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auxiliary feedwater system for pressurized water reactors

an American National Standard

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American National Standard for Auxiliary Feedwater System for Pressurized Water Reactors

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American Nuclear Society

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Working Group ANS-51.10

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Foreword

(This Foreword is not a part of American National Standard for Auxiliary Feedwater System for Pressurized Water Reactors, ANSI/ANS-51.10-1979.)

ANS-51, the PWR management group for ANS-50, Power Reactor Systems Subcommittee, formed working group ANS-51.10 to develop a standard for auxiliary feedwater systems because of the safety importance of these systems to pressurized water reactor plants. This standard sets forth design bases, performance requirements, design criteria, testing requirements, and interfaces for the safety-related portion of the auxiliary feedwater system. ANS-51.10 began work on the standard in 1975.

The requirement for diversity of power sources for the pumps - that one power source be independent of AC power - received a great deal of attention. The concern was that this requirement could become a generic one applicable to all safety-related systems. A probabilistic argument can be made to justify the applicability of this requirement to the auxiliary feedwater system which is required during the initial stages of any shutdown and the non-applicability of this requirement to other safety-related systems which are not required for the loss of all AC power. It became apparent that it would be difficult to obtain approval of the standard with this rationale included. Therefore, the requirement is given with no rationale but with a footnote pointing out that this is an NRC regulatory position.

The requirement is included that the system be capable of operating for two hours with the loss of all AC power. The working group feels that this requirement can be justified based on the low probability of losing offsite power and both diesel generators for longer than two hours. Again, no rationale is included in the standard.

The standard does allow a two-pump safety-related auxiliary feedwater system. However, if two safety-related pumps are used then a third non-safety-related pump must be provided for use during startup, hot standby, and shutdown in order to meet the NRC postion on high energy line breaks.

The requirements of ANS-51.4, "Criteria for Safety-Related Operator Actions," were used to develop the instrumentation and control requirements of this standard. References to the trial use draft of this proposed standard can be found in Appendix A.

The membership of Working Group ANS-51.10 of the Standards Committee of the American Nuclear Society during its development of this document was:

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The membership of N18, Nuclear Power Plant Design, in July 1978, at the time of its ballot, on this document, was:

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Contents

Auxiliary Feedwater System for Pressurized Water Reactors

1. Introduction and Scope

1.1 Scope. This standard sets forth design bases, performance requirements, design criteria, testing requirements, and interfaces for the safety-related portion of the auxiliary feedwater system (AFS) of pressurized-water reactor (PRW) plants.

1.2 Limits of Application. This standard applies to the safety-related portion of the AFS and its instrumentation and controls, source of power, water supply, and support systems.

1.3 System Safety Functions

1.3.1 Operation During Condition I Occurrences.[1] The AFS may operate during the following Condition I occurrences:

(A) Startup

(B) Shutdown

(C) Hot Standby

(D) Operation with specific items of equipment out of service or under tests as may be permitted by the technical specifications for the plant.

Condition I, II, III, and IV occurrences are defined in American National Standard N18.2-1973 (ANS-51.1), Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants, and its revision and addendum, N18.2a-1975 (ANS-51.8). [1][2]

1.3.2 Required Operation During Condition II Occurrences. The AFS is required to operate during the following Condition II occurrence with or without concurrent loss of offsite power:

Loss of normal feedwater.

1.3.3 Required Operation During Condition III Occurrences. The AFS is required to operate during the following Condition III occurrences with or without concurrent loss of offsite power:

(A) Loss of reactor coolant, such as from a small ruptured pipe or from a crack in a large pipe, which would prevent orderly reactor shutdown and cooldown.

(B) Secondary system pipe break which would prevent orderly reactor shutdown and cooldown.

1.3.4 Required Operation During Condition IV Occurrences. The AFS may be required to operate during the following Condition IV occurrence with or without concurrent loss of offsite power:

Major rupture of a pipe containing reactor coolant up to and including double-ended rupture of the largest pipe in the reactor coolant pressure boundary.

The AFS is required to operate during the following Condition IV occurrence with or without concurrent loss of offsite power:

Major secondary system pipe rupture up to and including double-ended rupture.

1.4 Appendices

Appendices A and B are nonmandatory and are included to provide additional clarity.

2. Definitions

In this standard the following definitions shall apply:

active failure. A malfunction, excluding passive failures, of a component which relies on mechanical movement to complete its intended function upon demand. Spurious action of a powered component originating within its actuation system shall be regarded as an active failure unless specific design features or administrative controls preclude such spurious action.

alternate source. A source of water which, when combined with the primary source, has sufficient capacity to allow maintaining hot shutdown conditions for a minimum period of

[1] This paragraph was added for clarity and does not imply any safety function.

[2] Numbers in brackets refer to corresponding numbers in Section 5, References.