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U.S. ATOMIC ENERGY COMMISSION

# REGULATORY GUIDE

DIRECTORATE OF REGULATORY STANDARDS

## REGULATORY GUIDE 1.53

### APPLICATION OF THE SINGLE-FAILURE CRITERION TO NUCLEAR POWER PLANT PROTECTION SYSTEMS

#### A. INTRODUCTION

Section 50.55a, "Codes and Standards," of 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that protection systems meet the requirements set forth in the Institute of Electrical and Electronics Engineers Criteria for Nuclear Power Plant Protection Systems (IEEE-279). Section 4.2 of IEEE Std 279-1971 (also designated ANSI N42.7-1972) requires that any single failure within the protection system shall not prevent proper protective action at the system level when required. This guide describes an acceptable method of complying with the Commission's requirements with respect to satisfying the single-failure criterion. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

#### B. DISCUSSION

IEEE Std 379-1972 (also designated ANSI N41.2), "IEEE Trial-Use Guide for the Application of the Single-Failure Criterion to Nuclear Power Generating Station Protection Systems,"<sup>1</sup> was prepared by Subcommittee 1 of the Joint Committee on Nuclear Power Standards of the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and subsequently approved by the IEEE Standards Committee on June 22, 1972. It is a trial-use guide that provides guidance for applying the single-failure criterion to the design and analysis of nuclear power plant protection systems.

It is recognized that IEEE Std 379-1972 has been published only for trial use and as a draft American National Standard. As experience is obtained in its use,

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

the standard may be modified to improve its usefulness by deleting provisions which prove to be unacceptable or by appropriately supplementing those provisions in which inadequacies are found.

#### C. REGULATORY POSITION

The guidance in trial-use IEEE Std 379-1972 for applying the single-failure criterion to the design and analysis of nuclear power plant protection systems is generally acceptable and provides an adequate interim<sup>2</sup> basis for complying with Section 4.2 of IEEE Std 279-1971, subject to the following:

1. Because of the trial-use status of IEEE Std 379-1972, it may be necessary in specific instances to depart from one or more of its provisions.

2. Section 5.2 of IEEE Std 379-1972 should be supplemented as follows:

"The detectability of a single failure is predicated on the assumption that the test results in the presence of a failure are different from the results that would be obtained if no failure is present. Thus, inconclusive testing procedures such as "continuity checks" of relay circuit coils in lieu of relay operations should not be considered as adequate bases to classify as detectable all potential failures which could negate the functional capability of the tested device."

3. Section 6.2 of IEEE Std 379-1972 should be supplemented as follows:

"Where a single mode switch supplies signals to redundant channels, it should be considered that the

<sup>2</sup>Pending issuance of non-trial-use standards on this subject which are acceptable to the AEC.

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single-failure criterion will not be satisfied if either (a) individual switch sections supply signals to redundant channels, or (b) redundant circuits controlled by the switch are separated by less than six inches without suitable barriers.”

4. Section 6.3 and 6.4 of IEEE Std 379-1972 should be interpreted as not permitting separate failure mode analyses for the protection system logic and the actuator

system. The collective protection system logic-actuator system should be analyzed for single-failure modes which, though not negating the functional capability of either portion, act to disable the complete protective function. [An example of such a potential failure mode is a misapplication of Regulatory Guide 1.6 (Safety Guide 6) wherein a single d-c source supplies control power for one channel of protection system logic and for the redundant actuator circuit.]