



U.S. NUCLEAR REGULATORY COMMISSION

# REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

## REGULATORY GUIDE 1.118 PERIODIC TESTING OF ELECTRIC POWER AND PROTECTION SYSTEMS

### A. INTRODUCTION

Section 50.55a, "Codes and Standards," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires in paragraph (h) that protection systems meet the requirements set forth in the Institute of Electrical and Electronics Engineers' Standard, "Criteria for Protection Systems for Nuclear Power Generating Stations" (IEEE 279).<sup>1</sup> Section 4.9 of IEEE Std 279-1971 (also designated ANSI N42.7-1972) requires, in part, that means be provided for checking the operational availability of each protection system input sensor during reactor operation and includes examples of how this can be accomplished. Section 4.10 of IEEE Std 279-1971 requires, in part, that capability be provided for testing and calibrating protection system equipment other than sensors and indicates when such equipment must be tested during reactor operation. General Design Criterion 21, "Protection System Reliability and Testability," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires, in part, that the protection system be designed to permit its periodic testing during reactor operation, including a capability to test channels independently to determine failures and losses of redundancy that may have occurred. General Design Criterion 18, "Inspection and Testing of Electric Power Systems," requires, in part, that electric power systems important to safety be designed to permit periodic testing, including performance of the components of the system and the system as a whole. The testing should be carried out under conditions as close to design as practical and should involve the full operational sequence, including operation of portions of the protection system,

as well as transfer of power among the nuclear power unit, the offsite power system, and the onsite power system. Criterion XI, "Test Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires, in part, that a test program be established to ensure that all testing, including operational testing required to demonstrate that systems and components will perform satisfactorily in service, is identified and performed.

This guide describes a method acceptable to the NRC staff of complying with the Commission's regulations with respect to the periodic testing of the protection system and electric power systems for systems important to safety.<sup>2</sup> It also provides supplementary guidance to that included in Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants," regarding the periodic testing of electric power systems.

This revision of Regulatory Guide 1.118 has been prepared to account for changes made between the 1975 version of the standard, IEEE Std 338-1975, "Criteria for the Periodic Testing of Class 1E Power and Protection Systems," and the 1977 version, IEEE Std 338-1977, "Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems."

The scope and technical content of this revision of Regulatory Guide 1.118 are the same as those of Revision 1 of Regulatory Guide 1.118, dated November 1977. The guide has been changed to account for the changes in IEEE Std 338 between the 1975 and 1977 versions.

<sup>1</sup> Copies may be obtained from the Institute of Electrical and Electronics Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

<sup>2</sup> Systems important to safety are defined in Regulatory Guide 1.105, "Instrument Setpoints."

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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. This guide was revised as a result of substantive comments received from the public and additional staff review.

Comments should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch.

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The Advisory Committee on Reactor Safeguards was consulted concerning Revision 1 of this guide and concurred in the regulatory positions thereof. These editorial changes have not been reviewed by that committee.

## B. DISCUSSION

IEEE Std 338-1977, "Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems," was prepared by Subcommittee 3, Operations, Surveillance and Testing, of the IEEE Nuclear Power Engineering Committee (NPEC). IEEE Std 338-1977 was subsequently approved by NPEC on March 30, 1977, and by the IEEE Standards Committee on June 2, 1977.

IEEE Std 338-1977 is ancillary to IEEE Std 279-1971 and IEEE Std 308-1974 with regard to the criteria, requirements, and recommendations for the development of periodic testing programs for electric power and protection systems in commercial nuclear power plants. The requirements are indicated by the verbs "shall" and "must" and the recommendations are indicated by the verb "should."

## C. REGULATORY POSITION

The requirements and recommendations contained in IEEE Std 338-1977 are considered acceptable methods for the periodic testing of electric power and protection systems, subject to the following:

1. The term "safety system" is used in IEEE Std 338-1977 in many places. For the purposes of this guide, "safety system" should be understood to mean, collectively, the electric, instrumentation, and controls portions of the protection system; the protective action system; and auxiliary or supporting features that must be operable for the protection system and protective action system to perform their safety-related functions.

2. Item (6) of Section 5 of IEEE Std 338-1977 lists alternative means of including the actuated equipment in the periodic testing of protection system equipment. The method in which actuated equipment is simultaneously tested with the associated protection system equipment is preferred by the NRC staff; however, overlap testing is acceptable. In addition to the requirements of item (2) in Section 6.1, complete systems tests should be performed at suitable intervals.

3. Item (11) of Section 5 of IEEE Std 338-1977 should be supplemented by the following:

"Where perturbing the monitored variable is not practical, the proposed substitute tests shall be shown to be adequate."

4. Section 5 of IEEE Std 338-1977 should be supplemented by the following:

"(13) Means shall be included in the design to prevent the expansion of any bypass condition to

redundant channels or load groups during testing operations. Where simulated signals are used to test protective channels or load groups or in other cases where such equipment can be effectively bypassed during a test, care shall be exercised to ensure that more channels are not bypassed than are necessary to perform the test. The remaining channels (those not bypassed) shall provide that safety function consistent with the provisions of item (4) in Section 5 of IEEE Std 338-1977."

"(14) Where redundant components are used within a single channel or load group, the design shall permit each to be tested independently."

5. Section 6.3.4 of IEEE Std 338-1977 should be supplemented by the following:

"For neutron detectors (1) tests of detector-cable assemblies for increased capacitance, (2) monitoring of noise characteristics of neutron detector signals, or (3) some other test that does not require removal of detectors from their installed location should be used to confirm neutron detector response time characteristics to avoid undue radiation exposure of plant personnel unless such tests are not capable of detecting response time changes beyond acceptable limits."

6. Section 6.4(5) of IEEE Std 338-1977 should be supplemented by the following:

"... makeshift test setups except as follows:

"a. Temporary jumper wires may be used with portable test equipment where the safety system equipment to be tested is provided with facilities specifically designed for connection of this test equipment. These facilities shall be considered part of the safety system and shall meet all the requirements of this standard, whether the portable test equipment is disconnected or remains connected to these facilities.

"b. Removal of fuses or opening a breaker is permitted only if such action causes (1) the trip of the associated protection system channel, or (2) the actuation (startup and operation) of the associated Class 1E load group."

7. In addition to items (1) through (7) of Section 6.5.1 of IEEE Std 338-1977, the ability to detect significant changes in failure rates should be considered in the selection of initial test intervals.

8. The following provisions of IEEE Std 338-1977 have been added in the 1977 version of this standard. These provisions will be considered by the NRC staff and endorsed or supplemented in a future revision of this regulatory guide.

a. Section 4, eighth paragraph, now excludes the process to sensor coupling and the actuated equipment to process coupling from response time testing required by the standard.

b. Section 5, first paragraph, items (2) and (3)

now allow tripping of the channel being tested, or bypass of the equipment consistent with availability requirements, during test of redundant channels or load groups.

c. Section 6.6.2, item (8) now only requires listing of anticipated responses in test procedures "when required as a precautionary measure."

#### **D. IMPLEMENTATION**

The purpose of this section is to provide informa-

tion to applicants regarding the NRC staff's plans for using this regulatory guide.

This guide reflects current NRC staff practice. Therefore, except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein is being and will continue to be used in the evaluation of submittals in connection with construction permit applications until this guide is revised as a result of suggestions from the public or additional staff review.