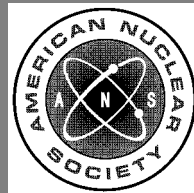


# American Nuclear Society

**non-real-time, high-integrity software for the  
nuclear industry—developer requirements**

**an American National Standard**



published by the  
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**American National Standard  
Non-Real-Time, High-Integrity Software for the  
Nuclear Industry—Developer Requirements**

Secretariat  
**American Nuclear Society**

Prepared by the  
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Working Group ANS-10.7**

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## American National Standard

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Comments on this standard are encouraged and should be sent to Society Headquarters.

Published by

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- (3) the purposes of the inquiry;
- (4) the inquiry stated in a clear, concise manner;
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## Foreword

(This Foreword is not a part of American National Standard “Non-Real-Time, High-Integrity Software for the Nuclear Industry—Developer Requirements,” ANSI/ANS-10.7-2013.)

The purpose of this standard is to provide quality assurance requirements for non-real-time, high-integrity software developed for nuclear industry applications. The standard does not recommend a specific approach to software development but does recommend that quality assurance activities be carried out in parallel with software development. For a specific project, the project sponsor should determine the level of the verification and validation effort to be applied. Compliance with this standard does not automatically guarantee compliance with any other standard.

This standard complements the following ANS-10 standards relating to computer program development:

- ANSI/ANS-10.2-2000 (R2009), “Portability of Scientific and Engineering Software”;
- ANSI/ANS-10.3-1995 (W2005), “Documentation of Computer Software”;
- ANSI/ANS-10.4-2008, “Verification and Validation of Non-Safety-Related Scientific and Engineering Computer Programs for the Nuclear Industry”;
- ANSI/ANS-10.5-2006 (R2011), “Accommodating User Needs in Scientific and Engineering Computer Software Development.”

This standard builds upon NUREG/CR-6263, “High-Integrity Software for Nuclear Power Plants: Candidate Guidelines, Technical Basis and Research Needs,” which was prepared for the U.S. Nuclear Regulatory Commission to assist with development of a technical basis for regulatory positions related to the use of high-integrity software in nuclear power plants. NUREG/CR-6263 was the result of a comprehensive review of the present state of software engineering processes and design attributes. While the focus of that effort was on real-time, high-integrity software, this standard focuses on non-real-time, high-integrity software, such as for design and analysis. Therefore, the requirements of this standard were carefully adapted from the former and new requirements developed and added for model development and validation, which are key aspects of analytical, non-real-time software (computer codes). NUREG/CR 6263 and NUREG/CR-5930, NIST SP 500-204, “High-Integrity Software Standards and Guidelines,” were developed for application to nuclear power plants, and therefore, this standard is primarily applicable to nuclear power plants and other nuclear facilities and operations with similar high consequences and hazards.

In addition, an effort has been made to maintain consistency in terminology and concepts with various software standards being developed under the sponsorship of the Institute of Electrical and Electronics Engineers and to identify areas of disagreement.

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 references section that provides guidance on the use of references.

This standard does not incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard. For example, the software requirements of this standard, which have been developed for high-consequence applications, could be appropriately tailored or graded for applications of lower consequence.

This standard has been written by Working Group ANS-10.7 of the American Nuclear Society's Standards Committee. The membership of this group during the preparation of the final drafts consisted of the following:

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# Non-Real-Time, High-Integrity Software for the Nuclear Industry—Developer Requirements

## 1 Scope and objective

### 1.1 Scope

This standard provides minimum requirements for assurance that high-integrity software developed for use by the nuclear industry meets state-of-the-practice expectations for quality. The requirements in this standard are specified for development of high-integrity software. The intent is to set a minimum level of quality assurance and critical technical process requirements to satisfy due diligence. NUREG/CR 6263 [1],<sup>1)</sup> from which many of the requirements of this standard are derived, was developed for application to nuclear power plants, and this standard is primarily applicable to nuclear power plants and other nuclear facilities and operations with similar high consequences and hazards.

This standard addresses rigorous, systematic development of high-integrity, non-real-time safety analysis, design, and simulation software that includes calculations or simulations requiring high functional reliability in order to avoid undetected errors that could have serious consequences if such errors are not detected (the scope of this standard does not include electronic procedures). It is especially important that this standard be followed in cases where calculations are so complex that typical peer reviews are not likely to identify errors. For complex software, hand calculations and code-to-code comparisons may not be adequate to verify and validate the software. This may include software used for nuclear design and analysis; analysis of postulated accidents and assignment of safety classification levels to systems, structures, and components at nuclear facilities; computational fluid dynamics (CFD); thermal hydraulics; structural mechanics; complex Monte Carlo simula-

tions; radiation dosimetry; and nuclear medical applications.

An important area covered in this standard is model development and verification (including physics validation), which are critically important tasks for high-integrity analysis and simulation software. The requirements in this standard for model development and verification take into consideration several standards for the development of computational models and methods, including ANSI/ASME V&V 10-2006 [2]; AIAA G-077-1998 (2002) [3]; U.S. Nuclear Regulatory Commission (NRC) Standard Review Plan, NUREG-0800, Sec. 15.0.2 [4]; and NRC Regulatory Guide 1.203 [5]. This standard provides the requirements necessary to validate the model by specifying requirements for model development and validation, except that it does not address the actual planning, design, and conduct of validation tests/experiments.

Cybersecurity is another important aspect of high-integrity software and is explicitly addressed in this standard. The requirements in this standard for security requirements were principally derived from NRC Regulatory Guide 1.152 [6].

### 1.2 Objective

The objective of this standard is to identify requirements for software development and verification and validation (V&V), including both software development and assurance activities that will provide high confidence in the correctness and quality of high-integrity, non-real-time software. It does not specify the methods to carry them out, but it does refer to other standards, where appropriate, which are considered adequate to satisfy the need for due diligence in implementing the requirements of this standard.

<sup>1)</sup> Numbers in brackets refer to corresponding numbers in Sec. 18, "References."