uniform, although the rainfall rate (intensity) typically varies over the rainfall event. Although total duration of the LIP-caused flooding event depends on the scenario and site-specific characteristics (e.g., site drainage, susceptibility to ponding of water), LIP events are typically associated with a short duration (e.g., 1 to 6 hrs) of intense rainfall. These intense rainfall events may be imbedded within longer rainfall events and (depending on site drainage characteristics) may affect a site for longer durations. In the context of this Standard, LIP is defined generically and is not limited to stylized deterministic events, such as the so-called 1-hr, 1-square-mile, probable maximum precipitation event.

lower bound wind speed, V_L : the lower bound wind speed used to define the wind speed threshold for HWs in an HWPRA. Wind speeds less than V_L are assumed to be unable to produce damage to risk-significant SSCs at the plant.

low-ruggedness relays: electromechanical relays that may chatter at low levels of earthquake excitation or on impact, causing malfunction of electrical circuits.

master logic diagram: summary fault tree constructed to guide the identification and grouping of initiating events and their associated sequences to ensure completeness.

may: used to state an option to be implemented at the user's discretion.

method: an analytical approach used to satisfy a supporting requirement or collection thereof in the PRA. An analytical approach is generally a compilation of the analyses, tools, assumptions, and data used to develop a model.

missile fragility: fragility of SSCs for a given missile impact.

mission time: the time period that a system or component is required to operate in order to successfully perform its function.

model: a qualitative and/or quantitative representation that is constructed to portray the inherent characteristics and properties of what is being represented (e.g., a system, component or human performance, theory or phenomenon). A model may be in the form, for example, of a structure, schematic, or equation. Method(s) are used to construct the model under consideration.

multicompartment fire scenario: a fire scenario involving targets in a room or fire compartment other than or in addition to the one where the fire was originated.

multiple spurious operations: concurrent spurious operations of two or more equipment items.

mutually exclusive events: a set of events where the occurrence of any one precludes the simultaneous occurrence of any remaining events in the set.

newly developed method: a method used in a PRA that has either been developed separately from a state-of-practice method or is one that involves a fundamental change to a state-of-practice method. A newly developed method is not a state-of practice or a consensus method.

nonsuppression probability: probability of failing to suppress a fire before target damage occurs.

operating time: total time during which components or systems are performing their designed function.

parameter uncertainty: the uncertainty in the value of an input parameter that represents the degree of belief in the range of values the input parameter may assume. Examples of parameter uncertainty include, but are not limited to, probability distributions or confidence intervals (i.e., a range of probability values within which the actual value of the input parameter is expected to reside) for an input parameter such as an initiating event frequency or a component failure probability.

passive flood protection feature: a flood protection feature that does not require the change of state of a component in order for it to perform as intended. Examples include dikes, berms, sumps, drains, basins, yard drainage systems, walls, floors, structures, penetration seals, and external berms/barriers that are under licensee control.

passive SSC: an SSC that performs one or more safety functions either fully or partially via passive means (i.e., relying on natural physical processes such as natural convection, thermal conduction, radiation, gravity, or pressure differentials, or depending on the integrity of a pressure boundary or structural component). Examples include piping systems that are used to maintain an

inventory of fluid and deliver flow along a fluid path, and structural supports for SSCs.

peak ground acceleration: maximum value of acceleration displayed on an accelerogram; the largest ground acceleration produced by an earthquake at a site.

performance shaping factor: a factor that influences HEPs as considered in a PRA's Human Reliability Analysis and includes such items as level of training, quality/availability of procedural guidance, time available to perform an action, and so on.

physical analysis units: the spatial subdivisions of the plant on which an internal flood or internal fire PRA is based. The physical analysis units are generally defined in terms of flood or fire areas and/or flood or fire compartments under the plant partitioning technical element.

plant: a general term used to refer to a nuclear power facility (e.g., "plant" could be used to refer to a single unit or multiunit site).

plant boundary: defined by the user based on the scope of plant structures.

plant damage state: group of accident sequence end states that have similar characteristics with respect to accident progression and containment or engineered safety feature operability.

plant response model: a logic model, including the event trees and fault trees and the various SSC and human failures, that is used to delineate and evaluate the CDF/LERF accident sequences conditional on the occurrence of a hazard event (or hazard group).

plant-specific data: data consisting of observed sample data from the plant being analyzed.

point estimate: estimate of a parameter in the form of a single number.

post-initiator human failure events: HFEs that represent the impact of human errors committed during response to abnormal plant conditions.

power block elevation (for purposes of external-flood PRA): the as-built elevation of the ground surface in the area of the site power block. There may be more than one elevation of relevance to the external flood PRA; for example, different elevations may be relevant to different locations around the site.

PRA application: a documented analysis based in part or whole on a plant-specific PRA that is used to assist in decision-making with regard to the design, licensing, procurement, construction, operation, or maintenance of a nuclear power plant.

PRA maintenance: a change in the PRA that does not meet the definition of PRA upgrade.

PRA upgrade: a change in the PRA that results in the applicability of one or more SRs or Capability Categories that were not previously included within the PRA (e.g., performing qualitative screening in [Part 4](#) when this HLR was previously not applicable or the addition

of a new hazard model), an implementation of a PRA method in a different context, or the incorporation of a method not previously used.

pre-initiator human failure events: HFEs that represent the impact of human errors committed during actions performed prior to the initiation of an accident (e.g., during maintenance or the use of calibration procedures).

primary hazard: those hazards that are not the consequence of other preceding hazards.

prior distribution (priors): in Bayesian analysis, the expression of an analyst's prior belief about the value of a parameter prior to obtaining sample data.

probabilistic risk assessment: a quantitative assessment of the risk including all technical elements for modeled hazards associated with plant operation and maintenance that is measured in terms of frequency of occurrence of risk metrics, such as core damage or a radioactive material release and its effects on the health of the public (also referred to as a probabilistic safety analysis).

probability of exceedance (as used in seismic hazard analysis): the probability that a specified level of ground motion for at least one earthquake will be exceeded at a site or in a region during a specified exposure time.

raceway: an enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or bus bars, with additional functions as permitted by code. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquid-tight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical non-metallic tubing, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

randomness (as used in seismic fragility analysis): the variability in seismic capacity arising from the randomness of the earthquake characteristics for the same acceleration and to the structural response parameters that relate to these characteristics.

rare event: one that might be expected to occur only a few times throughout the world nuclear industry over many years (e.g., $<1.0\text{E-}4$ per reactor-yr).

reactor critical year: a calendar year in the operating life of one reactor, assuming that the reactor operated continuously for a year.

reactor-operating-state-year: an equivalent calendar year of operation in a particular plant operating state.

reactor-year: a calendar year in the operating life of one reactor, regardless of power level.

realism: an accurate representation (to the extent practical) of the expected response of the as-built, as-operated plant.

recovery: restoration of a function lost as a result of a failed SSC by overcoming or compensating for its failure. It is generally modeled by using HRA techniques.

reference wind speed: refers to a set of specified wind parameters associated with the use of wind speed as the independent hazard and fragility parameter in HWPRAs. The parameters required to define the reference wind (based on wind speed) include averaging time, surface roughness, height above ground, and direction.

reliability: the complement of unreliability.

repair: restoration of a failed SSC by correcting the cause of failure and returning the failed SSC to its modeled functionality; generally modeled by using actuarial data.

repair time: the period from identification of a component failure until it is returned to service.

resource expert: a technical expert with knowledge of a particular technical area of a PRA.

response: a reaction to a cue for action in initiating or recovering a desired function.

response spectrum: a curve calculated from an earthquake accelerogram that gives the value of peak response in terms of acceleration, velocity, or displacement of a damped linear oscillator (with a given damping ratio) as a function of its period (or frequency).

risk: probability and consequences of an event, as expressed by the “risk triplet” that is the answer to the following three questions:

- (a) What can go wrong?
- (b) How likely is it?
- (c) What are the consequences if it occurs?

risk achievement worth (RAW) importance measure: for a specified basic event, risk achievement worth importance represents the increase in a selected figure of merit when an SSC is assumed to be unable to perform its function due to testing, maintenance, or failure. It is the ratio or interval of the figure of merit, evaluated with the SSC’s basic event probability set to one, to the base case figure of merit.

risk-relevant consequences: the fire-induced failure of any risk-relevant target, or the fire-induced creation of environmental conditions that may complicate or preclude credited postfire operator actions.

risk-relevant damage targets: any equipment item or cable whose operation is credited in the fire PRA plant response model or whose operation may be required to support a credited postfire operator action.

risk-relevant ignition source: any ignition source included in the fire PRA fire scenario definitions that could cause a fire that might induce a plant initiating event or adversely affect one or more damage targets.

risk-significant: see definitions in Table 1-1.9-1.

safe stable state: a plant condition, following an initiating event, in which RCS conditions are controllable at or near desired values.

safety function: function that must be performed to control the sources of energy in the plant and radiation hazards.

safety systems: those systems that are designed to prevent or mitigate a design-basis accident.

screening: a process that eliminates items from further consideration based on their negligible contribution to the probability of an accident or its consequences, or from further analysis of a specific issue.

screening criteria: the values and conditions used to determine whether an item is a negligible contributor to the probability of an accident sequence or its consequences.

secondary combustible: combustible or flammable materials that are not a part of the fire ignition source that may be ignited if there is fire spread beyond the fire ignition source.

secondary hazard: used in connection with, and in contrast to, a primary hazard. It is an additional hazard effect that is induced by the primary hazard.

seismic margin: seismic margin is expressed in terms of the earthquake motion level that compromises plant safety, specifically leading to severe core damage. The margin concept can also be extended to any particular structure, function, system, equipment item, or component for which “compromising safety” means sufficient loss of safety function to contribute to core damage either independently or in combination with other failures.

seismic source: a general term referring to both seismogenic sources and capable tectonic sources. A seismogenic source is a portion of the Earth assumed to have a uniform earthquake potential (same expected maximum earthquake and recurrence frequency), distinct from the seismicity of the surrounding regions. A capable tectonic source is a tectonic structure that can generate both vibratory ground motion and tectonic surface deformation such as faulting or folding at or near the Earth’s surface. In a probabilistic seismic hazard analysis, all seismic sources in the site region with a potential to contribute to the frequency of ground motions (i.e., the hazard) are included.

seismic spatial interaction: an interaction that could cause an equipment item to fail to perform its intended safety function. It is the physical interaction of a structure, pipe, distribution system, or other equipment item with a nearby item of safety equipment caused by relative motions from an earthquake. The interactions of concern are

- (a) proximity effects
- (b) structural failure and falling
- (c) flexibility of attached lines and cables

severe accident: an accident that involves extensive core damage and fission product release into the reactor vessel and containment, with potential release to the environment.

severity factor: severity factor is the probability that fire ignition would include certain specific conditions that

influence its rate of growth, level of energy emanated, and duration (time to self-extinguishment) to levels at which target damage is generated.

shall: used to state a mandatory requirement.

should: used to state a recommendation.

skill of the craft: actions that one can assume that trained staff would be able to readily perform without written procedures (e.g., simple tasks such as turning a switch or opening a manual valve as opposed to a series of sequential actions or set of actions that need to be coordinated).

source of model uncertainty: the uncertainty associated with the variability of an input of interest where the input of interest can be derived or calculated via different modeling approaches, where the selected approach is not clearly more correct or does not represent a consensus of the technical community, and where the choice of modeling approach is known to have an impact on the PRA model (e.g., introduction of a new basic event, changes to basic event probabilities, change in success criterion, or introduction of a new initiating event).

spectral acceleration: given as a function of period or frequency and damping ratio (typically 5%), spectral acceleration is equal to the peak relative displacement of a linear oscillator of frequency, f , attached to the ground, times the quantity $(2\pi f)^2$. It is expressed in gravitational acceleration (g) or centimeters per second squared (cm/s^2).

split fraction: a unitless quantity that represents the conditional (on preceding events) probability of choosing one direction rather than the other through a branch point of an event tree.

spurious operation: the undesired operation of equipment resulting from a fire that could affect the capability to achieve and maintain safe shutdown.

state of practice: those practices that are widely accepted and implemented throughout the nuclear industry, that have been shown to be technically acceptable in documented analyses or engineering assessments, and that have been shown to be acceptable in the context of the intended application.

state-of-knowledge correlation: the correlation that arises between sample values when performing uncertainty analysis for cutsets consisting of basic events by using a sampling approach (e.g., the Monte Carlo method). When the state of knowledge correlation is included, it results, for each sample, in the same value being used for all basic event probabilities to which the same data apply.

station blackout: complete loss of alternating current electric power to the essential and nonessential switchgear buses in a nuclear power plant.

statistical model: a model in which a modeling parameter or behavior is analyzed as a random variable with specified statistical characteristics.

straight winds: wind hazards that do not have a powerful rotational wind component. For example, straight winds include thunderstorm and extratropical cyclone winds.

success criteria: criteria for establishing the minimum number or combinations of systems or components required to operate, operator actions, or minimum levels of performance per component during a specific period of time to ensure that the safety functions are satisfied.

support system: a system that provides a support function (e.g., electric power, control power, or cooling) for one or more other systems.

system failure: loss of the ability of a system to perform a modeled function.

target: may refer to a HW, a fire damage target, and/or an ignition target. A fire damage target is any item whose function can be adversely affected by the modeled fire. Typically, a fire damage target is a cable or equipment item that belongs to the fire PRA cable or equipment list and that is included in event trees and fault trees for fire risk estimation. An ignition target would be any flammable or combustible material to which fire might spread.

target set: a group of damage targets that will be assumed to suffer fire-induced damage based on the same damage criteria and damage threshold in any given fire scenario. The collection of target sets associated with a fire scenario often represents a subset of the damage targets present in the fire compartment but may also encompass all risk-relevant damage targets in a single physical analysis unit or a collection of damage targets in multiple physical analysis units. This definition implies that all members of any single target set will be assumed to fail when the first member of the target set fails (i.e., “damage based on the same damage criteria and damage threshold”). Progressive or time-dependent states of fire damage may be represented through the definition of multiple target sets for a single fire scenario (e.g., cables in raceways directly above a fire source versus cables in raceways remote from the fire source). The level of detail associated with target set definition will generally parallel the level of detail employed in fire scenario selection and analysis (e.g., screening level analysis versus detailed analysis).

time available: the time period from the presentation of a cue for human action or equipment response to the time of adverse consequences if no action is taken.

top event: undesired state of a system in the fault tree model (e.g., the failure of the system to accomplish its function) that is the starting point (at the top) of the fault tree.

truncation limit: the numerical cutoff value of probability or frequency below which results are not retained in the quantitative PRA model or used in subsequent calculations (such limits can apply to accident sequences/cutsets, system level cutsets, and sequence/cutset database retention).

unavailability: the probability that a system or component is not capable of supporting its function including, but not limited to, the time it is disabled for test or maintenance. Total system unavailability includes unreliability.

uncertainty analysis: the process of identifying and characterizing the sources of uncertainty in the analysis and evaluating their impact on the PRA results and developing a quantitative measure to the extent practical.

uncertainty: a representation of the confidence in the information or state of knowledge about the parameter values and models used in constructing the PRA.

uniform hazard response spectrum: a plot of a ground response parameter (e.g., spectral acceleration or spectral velocity) that has an equal likelihood of exceedance at different frequencies.

unreliability: the probability that a system or component will not perform its specified function under given conditions on demand or for a prescribed time.

walkdown: physical inspection of relevant areas of the nuclear power plant site (and its surroundings, as necessary) to obtain or confirm information such that the PRA model represents the as-built, as-operated plant.

walkthrough: step-by-step consideration of a procedure along with, if possible, visits to relevant locations and demonstration of actions.

wind-driven rain: wind-driven rain is rain that has a horizontal velocity component from wind. Wind-driven rain is an effect that may require consideration when HWs damage a building, exposing interior equipment to water damage from rain water, drips, and splash.

wind effects: the physical loading effects that can result from HW hazards, including wind pressure and atmospheric pressure change, wind-generated missiles, structural interactions, wind-driven rain, and correlated hazard effects.

Section 1-3

PRA Scope and Capabilities in Support of Risk-Informed Applications

1-3.1 PURPOSE

This Section describes needed activities to establish the capability of a PRA to support a particular risk-informed application. For this Section, the term “PRA” (or “PRA model”) can refer to either an integrated model that includes all relevant hazard groups or multiple PRA models that address one or more hazard groups. For a specific application, PRA capabilities are evaluated in terms of Capability Categories for individual SRs rather than by specifying a single Capability Category for the whole PRA. Depending on the application, the required PRA capabilities may vary over and within different Parts of this Standard. The process is intended to be used with PRAs that have had a peer review that meets the requirements of the Peer Review Section of each respective Part of this Standard.

1-3.2 IDENTIFICATION OF APPLICATION AND DETERMINATION OF CAPABILITY CATEGORIES

1-3.2.1 Identification of Application

Define the application by

- (a) evaluating the plant design or operational change being assessed
- (b) identifying the SSCs and plant activities affected by the change including the cause-effect relationship between the plant design or operational change and the PRA model
- (c) identifying the hazard groups, PRA model scope, and PRA risk metrics that are needed to assess the change

EPRI 3002014783 [1-2] and RG 1.174 [1-3] provide guidance for the above activities.

1-3.2.2 Determination of Capability Categories

Other Parts of this Standard state SRs for the PRA Capability Categories whose attributes are described in [Section 1-1.3](#).

For many of the SRs, the distinction between Capability Categories is based on the treatment of significant contributors. Definitions in this Standard containing the word “significance” or “significant” are generally

written from the perspective of a specific hazard group. It is important to recognize that, for applications whose risk stems from more than one hazard group, these definitions should be generalized to apply to the sum of risks from all contributing hazard groups. “Significance” should also be treated differently for those SRs that refer to SRs in other hazard groups.

For the application, determine the relative importance of each portion of the PRA for each hazard group needed to support the application. This determination dictates which Capability Category is needed for each SR for each portion of the PRA to support the application. To determine these capabilities, an evaluation of the application should be performed to assess the role of the PRA in supporting that application, including determining the relative importance of SRs to the application; identifying the portions of the hazard group PRA relevant to the application; and for each relevant portion, determining the Capability Category for each SR needed to support the application. When performing this evaluation, the following application attributes shall be considered:

- (a) the role of the PRA in the application and extent of reliance of the decision on the PRA results
- (b) the risk metrics to be used to support the application and associated decision criteria
- (c) the significance of the risk contribution from the hazard group to the decision
- (d) the degree to which bounding or conservative methods for the PRA or in a given portion of the PRA would lead to inappropriately influencing the decisions made in the application and the approach(es) to accounting for this in the decision-making process
- (e) the degree of accuracy and evaluation of uncertainties and sensitivities required of the PRA results
- (f) the degree of confidence in the results that is required to support the decision
- (g) the extent to which the decisions made in the application will impact the plant design basis

The Capability Categories and the bases for their determination shall be documented.

Section 1-4

Requirements for Use of Expert Judgment

1-4.1 PURPOSE

This Section states general requirements for use of expert judgment.

1-4.2 USE OF EXPERT JUDGMENT

This section states requirements for the use of expert judgment outside of the PRA analysis team to resolve a specific technical issue.

Guidance from NUREG/CR-6372 [1-4] and NUREG-1563 [1-5] may be used to meet the requirements in this paragraph. Other approaches, or a mix of these, may also be used.

1-4.2.1 Objective of Using Expert Judgment

The PRA analysis team shall explicitly and clearly define the objective of the information that is being sought through the use of outside expert judgment and shall explain this objective and the intended use of the information to the expert(s).

1-4.2.2 Identification of the Technical Issue

The PRA analysis team shall explicitly and clearly define the specific technical issue to be addressed by the expert(s).

1-4.2.3 Determination of the Need for Outside Expert Judgment

The PRA analysis team may elect to resolve a technical issue by using their own expert judgment or the judgment of others within their organization.

The PRA analysis team shall use outside experts when the needed expertise on the given technical issue is not available within the analysis team or within the team's organization. The PRA analysis team should use outside experts, even when such expertise is available inside, if there is a need to obtain broader perspectives for any of the following or related reasons:

- (a) Complex experimental data exist that the analysts know have been interpreted differently by different outside experts.
- (b) More than one conceptual model exists for interpreting the technical issue, and judgment is needed as to the applicability of the different models.
- (c) Judgments are required to assess whether bounding assumptions or calculations are appropriately conservative.

- (d) Uncertainties are large and risk significant, and judgments of outside technical experts are useful in illuminating the specific issue.

1-4.2.4 Identification of Expert Judgment Process

The PRA analysis team shall determine

- (a) the degree of importance and the level of complexity of the issue
- (b) whether the process will use a single entity (individual, team, company, etc.) that will act as an evaluator and integrator and will be responsible for developing the community distribution or a panel of expert evaluators and a facilitator/integrator

The facilitator/integrator shall be responsible for aggregating the judgments and community distributions of the panel of experts so as to develop the composite distribution of the informed technical community.

1-4.2.5 Identification and Selection of Evaluator Experts

The PRA analysis team shall identify one or more experts capable of evaluating the relative credibility of multiple alternative hypotheses to explain the available information. These experts shall evaluate potential hypotheses and bases of inputs from the literature, and from proponents and resource experts, and shall provide

- (a) their own input
- (b) their representation of the community distribution

1-4.2.6 Identification and Selection of Technical Issue Experts

If needed, the PRA analysis team shall also identify other technical issue experts such as

- (a) experts who advocate particular hypotheses or technical positions (e.g., an individual who evaluates data and develops a particular hypothesis to explain the data)
- (b) technical experts with knowledge of a particular technical subject of relevance to the issue

1-4.2.7 Responsibility for the Expert Judgment

The PRA analysis team shall assign responsibility for the resulting judgments to an integrator or the experts. Each individual expert shall accept responsibility for their individual judgments and interpretations.

Section 1-5

PRA Configuration Control Program

1-5.1 INTRODUCTION

This Section states requirements for a configuration control program to support the use of a PRA in risk-informed decisions for nuclear power plants. The HLRs and SRs for this PRA Configuration Control (CC) Program are contained in [Table 1-5.3-1](#), [Table 1-5.3-2](#), [Table 1-5.3-3](#), [Table 1-5.3-4](#), [Table 1-5.3-5](#), and [Table 1-5.3-6](#). As these are administrative requirements, there is no gradation across Capability Categories. A discussion of the requirements is presented below.

1-5.2 OBJECTIVE

The objective of the configuration control program is to ensure that when a PRA is to be used in risk-informed decisions, it represents the as-built, as-operated plant at the time of the decision. Furthermore, it ensures that any updates of the PRA are consistent with the technical requirements of this Standard.

Table 1-5.3-1 High Level Requirements for PRA Configuration Control (CC) Program

Designator	Requirement
HLR-CC-A	The PRA Configuration Control Program shall include a process for monitoring changes to the plant design, operation, PRA technology, and industry experience and for collecting updated performance information that could result in changes to PRA inputs.
HLR-CC-B	The PRA Configuration Control Program shall include a process that maintains and upgrades the PRA to be consistent with the as-built, as-operated plant.
HLR-CC-C	The PRA Configuration Control Program shall consider the cumulative impact of pending changes in the performance of risk applications.
HLR-CC-D	The PRA Configuration Control Program shall include a process that maintains configuration control of computer codes and associated files used to support PRA.
HLR-CC-E	The PRA Configuration Control Program and its implementation shall be documented.

Table 1-5.3-2 Supporting Requirements for HLR-CC-A

The PRA Configuration Control Program shall include a process for monitoring changes to the plant design, operation, PRA technology, and industry experience and for collecting updated performance information that could result in changes to PRA inputs (HLR-CC-A).

Index No. CC-A	Requirements
CC-A1	IMPLEMENT a process to track plant changes, PRA technology, and related industry equipment performance/operational experience focused on collecting the necessary information to update PRA inputs.
CC-A2	In the information collected, INCLUDE the plant-specific changes in design, operation, and maintenance of the plant that impact, for example, the following: (a) operating procedures and practices (e.g., operations orders) (b) emergency and abnormal operating procedures (c) design configuration (d) initiating event frequencies (e) system or subsystem unavailabilities (f) component failure rates (g) maintenance policies (h) operator training (i) technical specifications (j) engineering calculations (k) emergency plan (l) accident management programs
CC-A3	In the information collected, INCLUDE changes to external facilities, sources of external hazards, or internal or external features that impact how external hazards may affect the plant. Such information may include, but is not limited to (a) changes in dam operating procedures that impact water release strategies (b) regional changes that impact riverine flooding hazard analysis (c) capabilities of external response centers if such centers are credited in the PRA
CC-A4	In the information collected, INCLUDE changes in industry experience that could impact (a) estimation of initiating event frequencies (b) generic system or subsystem unavailabilities (c) generic component failure rates (d) initiating events
CC-A5	In the information collected, INCLUDE changes to the PRA technology that could change the results of the PRA model.

Table 1-5.3-3 Supporting Requirements for HLR-CC-B

The PRA Configuration Control Program shall include a process that maintains and upgrades the PRA to be consistent with the as-built, as-operated plant (HLR-CC-B).

Index No. CC-B	Requirements
CC-B1	EVALUATE changes in PRA inputs or new information identified pursuant to HLR CC-A to determine whether such information warrants PRA maintenance or PRA upgrade. INCLUDE in the PRA changes identified per HLR-CC-A .
CC-B2	INCLUDE in the PRA those maintenance or upgrade changes implemented per HLR-CC-A that would impact risk-significant insights.
CC-B3	PERFORM a peer review of portions of the PRA that are affected by a PRA upgrade in accordance with the applicable requirements specified in Section 1-6 . The scope may be limited within a technical element to only the SRs that are germane to a specific PRA upgrade.
CC-B4	ENSURE that changes to the PRA due to PRA maintenance or upgrade meet the requirements of the Technical Requirements section of each respective Part of this Standard.
CC-B5	REVIEW maintenance or upgrade changes made to the PRA by using a utility-approved process.

Table 1-5.3-4 Supporting Requirements for HLR-CC-C

The PRA Configuration Control Program shall consider the cumulative impact of pending changes in the performance of risk applications (HLR-CC-C).

Index No. CC-C	Requirements
CC-C1	IDENTIFY plant changes that have been identified to have a potential impact on PRA.
CC-C2	IDENTIFY known industry issues or events and PRA technology changes that may have an impact on the PRA model.

Table 1-5.3-5 Supporting Requirements for HLR-CC-D

The PRA Configuration Control Program shall include a process that maintains configuration control of computer codes used to support and perform PRA analyses (HLR-CC-D).

Index No. CC-D	Requirements
CC-D1	ENSURE that the computer codes and associated files used to support and to quantify the PRA are controlled to ensure consistent, reproducible results.

Table 1-5.3-6 Supporting Requirements for HLR-CC-E

The PRA Configuration Control Program and its implementation shall be documented (HLR-CC-E).

Index No. CC-E	Requirements
CC-E1	DOCUMENT the Configuration Control Program and the performance of the above elements in a manner adequate to demonstrate that the PRA is being maintained consistently with the as-built, as-operated plant. The documentation typically includes (a) a description of the process used to monitor PRA inputs and collect new information (b) evidence that the aforementioned process is active (c) descriptions of proposed and implemented changes (d) a description of changes in a PRA due to each PRA upgrade or PRA maintenance (e) a record of the performance and results of the appropriate PRA reviews (consistent with the requirements of Section 1-6.6) (f) a record of the process and results used to address the cumulative impact of pending changes (g) a description of the process used to maintain software configuration control (h) a record of the process and results used to evaluate changes on previously implemented risk-informed decisions
CC-E2	DOCUMENT the bases for the changes made to the PRA model.

Section 1-6

Peer Review

1-6.1 PURPOSE

This Section states requirements for peer review of the PRA to be used in risk-informed decisions for commercial nuclear power plants. Those portions of PRAs used for PRA applications applying this Standard shall be peer reviewed. The peer review shall assess the PRA to the extent necessary to determine whether the method and its implementation meet the requirements of this Standard. Another purpose of the peer review is to determine the potential gaps in the PRA relative to this Standard's requirements. The peer review need not assess all aspects of the PRA against all requirements in the Technical Requirements section of each respective Part of this Standard but must address all SRs relevant to the scope of the peer review. However, enough aspects of the PRA shall be reviewed for the reviewers to achieve consensus on the adequacy of the assessment of each applicable SR as well as on the methods and their implementation for each PRA technical element.

1-6.1.1 Documentation and Self-Assessment

A prerequisite for performing the peer review is that the PRA has documented the supporting analyses/calculations, including the independent reviews performed, and a self-assessment of the PRA has been conducted to establish the extent to which the PRA meets the requirements of this Standard. The results of the self-assessment process shall be documented.

1-6.1.2 Scope

Peer reviews shall be performed against the requirements in those Parts of this Standard that are applicable to the hazard groups of the PRA that are being used to support risk-informed decisions. It is permissible to conduct a separate and distinct peer review for each relevant hazard or individual elements of a hazard group. This Standard does not require that a single peer review be integrated across all hazard groups of the PRA.

The scope of the peer review may be a "focused-scope" peer review. A focused-scope peer review is a subset of a complete (full-scope) peer review and involves specified SRs. A focused-scope peer reviewed may be requested

- (a) to support a specific application that does not involve the complete hazard specific PRA model
- (b) to address changes to the PRA model as a result of upgrades, or

(c) to close significant deficiencies from previous peer reviews

When included in the scope of a peer review, a newly developed method shall be reviewed following the dedicated requirements discussed in [Section 1-7](#).

1-6.1.3 Peer Review Process

The review shall be performed using a written process that assesses the requirements of the Technical Requirements section of each respective Part of this Standard and addresses the requirements of the Peer Review Section of each respective Part of this Standard.

The peer review process shall consist of the following elements:

- (a) selection of the peer review team
- (b) training in the peer review process
- (c) an approach to be used by the peer review team for assessing if the PRA meets the supporting requirements of the Technical Requirements section of each respective Part of this Standard
- (d) management and resolution of potential differing professional opinions
- (e) documentation of the results of the review

1-6.2 PEER REVIEW TEAM COMPOSITION AND PERSONNEL QUALIFICATIONS

1-6.2.1 Collective Team

The peer review team shall consist of personnel whose collective qualifications include

- (a) the ability to assess all the PRA technical elements of the Technical Requirements section of each respective Part of this Standard, as applicable, and the interfaces between those elements
- (b) the collective knowledge of the plant nuclear steam supply system design, containment design, and plant operation

1-6.2.2 Individual Team Members

The peer review team members individually shall be

- (a) knowledgeable of the requirements in this Standard for their area of review
- (b) experienced in performing the activities related to the PRA technical elements for which the reviewer is assigned
- (c) independent from the team that developed the PRA model or the method being peer reviewed

(d) subject matter experts included to judge the technical adequacy of non-PRA engineering evaluations and to confirm that the applicable envelope defining the limits of the method are identified

(e) prohibited from reviewing work performed by a direct supervisor or work they have directly supervised

1-6.2.3 Specific Review Team Qualifications

The peer reviewer shall also be knowledgeable (by direct experience) of the specific method, code, tool, or approach (e.g., large event-tree linking approach, Modular Accident Analysis Program (MAAP) code, Technique for Human Error Rate Prediction (THERP) method, external hazard analysis, fragility assessment and walkdowns) that was used in the PRA technical element assigned for review. Understanding and competence in the assigned area shall be demonstrated by the range of the individual's experience in the number of different, independent activities performed in the assigned area, as well as the different levels of complexity of these activities:

(a) One member of the peer review team (the technical integrator) shall be familiar with all the PRA technical elements identified in the relevant Part of this Standard under review and shall have demonstrated the capability to integrate these PRA technical elements. When more than one Part is under review, a separate technical integrator may be used for each Part.

(b) The peer review team shall have a team leader to lead the team in the performance of the review. The team leader need not be the technical integrator.

(c) The peer review shall have at least two reviewers dedicated to each reviewed technical element to ensure that consensus can be reached on the technical adequacy of the PRA being reviewed and be conducted over a period of time adequate to ensure that reviewed technical element receives the attention necessary to assess the technical adequacy.

(d) Exceptions to the requirements of this paragraph may be taken based on the nature of the PRA model change. A single-person peer review shall be justified only when the review involves an upgrade of a single element and the reviewer has acceptable qualifications for the technologies involved in the upgrade. All such exceptions shall be documented in accordance with [Section 1-6.6](#) of this Standard. Regardless of any such exceptions, the collective qualification of the review team shall be appropriate to the scope of the peer review

(e) If the peer reviewer is reviewing a newly developed method, the reviewer shall be knowledgeable of the technical subject addressed by the newly developed method. Understanding and competence of the newly developed method shall be demonstrated by the range of the individual's experience in that technical subject. Subject matter experts should be included to judge the technical adequacy of non-PRA engineering evaluations

and to confirm that the applicable envelope defining the limits of the method are identified.

1-6.3 REVIEW OF PRA TECHNICAL ELEMENTS TO CONFIRM THE METHODS USED

The peer review team shall use the requirements of this Section. The peer review team shall review the technical requirements of the hazard group to determine if the method and the implementation of the method for each PRA technical element meet the requirements of this Standard. Additional material for those elements may be reviewed depending on the results obtained. The judgment of the reviewer shall be used to determine the specific scope and depth of the review in each PRA technical element and the need for walkdowns.

The results of the appropriate hazard group PRA, including models and assumptions, and the results of each PRA technical element shall be reviewed to determine their reasonableness given the design and operation of the plant (e.g., investigation of cutset or sequence combinations for reasonableness).

Any newly developed method included in the scope of the peer review is reviewed against the requirements of [Section 1-7](#). It is noted that a newly developed method can be peer reviewed within the scope of a plant PRA (i.e., concurrently with its implementation in a plant PRA) or via a dedicated stand-alone peer review. If newly developed methods are peer-reviewed concurrently with the implementations of methods, all specific requirements for the newly developed methods peer review shall be met. If the implementation of the method is peer reviewed in a separate peer review, only the applicable requirements for the scope of the review need to be met.

Even if exceptions to the requirements of [Section 1-6.2.3\(c\)](#) occur, concerning the composition of the peer review team or the duration of the review, all SRs relevant to the scope of the peer review of the PRA are to be reviewed.

The extent of a focused-scope peer review includes all SRs (e.g., not just those for which significant deficiencies were cited), within the HLRs containing SRs with significant deficiencies. New significant deficiencies may be issued even for SRs that did not have previous significant deficiencies, as a focused-scope peer review encompasses all the SRs within an affected HLR.

1-6.4 EXPERT JUDGMENT

The use of expert judgment to implement requirements in this Standard shall be reviewed using the general requirements in [Section 1-4.2](#).

1-6.5 PRA CONFIGURATION CONTROL PROGRAM

The peer review team shall review the process, including implementation, for maintaining or upgrading the

PRA against the configuration control requirements of this Standard. The PRA configuration control program is reviewed against the requirements presented in [Section 1-5](#).

1-6.6 DOCUMENTATION

1-6.6.1 Peer Review Team Documentation

The peer review team's documentation shall demonstrate that the review process appropriately implemented the review requirements. Specifically, the peer review documentation shall include the following:

- (a) identification of the version of the PRA reviewed
- (b) a statement of the scope of the peer review
- (c) the names of the peer review team members
- (d) a brief resume for each team member describing the individual's employer, education, PRA training, and PRA and PRA technical element experience and expertise
- (e) the elements of the PRA reviewed by each team member
- (f) a discussion of the extent to which each PRA technical element was reviewed, including justification for any supporting requirements within the peer review scope that were not reviewed
- (g) results of the review identifying any differences between the requirements in the Technical Requirements section of each respective Part of this Standard and [Section 1-5](#) and the method implemented, defined to a sufficient level of detail that will allow the resolution of the differences

(h) identification and significance of exceptions and gaps relative to this Standard's requirements, in sufficient detail to allow the resolution of the gaps that the peer reviewers have determined to be material to the PRA

(i) an assessment of PRA assumptions that the peer reviewers have determined to be material to the PRA

(j) differences or dissenting views among peer reviewers

(k) recommended alternatives for resolution of any differences

(l) an assessment of the Capability Category of the SRs (i.e., identification of what Capability Category is met for the SRs)

(m) peer-review consistent with newly developed method requirements

1-6.6.2 Resolution of Peer Review Team Comments

Resolution of deficiencies against the requirements of this Standard that are identified by the peer review team shall be documented. The resolution of these deficiencies shall describe how each was addressed such that the associated SR can be demonstrated to be met. The documentation shall indicate whether the deficiency is resolved via PRA maintenance or a PRA upgrade. The determination of whether the resolution adequately eliminates the deficiency shall be made by one or more individuals who meet the qualification requirements of [Section 1-6.2.2](#).

Section 1-7

Newly Developed Methods

1-7.1 INTRODUCTION

This Section states requirements for Newly Developed Methods (NM) explicitly developed for use in PRA to support risk-informed decisions for nuclear power plants. The HLRs and SRs for the newly developed methods are contained in [Table 1-7.2-1](#), [Table 1-7.2-2](#), [Table 1-7.2-3](#), [Table 1-7.2-4](#), [Table 1-7.2-5](#), [Table 1-7.2-6](#), and [Table 1-7.2-7](#).

1-7.2 OBJECTIVE

The objectives of the newly developed methods requirements are to ensure that a newly developed method is technically adequate and

- (a) has a clearly defined scope and limitations
- (b) is based on sound engineering and relevant science
- (c) has proper treatment of assumptions and uncertainties
- (d) is based on appropriate and well-understood data
- (e) produces results that are consistent with expectations

(f) is clearly documented in such a way that knowledgeable personnel can understand it without ambiguity and that there is enough documentation so that it can be peer reviewed.

The objectives above are intended to be applicable to a large spectrum of methods, although it is understood that not all the SRs could be applicable to all methods. In some cases, depending on the method, scope, and purpose, some of the SRs may not be applicable. In addition, the SRs are designed to be able to address a stand-alone method (i.e., independent from its implementation on a specific plant PRA). It is recognized that, in some circumstances, a method can be so plant or site specific (especially in the external hazard domain) that a full review of the method can be performed only within its implementation. In such cases, it is envisioned that some of the Newly Developed Methods SRs could be overlapping with Part-specific SRs (e.g., SRs in [Part 8](#)). In such cases, the technical SRs in the appropriate Part may take priority over some Newly Developed Methods SRs.

Table 1-7.2-1 High Level Requirements for Newly Developed Methods (NM)

Designator	Requirement
HLR-NM-A	The purpose and scope of the newly developed method shall be clearly stated.
HLR-NM-B	The newly developed method shall be based on sound engineering and science relevant to its purpose and scope.
HLR-NM-C	The data (note that data can be numeric or non-numeric in nature) shall be relevant to the newly developed method, technically sound, and properly analyzed and applied.
HLR-NM-D	Uncertainties in the newly developed method shall be characterized. Sources of model uncertainties and related assumptions shall be identified.
HLR-NM-E	The results of the newly developed method shall be reproducible, reasonable, and consistent with the assumptions and data, given the purpose and scope of the newly developed method.
HLR-NM-F	The documentation of the newly developed method shall provide traceability of the work and facilitate incorporation of the newly developed method in a PRA model.

Table 1-7.2-2 Supporting Requirements for HLR-NM-A

The purpose and scope of the newly developed method shall be clearly stated (HLR-NM-A).

Index No. NM-A	Requirements
NM-A1	ENSURE that the stated purpose of the newly developed method (i.e., what is being achieved by the newly developed method) is consistent with the scope (established boundary) of the newly developed method.
NM-A2	ENSURE that the applicability and limitations of the newly developed method are consistent with the purpose and scope in SR NM-A1.
NM-A3	Based on the limitations and applicability of the newly developed method, IDENTIFY the areas of the PRA for which the newly developed method is intended to be used and those for which it is specifically not intended (e.g., hazards, technical elements, plant features, SRs impacted by the newly developed method).

Table 1-7.2-3 Supporting Requirements for HLR-NM-B

The newly developed method shall be based on sound engineering and science relevant to its purpose and scope (HLR-NM-B).

Index No. NM-B	Requirements
NM-B1	ESTABLISH the technical bases for the newly developed method by using approaches founded on established mathematical, engineering, and/or scientific principles (e.g., established through operating experience, tests, benchmarking, or acceptance by the scientific community).
NM-B2	If empirical models are used, ENSURE that they are supported by sufficient data, which are relevant to the newly developed method and, to the extent possible, that the experimental data have been shown to be repeatable.
NM-B3	IDENTIFY assumptions used to develop the technical bases of the newly developed method.
NM-B4	JUSTIFY the rationale for the assumptions identified in SR NM-B3 (e.g., backed by appropriate operational experience).

Table 1-7.2-4 Supporting Requirements for HLR-NM-C

The data (note that data can be numeric or non-numeric in nature) shall be relevant to the newly developed method, technically sound, and properly analyzed and applied (HLR-NM-C).

Index No. NM-C	Requirements
NM-C1	IDENTIFY the data needed in the development of the newly developed method (e.g., relevant plant-specific data, industry-wide current operating experience and data, or experimental or test data).
NM-C2	COLLECT relevant data consistent with current technical state of practice.
NM-C3	DEMONSTRATE that the data used, including experimental data or test data, are relevant to and support the technical basis of the newly developed method.
NM-C4	SPECIFY the basis for exclusion of data identified in SR NM-C1.
NM-C5	ANALYZE data (e.g., modifications to the data, use of data in a different context or beyond the original ranges, statistical analysis) using technically sound basis or criteria.
NM-C6	ENSURE that data are applied consistently with the purpose and scope of the newly developed method.

Table 1-7.2-5 Supporting Requirements for HLR-NM-D

Uncertainties in the newly developed method shall be characterized. Sources of model uncertainties and related assumptions shall be identified (HLR-NM-D).

Index No. NM-D	Requirements
NM-D1 [Note (1)]	CHARACTERIZE the parameter uncertainties associated with the newly developed method consistent with the intended scope and purpose of the method; this characterization may include, for example, specifying the uncertainty range, qualitatively discussing the uncertainty range, or identifying the parameter estimate as conservative or bounding.
NM-D2	IDENTIFY the sources of model uncertainty associated with assumptions identified in SR NM-B3 .
NM-D3	CHARACTERIZE the model uncertainties (identified in SR NM-D2) associated with the newly developed method; this characterization may be in the form of sensitivity studies.

NOTE:

- (1) Depending on the purpose and scope of the method, uncertainty distributions may need to be explicitly calculated to allow for application of a method for risk-significant items to meet CC-II of related technical SRs in other Parts of this Standard.

Table 1-7.2-6 Supporting Requirements for HLR-NM-E

The results of the newly developed method shall be reproducible, reasonable, and consistent with the assumptions and data, given the purpose and scope of the newly developed method (HLR-NM-E).

Index No. NM-E	Requirements
NM-E1	REVIEW the results from the newly developed method to determine that they are reproducible, reasonable, and consistent with assumptions and data addressed in the SRs under HLR-NM-B and HLR-NM-C .
NM-E2	COMPARE the results of the newly developed method with existing methods and, when possible, IDENTIFY causes for substantial differences.
NM-E3	ENSURE uncertainties do not preclude meaningful use of the newly developed method results.

Table 1-7.2-7 Supporting Requirements for HLR-NM-F

The documentation of the newly developed method shall provide traceability of the work and facilitate incorporation of the newly developed method in a PRA model (HLR-NM-F).

Index No. NM-F	Requirements
NM-F1	DOCUMENT the newly developed method specifying what is used as input, the technical basis, and the implementation limitations by addressing the following, as well as other details needed to fully document how the set of the newly developed method SRs are satisfied: (a) the purpose and scope of the newly developed method (b) the intended use of the newly developed method (c) the limitations of the newly developed method (d) the technical basis for the newly developed method (e) the sources of data, the collection process, and how the data is used to support the newly developed method (f) the assumptions and uncertainties associated with the newly developed method (g) the interpretation of the results of the newly developed method in the framework of the intended use and application
NM-F2	DOCUMENT the intended process by which the newly developed method can be applied to a PRA model consistently with the intended use of the newly developed method and taking into account the purpose, scope, and limitations.

Section 1-8

References

References are cited here and in other Parts of this Standard as guides to the user. The user is cautioned that (a) the reference is not to be interpreted that there is a consensus approval on the technical acceptability of the reference and (b) there may be more recent versions of the references or alternative documents more pertinent to particular PRA applications.

[1-1] NUREG/CR-1278 and SAND80-0200, “Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications,” A. D. Swain and H. E. Guttman, Sandia National Laboratories (SNL) (Technique for Human Error Rate Prediction), August 1983; U.S. Nuclear Regulatory Commission (NRC), One White Flint North, 11555 Rockville Pike, Rockville, MD 20852

[1-2] EPRI Report 3002014783, “A Framework for Using Risk Insights in Integrated Risk-Informed Decision-Making,” 2019; Publisher: Electric Power Research Institute (EPRI), 3420 Hillview Avenue, Palo Alto, CA 94304-1388

[1-3] Regulatory Guide 1.174, Rev. 3, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” January 2018; U.S. Nuclear Regulatory Commission (NRC), One White Flint North, 11555 Rockville Pike, Rockville, MD 20852

[1-4] NUREG/CR-6372 and UCRL-ID-122160, R. J. Budnitz, D. M. Boore, G. Apostolakis, L. S. Cluff, K. J. Coppersmith, C. A. Cornell, and P. A. Morris, “Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts,” Lawrence Livermore National Laboratory, April 1997; U.S. Nuclear Regulatory Commission (NRC), One White Flint North, 11555 Rockville Pike, Rockville, MD 20852

[1-5] NUREG/CR-1563, J. P. Kotra, M. P. Lee, N. A. Eisenberg, and A. R. DeWispelare, “Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program,” 1996; U.S. Nuclear Regulatory Commission (NRC), One White Flint North, 11555 Rockville Pike, Rockville, MD 20852

NONMANDATORY APPENDIX 1-A

MEANINGS OF ACTION VERBS

This Standard uses action verbs to state requirements. Dictionaries provide multiple meanings for most verbs. Table 1-A-1 states, with examples, the meanings of action verbs as used in this Standard. The relevant dictionary

meanings were derived from American dictionaries [e.g., Random House Unabridged ([dictionary.com](https://www.randomhouse.com/dictionary)), Merriam-Webster ([merriam-webster.com](https://www.merriam-webster.com))] with a few modifications to address specific usage in this Standard.

Table 1-A-1 List of Action Verbs

Action Verb	Relevant Dictionary Meaning	Examples of Usage in This Standard
ADDRESS	To direct the efforts or attention to	An example of the appropriate usage of the action verb can be found in SR HR-G3 in Part 2 , where CC-I states, when estimating HEPs, ADDRESS specific items.
ADJUST	To bring to a more satisfactory state	An example of the appropriate usage of the action verb can be found in SR WPR-D8 in Part 7 , which states ADJUST the credited recovery models based on results of SR WPR-D6 .
ANALYZE	To examine critically so as to bring out the essential elements	An example of the appropriate usage of the action verb can be found in SR WHA-C3 in Part 7 , where CC-II states ANALYZE thunderstorm and nonthunderstorm data separately.
ASSESS	To determine the importance, size, or value of	An example of the appropriate usage of the action verb can be found in SR QU-C2 in Part 2 , which states ASSESS the degree of dependency between HFEs.
ASSOCIATE	To connect or bring into relation	An example of the appropriate usage of this action verb can be found in SR CS-A1 in Part 4 , where CC-II states ASSOCIATE cables with equipment failure modes specific to each cable.
ASSUME	To take for granted without proof	An example of the appropriate usage of this action verb can be found in SR SC-A5 in Part 2 , where CC-I states ASSUME core damage where stable plant conditions would not be achieved within 24 hrs using modeled plant equipment and human actions.
AUGMENT	To make greater, more numerous, or larger	An example of the appropriate usage of the action verb can be found in SR IE-C13 in Part 2 , where CC-I states AUGMENT rare initiating events with applicable generic data sources.
BASE	To make, form, or serve as a base for	An example of the appropriate usage of the action verb can be found in SR DA-C7 in Part 2 , where CC-II states BASE the number of unplanned maintenance acts on actual plant experience.
CALCULATE	To determine by mathematical processes, compute	CALCULATE involves a mathematical process, whereas ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency) and can be derived qualitatively. An example of the appropriate usage of the action verb can be found in SR LE-D1 in Part 2 , which states CALCULATE the containment ultimate capacity for containment challenges.
CHARACTERIZE	To describe the character or quality of	In this Standard, CHARACTERIZE is used with respect to sources of uncertainty. An example of the appropriate usage of the action verb can be found in SR IGN-A9 in Part 4 , where CC-I states CHARACTERIZE the uncertainty for those ignition frequencies associated with fire scenarios that are risk-significant contributors.
COLLECT	To bring together into one body or place	An example of the appropriate usage of the action verb can be found in SR SY-A2 in Part 2 , which states COLLECT pertinent information to ensure that the systems analysis appropriately represents the as-built, as-operated systems.

Table 1-A-1 List of Action Verbs (Cont'd)

Action Verb	Relevant Dictionary Meaning	Examples of Usage in This Standard
COMPARE	To examine the character or qualities of especially in order to discover similarities or differences	An example of the appropriate usage of the action verb can be found in SR QU-D4 in Part 2 , which states COMPARE results to those from similar plants.
COMPILE	To put together (documents, or other materials) in one book or work	An example of the appropriate usage of the action verb can be found in SR XFHA-A1 in Part 8 , which states COMPILE a list of flood hazards that are applicable to the site.
COMPLETE	To bring to an end and especially into a perfected state	An example of the appropriate usage of the action verb can be found in SR IFHR-B3 in Part 3 , where CC-I and CC-II state COMPLETE the definition of HFEs identified in SR IFHR-B1 and SR IFHR-B2 by including the relevant internal flood-related context.
CONFIRM	To give new assurance of the validity of	An example of the appropriate usage of the action verb can be found in SR WHA-A7 in Part 7 , which states CONFIRM that the HW hazard screening correctly represents the as-built, as-operated configuration of the plant.
CONSTRUCT	To make or form by combining or arranging parts or elements	An example of the appropriate usage of the action verb can be found in SR PRM-A2 in Part 4 , which states CONSTRUCT the fire PRA plant response model so that it is capable of determining CDFs and LERFs once the fire frequencies are also applied to the quantification.
COUNT	To indicate or name by units or groups so as to find the total number of units involved	An example of the appropriate usage of the action verb can be found in SR DA-C5 in Part 2 , which states COUNT repeated plant-specific component failures occurring within a short time interval as a single failure if there is a single, recurring problem that causes the failures.
DO NOT COUNT		An example of the appropriate usage of the action verb can be found in SR DA-C7 in Part 2 , which states DO NOT COUNT additional demands from post-maintenance testing.
CREATE	To make or bring into existence something new	An example of the appropriate usage of the action verb can be found in SR IFEV-A2 in Part 3 , where CC-I and CC-II state CREATE a new initiating event group if an appropriate initiating event group does not exist.
(TAKE) CREDIT	To account for the impacts or effects of something, which is typically beneficial	In the context of this Standard, CREDIT is a subset of INCLUDE and, as an action verb, is only used in Part 4 . Its usage is limited to requirements to including or excluding an item because it provides a potential risk benefit or reduction. Credit is used frequently in the text of Part 3 and Part 4 , where it pertains to drains and flood mitigation systems and to fire detection and suppression.
DO NOT (TAKE) CREDIT		An example of appropriate usage of the action verb is in SR CF-A1 in Part 4 , where CC-II states CREDIT the mitigating effects of limited hot short duration in the analysis.
DEFINE	To determine or identify the essential qualities or meaning of	An example of the appropriate usage of the action verb can be found in SR AS-A8 in Part 2 , which states DEFINE the end state of the accident sequence as occurring when either a core damage state or a steady state condition has been reached.
DELINEATE	To describe, portray, or set forth with accuracy or in detail	An example of the appropriate usage of the action verb can be found in SR AS-A7 in Part 2 , which states DELINEATE the possible accident sequences for each modeled initiating event.
DEMONSTRATE	To prove or make clear by reasoning or evidence	An example of the appropriate usage of the action verb can be found in SR SY-A18 in Part 2 , which states DEMONSTRATE that the exclusion of specified conditions do not impact the results.
DERIVE	To receive or obtain especially from a specified source	An example of the appropriate usage of the action verb can be found in SR XHA-A5 in Part 9 , which states DERIVE a mean hazard curve accounting for model and parameter uncertainties.
DESCRIBE	To represent or give an account of in words	An example of the appropriate usage of the action verb can be found in SR QU-F2 in Part 2 , which states DESCRIBE significant accident sequences or functional failure groups.

Table 1-A-1 List of Action Verbs (Cont'd)

Action Verb	Relevant Dictionary Meaning	Examples of Usage in This Standard
DETERMINE	To find out or come to a decision about by investigation, reasoning, or calculation	An example of the appropriate usage of the action verb can be found in SR XFHA-C7 in Part 8 , which states DETERMINE that a following factor is not applicable to the analysis of riverine flooding.
DEVELOP	To bring out the capabilities or possibilities of	An example of the appropriate usage of the action verb can be found in SR AS-B5 in Part 2 , which states DEVELOP the accident sequence models to a level of detail sufficient to identify intersystem dependencies and train-level interfaces.
DOCUMENT	To furnish documentary evidence of	An example of the appropriate usage of the action verb can be found in SR AS-C2 in Part 2 , which states DOCUMENT the sources of model uncertainty, related assumptions, and reasonable alternatives associated with the accident sequence analysis.
ENSURE	To make sure or certain	An example of the appropriate usage of the action verb can be found in SR QU-D1 in Part 2 , which states ENSURE that sufficient accident sequences/cutsets are reviewed to support this conclusion.
ESTABLISH	To bring into being on a firm basis	An example of the appropriate usage of the action verb can be found in SR NM-B1 in Part 1 , which states ESTABLISH the technical bases for the newly developed method.
ESTIMATE	To form an approximate judgement or opinion regarding the value, amount, size, etc.; to calculate approximately	ESTIMATE does not necessarily involve a calculation (e.g., quantification of a probability or frequency), and an estimate can be derived qualitatively, whereas CALCULATE involves a mathematical process. An example of the appropriate usage of the action verb can be found in SR HR-G5 in Part 2 , where CC-I states ESTIMATE the time required to complete actions when needed for the calculation of an HEP.
EVALUATE	To determine or set the value or amount of; appraise	An example of the appropriate usage of the action verb can be found in SR LE-C12 in Part 2 , where CC-I states EVALUTE containment bypass events in a conservative manner.
EXPLAIN	To make plain, clear, or intelligible	An example of the appropriate usage of the action verb can be found in SR IE-C12 in Part 2 , which states EXPLAIN differences in the initiating event analysis.
EXTEND	To enlarge the scope of, to make more comprehensive	An example of the appropriate usage of the action verb can be found in SR SHA-A4 in Part 5 , which states EXTEND the range of ground motion levels considered to large enough values such that the truncation does not distort final numerical results.
GROUP	(a) To combine into one entity (b) To assign to a group	GROUP is a verb with two meanings. An example of the first meaning can be found in SR DA-B1 in Part 2 , where CC-I states GROUP components according to type for parameter estimation. An example of the second meaning can be found in SR IE-B4 in Part 2 , which states GROUP separately from other initiating event categories those categories with different plant-response impacts (i.e., those with different success criteria) or those that could have more severe radionuclide release potential (e.g., LERF).
DO NOT GROUP		An example of the appropriate usage of the action verb can be found in SR IE-B5 in Part 2 , which states DO NOT GROUP multi-unit initiating events if they impact mitigation capability.
IDENTIFY	To recognize or establish as being a particular thing	An example of the appropriate usage of the action verb can be found in SR QU-B7 in Part 2 , which states IDENTIFY cutsets (or sequences) containing mutually exclusive events in the results.
IMPLEMENT	To put into effect according to or by means of a definite plan or procedure	An example of the appropriate usage of the action verb can be found in SR CC-A1 in Part 1 , which states IMPLEMENT a process to track changes, PRA technology, and so on.
INCLUDE	To place in an aggregate, class, category, or the like	An example of the appropriate usage of the action verb can be found in SR IE-A10 in Part 2 , which states INCLUDE multi-unit site initiators that may impact the model for multi-unit sites with shared systems.
DO NOT INCLUDE		An example of the appropriate usage of the action verb can be found in SR DA-C1 in Part 2 , which states DO NOT INCLUDE generic data for unavailability due to test, maintenance, and repair.

Table 1-A-1 List of Action Verbs (Cont'd)

Action Verb	Relevant Dictionary Meaning	Examples of Usage in This Standard
INTEGRATE	To bring together or incorporate (parts) into a whole	An example of the appropriate usage of the action verb can be found in SR QU-A1 in Part 2 , which states INTEGRATE the accident sequences, system models, data, HRA in the quantification process for each initiating event group, accounting for system dependencies, to arrive at accident sequence frequencies.
INTERVIEW	To have a conversation in order to question, consult, or seek information	An example of the appropriate usage of the action verb can be found in SR IE-A8 in Part 2 , where CC-II states INTERVIEW plant personnel to determine if potential initiating events have been overlooked.
JUSTIFY	To show a satisfactory reason for some action	An example of the appropriate usage of the action verb can be found in SR LE-C9 in Part 2 , where CC-II states JUSTIFY any credit given for equipment survivability or human actions under adverse conditions.
LIMIT	To restrict by establishing criteria	An example of the appropriate usage of the action verb can be found in SR DA-D8 in Part 2 , where CC-I states LIMIT the use of old data if modifications to the plant design or operating practice lead to a condition where past data are no longer representative of current performance.
MODEL	To create a representation of	An example of the appropriate usage of the action verb can be found in SR SY-A8 in Part 2 , which states MODEL, as separate basic events of the model, those subcomponents that are shared by another component or affect another component or affect another component to the dependent failure mode.
MODIFY	To change somewhat the form or qualities of; alter partially	An example of the appropriate usage of the action verb can be found in SR IE-C9 in Part 2 , which states MODIFY, as necessary, the fault-tree computational methods that are used so that the top event quantification produces a failure frequency rather than a top event probability as normally computed.
ORDER	To arrange methodically or suitably	An example of the appropriate usage of the action verb can be found in SR AS-A6 in Part 2 , where CC-I and CC-II state ORDER sequentially the events representing the response of the system and operator actions according to the timing of the event as it occurs in the accident progression.
PERFORM	To carry out; execute; do	An example of the appropriate usage of the action verb can be found in SR IE-A5 in Part 2 , where CC-I and CC-II state PERFORM a systematic evaluation of each system, including support systems, to assess the possibility of an initiating event occurring due to failure of the system.
PLACE	To put in the proper position or order	An example of the appropriate usage of the action verb can be found in SR AS-B4 in Part 2 , which states PLACE Event A to the left of Event B in the ordering of event tops when using event trees with conditional split fraction method.
PROPAGATE	To assess the effect of variables' uncertainties on the uncertainty of a function based on them	PROPAGATE has a specific and special statistical meaning that is not totally captured by the dictionary definition (e.g., "The crack will propagate only to this joint"). When used in this Standard, PROPAGATE is referring to statistical uncertainties. An example of the appropriate usage of the action verb can be found in SR WHA-F2 in Part 7, where CC-II states PROPAGATE the aleatory and epistemic uncertainties that are risk-significant contributors to the HW frequency quantifications.
PROVIDE	To furnish, supply or equip	An example of the appropriate usage of the action verb can be found in SR AS-A6 in Part 2 , which states PROVIDE the rationale used for ordering the events representing the response of the systems and operator actions.
QUANTIFY	To determine, indicate, or express the quantity of	An example of the appropriate usage of the action verb can be found in SR SPR-E5 in Part 5 , where CC-II states QUANTIFY the mean seismic CDF and seismic LERF.
RETAIN	To keep possession of; to continue to use	An example of the appropriate usage of the action verb can be found in SR QU-C3 in Part 2 , which states, when linking event trees, RETAIN the sequence characteristics (e.g., failed equipment, flag settings) that impact the logic or quantification of the subsequent accident development, as well as the sequence frequency.
REVIEW	To go over or examine critically or deliberately	An example of the appropriate usage of the action verb can be found in SR QU-D1 in Part 2 , which states REVIEW a sufficiently large sample of the risk-significant accident sequences/cutsets sufficient to determine that the logic of the cutset or sequence is correct.

Table 1-A-1 List of Action Verbs (Cont'd)

Action Verb	Relevant Dictionary Meaning	Examples of Usage in This Standard
SATISFY	To give assurance to; to answer sufficiently	The use of SATISFY is exclusively directed to fulfilling requirements stipulated elsewhere in this Standard. An example of the appropriate usage of the action verb can be found in SR SY-A22 which refers to the expert judgement by saying SATISFY the requirements of Section 1-4.2, Use of Expert Judgment.
SCREEN OUT	To select, reject, consider, or group (objects, ideas, etc.) by a process of winnowing out	In this Standard, the action verb, SCREEN OUT, is not used.
DO NOT SCREEN OUT		An example of the appropriate usage of the action verb can be found in SR HR-B2 in Part 2 , which states DO NOT SCREEN OUT activities that could simultaneously have an impact on multiple trains of a redundant system or on diverse systems.
SELECT	To choose in preference to another or others; pick out	An example of the appropriate usage of the action verb can be found in SR QU-A4 in Part 2 , which states SELECT a quantification method that is capable of discriminating the contributors to the CDF commensurate with the level of detail in the model.
SPECIFY	To name or state explicitly or in detail	An example of the appropriate usage of the action verb can be found in SR SC-A2 in Part 2 , where CC-I states SPECIFY the plant parameters and associated acceptance criteria to be used in determining core damage.
USE	To employ for some purpose, make use of	An example of the appropriate usage of the action verb can be found in SR IE-B2 in Part 2 , which states USE a structured, systematic process for grouping initiating events.
DO NOT USE		An example of the appropriate usage of the action verb can be found in SR SY-B11 in Part 2 , which states DO NOT USE proceduralized recovery actions as the sole basis for eliminating a support system from the model.

PART 2

REQUIREMENTS FOR

INTERNAL-EVENTS

AT-POWER PRA

Section 2-1

Overview of Internal-Events At-Power PRA Requirements

2-1.1 PRA SCOPE

This Part states the technical requirements for a Level 1 and large early release frequency (LERF) analysis of the internal-events (excluding internal floods and internal fires) hazard group while at-power.

2-1.2 COORDINATION WITH OTHER PARTS OF THIS STANDARD

This Part is intended to be used together with [Part 1](#) of this Standard. In addition, many of the technical requirements in Part 2 are fundamental requirements for performing a PRA for any hazard group and, therefore, are relevant to [Parts 3, 4, 5, 6, 7, 8, and 9](#) of this Standard. They are incorporated by reference in those requirements that address the development of the plant response to the damage states created by the hazard groups addressed in Parts 3 through 9.

(The text presented in [blue font](#) in this Standard comprises hyperlinks to enable efficient access to referenced sections and elements, requirements, notes, references, etc., including hyperlinks to and from HLRs and SRs in the requirements section and appendix.)