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fire PRA methodology

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Foreword

(This Foreword is not a part of the American National Standard, "Fire PRA Methodology," ANSI/ANS-58.23-2007)

This standard sets forth requirements for probabilistic risk assessments (PRAs) and related analysis methodologies involving internal fires (i.e., fires that could occur within the boundaries of a nuclear power plant of causes inherent to the operation of the nuclear power plant) that can be used to support risk-informed decisions for commercial nuclear power plants. This standard also prescribes a method for applying these requirements for specific applications.

This standard is intended to be used together with other PRA standards that cover different aspects of PRA scope. Specifically, this standard is intended to be used directly with the PRA standard developed by the American Society of Mechanical Engineers ["Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME RA-S-2002 up to and including ASME RA-Sb-2005 (hereafter referred to as ASME-RA-2002/RA-Sb-2005)], which covers an Internal Events PRA for a commercial nuclear power plant operating at nominal full power. Similarly, this standard is intended to be used with two other standards: the American Nuclear Society (ANS) PRA-methodology standard covering low-power/shutdown operations (ANS-58.22, under development) and the ANS PRA-methodology standard covering accidents initiated by external events (ANSI/ANS-58.21-2007).

The scope of a PRA covered by this standard is limited to analyzing accident sequences initiated by fires that might occur while a nuclear power plant is at nominal full power. It is further limited to requirements for (a) a Level 1 analysis of the core damage frequency and (b) a limited Level 2 analysis sufficient to evaluate the large early release frequency. The scope of a Fire PRA covered by this standard is commensurate with the scope covered by the Fire PRA method produced by the Electric Power Research Institute (EPRI) and the U.S. Nuclear Regulatory Commission (NRC), jointly published as EPRI TR-1011989 and NUREG/CR-6850.

In contrast, the scope of ASME-RA-2002/RA-Sb-2005 covers internal plant initiators (except internal fires) that might occur while the nuclear power plant is at nominal full power. Accidents initiated by internal flooding are explicitly included in ASME-RA-2002/RA-Sb-2005, as are accidents initiated by a loss of off-site power (LOOP), unless the LOOP is due to a fire as covered herein that also causes other important damage to the plant, in which case analysis of the LOOP is within the scope of this standard. Therefore, this standard, ANSI/ANS-58.21-2007, and ASME-RA-2002/RA-Sb-2005, when used together, cover all potential accident initiators arising at nominal full power. The only initiators explicitly excluded are accidents resulting from purposeful human-induced security threats (e.g., sabotage).

The types of risk-informed PRA applications contemplated under this standard are very broad and include applications related to design, procurement, construction, licensing, operation, and maintenance. Both regulatory risk-informed applications involving the NRC and applications not involving those regulations are contemplated. In this regard, this standard's approach is intended to be identical to that used in the closely related ASME-RA-2002/RA-Sb-2005, so the approach and supporting logic of ASME-RA-2002/RA-Sb-2005 are relied upon heavily in this standard's guidance in this area.

This standard might reference documents and other standards that have been superseded or withdrawn at the time the standard is applied. A statement has

been included in the reference section that provides guidance on the use of references.

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Fire PRA Methodology

1 Introduction

1.1 Scope

This standard[1)] sets forth requirements for fire probabilistic risk assessments (Fire PRAs) used to support risk-informed decisions for commercial light water reactor (LWR) nuclear power plants and prescribes general requirements for Fire PRA practice intended to suit a wide range of applications. This standard covers fires occurring within the plant.[2)] The American National Standard "External-Events PRA Methodology," ANSI/ANS-58.21-2007 [1],[3)] covers fires occurring outside the plant.

1.2 Coordination with other PRA standards

This standard is intended to be used together with other PRA standards that cover different aspects of PRA scope. Specifically, this standard calls on and interfaces with the PRA standard developed by the American Society of Mechanical Engineers (ASME) American National Standard "Probabilistic Risk Assessment for Nuclear Power Plant Applications," ASME RA-S-2002, up to and including ASME RA-Sb-2005 [2] (hereafter referred to as ASME-RA-2002/RA-Sb-2005 [2]), whose scope covers an Internal Events PRA for a commercial nuclear power plant operating at nominal full power. This standard assumes as an entry point for the Fire PRA that an Internal Events PRA for initiators other than fire has been completed and that the PRA has been weighed against the requirements of ASME-RA-2002/RA-Sb-2005 [2]. Therefore, many of the Fire PRA requirements stated here build upon the foundations established by a preexisting Internal Events PRA.[4)]

Similarly, this standard is intended to be used with ANSI/ANS-58.21-2007 [1] and ANS-58.22, "Low Power and Shutdown PRA Methodology" (draft) [3], once completed. However, additions and modifications to the technical requirements of this standard will be necessary and are anticipated in a future revision, to cover Fire PRAs for accidents initiated by fires during low-power/shutdown operation.

Accident sequences that are not associated with fires within the plant are covered by these other interfacing standards. If the analyzed initiator is a result of a fire that is initiated within the plant boundaries, such as a fire-induced loss of off-site power (LOOP), fire-induced reactor trip, etc., or if the event is associated with a consequential fire that complicates plant response (e.g., a turbine blade ejection event or an earthquake that results in a consequential fire), it is intended that the requirements of this standard be followed. If the fire is initiated outside the plant boundaries (e.g., a forest fire or nearby industrial fire), the event would be considered an external event and lies outside the scope of this standard.

1.3 Applicability

The scope of a Fire PRA covered by this standard is limited to analyzing accident sequences associated with fires that might occur while a nuclear power plant is at nominal full power.[5)] It is further limited to requirements for (a) a Level 1 PRA that estimates the core damage frequency (CDF) and (b) a large early release

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[1)] The current standard, ANSI/ANS-58.23-2007, is herein referred to as "this standard."

[2)] Note that the term "fires occurring within the plant" in this context is defined as any fire originating within the global analysis boundary as defined per the plant partitioning technical element.

[3)] Numbers in brackets refer to corresponding numbers in Sec. 7, "References."

[4)] Examples of Fire PRA requirements that build on Internal Events PRA results can be found in various technical elements including, in particular, equipment selection, the Fire PRA plant response model, risk quantification, human reliability analysis, and uncertainty analysis.

[5)] The Fire PRA scope includes accident sequences initiated as a result of fire-induced damage (such as a fire in nonvital equipment that damages electrical cables causing a plant transient). The Fire PRA scope also includes plant accident sequences initiated by general plant equipment failures where a concurrent fire might complicate plant safe shutdown efforts (such as a turbine blade ejection event that causes both a plant transient and a concurrent turbine lube-oil fire).