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NUCLEAR POWER PLANT SIMULATION FACILITIES FOR USE IN OPERATOR TRAINING AND LICENSE EXAMINATIONS

A. INTRODUCTION

This regulatory guide describes methods acceptable to the NRC staff for complying with those portions of the NRC's regulations associated with approval or acceptance of a simulation facility for use in reactor operator and senior operator training and NRC license examinations.

In 10 CFR Part 55, "Operators' Licenses," Paragraphs 55.45(a) and 55.45(b) require that an applicant for an operator or senior operator license demonstrate both an understanding of and the ability to perform certain essential job tasks. The operating test will be administered in a plant walk-through and on a simulation facility or on the actual plant if approved by the Commission.

A simulation facility as defined in 10 CFR 55.4 means one or more of the following components, alone or in combination, used for the partial conduct of operating tests for operators, senior operators, and license applicants or to establish on-the-job training experience prerequisites for operator license

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This guide was issued after consideration of comments received from the public. Comments and suggestions for improvements in these guides are encouraged at all times, and guides will be revised, as appropriate, to accommodate comments and to reflect new information or experience. Written comments may be submitted to the Rules and Directives Branch, ADM, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001.

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eligibility: (1) a plant-referenced simulator, (2) a Commission-approved simulator in accordance with 10 CFR 55.46(b), or (3) another simulation device, including part-task and limited scope simulation devices approved under 10 CFR 55.46(b).

The requirements for the use of a simulation facility for the administration of the operator licensing operating test are in 10 CFR 55.46, as are the requirements for the use of a plant-referenced simulator for fulfilling a portion of the experience requirements for applicants for operator and senior operator licenses. The requirements for the licensed operator requalification programs, including evaluation, are in 10 CFR 55.59(c)(3) and (4).

The information collections contained in this regulatory guide are covered by the requirements of 10 CFR Part 55, which were approved by the Office of Management and Budget (OMB), approval number 3150-0018. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to the information collection.

B. DISCUSSION

THE ROLE OF SIMULATORS IN OPERATOR LICENSING

Facility licensees are responsible for ensuring that individuals who receive operator or senior operator licenses possess the knowledge, skills, and abilities necessary to operate the facility in a safe manner. In 10 CFR Part 55, Section 55.45, "Operating Tests," requires the applicant for a license to demonstrate (1) an understanding of and the ability to perform the actions necessary during normal, abnormal, and emergency situations; (2) the operation of systems that affect heat removal or reactivity changes; and (3) behaviors that show the individual's ability to function within the control room team in such a way that the facility licensee's procedures are adhered to and that the limitations in its license and amendments are not violated.

The use of a plant-referenced simulator for testing enables the examiner to evaluate a license applicant’s performance in a manner that replicates conditions in the plant for which that applicant has applied for a license. When applicants are tested on plant-referenced simulators, major facility differences are minimized between testing and operating environments, and examiners are able to make pass-fail judgments with confidence.

REGULATORY BACKGROUND

In 1981, the industry developed ANSI/ANS-3.5-1981, “Nuclear Power Plant Simulators for Use in Operator Training.” ANSI/ANS-3.5 has been revised three times: in 1985, 1993, and 1998. Regulatory Guide 1.149 has been revised to endorse successive versions of ANSI/ANS-3.5. Exceptions to previous standards in the area of performance testing were specified in the initial issuance through Revision 2 in 1996 of Regulatory Guide 1.149 to ensure that application of

previous standards would support the requirements of the regulations and be responsive to the NRC's concern that simulator fidelity must be ensured on a continuing basis.

SIMULATOR PERFORMANCE TESTING

The 1981 version of the standard specified a testing regimen that was written in the context of initial simulator procurement. Until the 1998 revision, the primary focus of the standard was the initial design and construction of the simulator, a unique condition in which extensive factory acceptance testing is performed on the basis of individual simulator capabilities before establishing a software configuration baseline. Except for infrequent simulator replacements and modifications, facility licensees' simulators are now in an update and maintenance phase of the simulator life cycle (an area for which previous revisions of the standard were not intended and for which the standard has offered little specific guidance); these simulators therefore do not need to repeat exhaustive full-scope testing. The type of testing described in previous revisions of the standard provides basic assurance that no noticeable differences exist between the simulator control room and simulated systems, when evaluated against the control room and systems of the referenced unit.

The performance testing formerly specified in 10 CFR 55.45 was suited for a capabilities and schedule-based performance testing program. This requirement is difficult to apply to the process of structured software development coupled with the scenario-based testing that is now fully adopted by the 1998 revision of the standard. The software development and performance testing requirements of ANSI/ANS-3.5-1998, "Nuclear Power Plant Simulators for Use in Operator Training and Examination,"[1] although neither prescriptive nor as extensive as those of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, bring the simulation facility into closer conformance with current industry norms and practices for software quality assurance and training program administration than did the 1985 and 1993 revisions of the standard. The NRC staff considers this improved software development and testing philosophy to be consistent with the NRC's intent that the simulation facility's ability to faithfully portray malfunctions and its general operability are to be verified by periodic performance testing.

In the staff's view, verification and validation testing in the software development process, coupled with scenario-based testing in the training and examination preparation processes, provides additional assurance of acceptable simulator performance over that provided by previous simulator capabilities-based, stand-alone testing programs.

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[1] Copies of this standard may be obtained from the American Nuclear Society, 555 N. Kensington Avenue, La Grange Park, IL 60525.

C. REGULATORY POSITION

1. ENDORSEMENT OF ANSI/ANS-3.5-1998

ANSI/ANS-3.5-1998, "Nuclear Power Plant Simulators for Use in Operator Training and Examination," sets forth provisions acceptable to the NRC staff for addressing minimum design, testing, performance, and configuration criteria for a plant-referenced simulator; for integrating simulator design and performance with an accredited training program; for comparing a simulator to its reference plant; for upgrading simulators to reflect changes to reference plant response or control room configuration; and for improving simulator fidelity. ANSI/ANS-3.5-1998 provides methods acceptable to the NRC staff for a facility licensee to demonstrate that, through meeting the criteria of ANSI/ANS-3.5-1998, the plant-referenced simulator will possess a sufficient degree of completeness and accuracy to meet the requirements of 10 CFR Part 55, "Operators' Licenses," for use in reactor operator and senior operator training and NRC license examinations. The following clarifications are applicable to the endorsement of ANSI/ANS-3.5-1998:

1.1 Licensees using a plant-referenced simulator in the conduct of operator licensing examinations after the date of this regulatory guide should meet the applicable requirements of ANSI/ANS-3.5-1998.

1.2 Unless otherwise specifically endorsed by the NRC, other documents referenced in Section 1.2, "Background," of ANSI/ANS-3.5-1998 are not endorsed in this regulatory guide.

1.3 Section 4.4.3, "Simulator Performance Testing," of ANSI/ANS-3.5-1998 requires that a record of the performance test results be maintained, including data comparisons. Section 4.4.3 has a footnote reference to Appendix A, "Guideline for Documentation of Simulator Design and Test Performance," of ANSI/ANS-3.5-1998. Appendix A provides examples that are applicable only to Section 4.4.3.1, "Simulator Operability Testing."

1.4 In regard to Section 4.4.3.2, "Scenario-Based Testing," documentation and performance test results should be consistent with facility licensees' defined objectives of the accredited training program or approved operator licensing operating tests.

1.5 The standard's quality assurance methodology (i.e., verification and validation during software development in a controlled configuration environment with ongoing scenario-based and recurring operability testing) is not expected to be included in the facility's Quality Assurance Program as described in Appendix B to 10 CFR Part 50. Appendix B does not apply to simulation facilities; it applies to nuclear power plants and fuel reprocessing plants, including their structures, systems, and components that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public. Appendix B establishes quality assurance requirements for the design, construction, and operation of those structures, systems, and components.

1.6 Editions of ANSI/ANS-3.5 that were previously endorsed by the NRC remain acceptable methods of meeting the regulations.

2. USE OF A SIMULATOR FOR MULTIPLE PLANTS

If a licensee wishes to use a simulation facility to train or examine operators for more than one nuclear power plant, it must be able to demonstrate to the NRC that the differences between the plants are not so significant that they will result in negative training. This demonstration should include an analysis and summary of the differences between each plant, including:

1. Facility design and systems relevant to control room personnel,
2. Technical specifications,
3. Procedures, primarily abnormal and emergency operating procedures,
4. Control room design and instrument/control location, and
5. Operational characteristics.

3. ACCEPTABILITY OF LICENSEE'S SIMULATION FACILITY

Licensees who maintain simulation facilities certified under editions of ANSI/ANS-3.5 that were previously endorsed by the NRC may, but are not required to, revise their software and testing documentation so that the simulation facility will be maintained in accordance with ANSI/ANS-3.5-1998. The NRC expects that a simulation facility will be maintained in accordance with a single revision of the standard.

4. SCHEDULING OF PERFORMANCE TESTING

The scheduling and evaluation of simulation facility testing under ANSI/ANS-3.5-1998 are set forth in Section 4.4.3. of the standard and are considered a function of the facility licensee's accredited training program.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees about the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant or facility licensee proposes an acceptable alternative method for complying with the specified portions of the NRC's regulations, the methods described in this guide will be used in the evaluation of the implementation of a facility licensee's simulation facility.

REGULATORY ANALYSIS

A separate Regulatory Analysis has not been prepared for this regulatory guide. A Regulatory Analysis was prepared for the recent amendments to 10 CFR Part 55; this Regulatory Analysis applies to Revision 3 of Regulatory Guide 1.149. A copy of the Regulatory Analysis is available for inspection and copying for a fee at the NRC Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301)415-4737 or toll-free 1-800-397-4209, fax (301)4153548; email PDR@NRC.GOV. Electronic copies of the Regulatory Analysis are available in NRC's Public Electronic Reading Room, which can be accessed through the NRC's web site, <WWW.NRC.GOV> .