



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

NEW

Section 7.9. Data Communication Systems

Review Responsibilities

Primary — Instrumentation and Controls Branch (HICB)

Secondary — None

I. Areas of Review

This SRP section describes the review process and acceptance criteria for data communication systems (DCSs) that are part of or support the systems described in Sections 7.2 through 7.8 of the applicant's safety analysis report (SAR). The scope and depth of the review and the acceptance criteria will vary according to the importance to safety of the system that the DCS is supporting.

The objectives of the review are to confirm that DCSs (1) conform to applicable acceptance criteria and guidelines, (2) will perform the safety functions assigned to them, (3) will meet the reliability and availability goals assumed for the system, and (4) will tolerate the effects of random transmission failures. A particular concern is that the transmission of multiple signals over a single path may constitute a single point of failure that may have a larger impact on plant safety than would occur in previous analog systems.

DCSs may include multiplexers and more general communication systems. The distinction between multiplexers and more general data communication systems is often blurred. For the purposes of this section, a multiplexer is equipment that transmits (or receives) or connects in turn several different signals over an electrical conductor or optical-fiber medium on a fixed schedule or rotation. Internal computer buses are specifically excluded from the definition of DCSs used in this section. Multiplexers may be analog or digital.

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

More generally, a data communication system transmits one or more signals on one or more electrical or optical media according to some analog or digital encoding. The schedule for transmission of the various signals may not be fixed, and particular signals or data may be transmitted at unpredictable intervals. Communications via media other than electrical conductors or optical fiber are not addressed by Section 7.9.

The review described in this section includes communication between systems and communication between computers within a system. This section addresses both safety and non-safety communication systems.

SRP Section 7.0 describes the coordination of reviews, including the information to be reviewed and the scope required for each of the different types of applications that the Office of Nuclear Reactor Regulation (NRR) may review. Refer to that section for information regarding how the areas of review are affected by the type of application under consideration and for a description of coordination between HICB and other branches.

II. Acceptance Criteria

Acceptance criteria for DCSs derive from the acceptance criteria for the system(s) supported by the DCS. The acceptance criteria for a specific DCS are the union of those criteria applicable to the systems supported by that DCS. These criteria are summarized below. A given plant design may contain more than one DCS. In this case, the criteria applicable to each DCS may be different. These acceptance criteria are summarized in the following tables:

1. Acceptance criteria applicable to any DCS

10 CFR 50.55a(a)(1), "Quality Standards for Systems Important to Safety."

10 CFR 50.55a(h), "Protection Systems," requires compliance with ANSI/IEEE Std 279, "Criteria for Protection Systems for Nuclear Power Generating Stations." The only requirement from ANSI/IEEE 279 that is applicable to all DCS is item 4.7.2, "Isolation Devices."

General Design Criteria 1, "Quality Standards and Records."

General Design Criterion 24, "Separation of Protection and Control Systems."

2. Acceptance criteria applicable to all DCSs proposed for design certification under 10 CFR 52, in addition to those listed in item 1 above

10 CFR 52.47(a)(1)(iv), "Resolution of Unresolved and Generic Safety Issues."

10 CFR 52.47(a)(1)(vi), "ITAAC in Design Certification Applications."

10 CFR 52.47(a)(1)(vii), "Interface Requirements."

10 CFR 52.42(a)(2), "Level of Detail."

10 CFR 52.47(b)(2)(i), "Innovative Means of Accomplishing Safety Functions."

3. Acceptance criteria applicable to all DCSs proposed as part of combined license applications under 10 CFR 52, in addition to those listed in item 1 above

10 CFR 52.79(c), "ITAAC in Combined Operating License Applications."

4. Acceptance criteria applicable to all DCSs that support protection system functions (reactor trip system (RTS) — Section 7.2 or engineered safety features actuation system (ESFAS) — Section 7.3), in addition to those listed in item 1 above

10 CFR 50.34(f)(2)(v), "Automatic Indication of Bypassed and Inoperable Status of Safety System Equipment."

10 CFR 50.55a(h), "Protection Systems," which requires compliance with ANSI/IEEE Std 279.

General Design Criterion 2, "Design Basis for Protection Against Natural Phenomena."

General Design Criterion 4, "Environmental and Missile Design Basis."

General Design Criterion 21, "Protection System Reliability and Testability."

General Design Criterion 22, "Protection System Independence."

General Design Criterion 23, "Protection System Failure Modes."

General Design Criterion 29, "Protection Against Anticipated Operational Occurrences."

Item II.Q, "Defense Against Common-Mode Failures in Digital Instrument and Control Systems," of the Staff Requirements Memorandum on SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs."

5. Acceptance criteria applicable to all DCSs that support these functions: safe shutdown systems (Section 7.4), information systems important to safety (Section 7.5), or interlock systems important to safety (Section 7.6), in addition to those listed in item 1 above

General Design Criterion 2, "Design Basis for Protection Against Natural Phenomena."

General Design Criterion 4, "Environmental and Missile Design Basis."

General Design Criterion 13, "Instrumentation and Control."

General Design Criterion 19, "Control Room."

Item II.T, "Control Room Annunciator (Alarm) Reliability," of the Staff Requirements Memorandum on SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs."

6. Acceptance criteria applicable to all DCSs that support control system functions (Section 7.7), in addition to those listed in item 1 above

General Design Criterion 13, "Instrumentation and Control."

General Design Criterion 19, "Control Room."

7. Acceptance criteria applicable to all DCSs that support diverse instrumentation and control (I&C) systems functions (Section 7.8), in addition to those listed in item 1 above

10 CFR 50.62, "Requirements for the Reduction of Risk from Anticipated Transients without Scram."

General Design Criterion 13, "Instrumentation and Control."

General Design Criterion 19, "Control Room."

Item II.Q, "Defense Against Common-Mode Failures in Digital Instrument and Control Systems," of the Staff Requirements Memorandum on SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs."

Section 7.1, Table 7-1, and Appendix 7.1-A list 10 CFR requirements, industry-endorsed standards, regulatory guides, and branch technical positions that provide information, recommendations, and guidance that describe a basis acceptable to the NRC staff. This basis may be used to implement the relevant requirements of NRC's regulations identified above.

III. Review Procedures

The review procedures of Section 7.1 describe the general procedures to be followed in reviewing any I&C system. Procedures for reviewing each acceptance criterion of 10 CFR 50 and 10 CFR 52 are provided in Appendix 7.1-A. Therefore, review procedures specific to any given DCS can be synthesized from Appendix 7.1-A. Note that while compliance with ANSI/IEEE Std 279, "Criteria for Protection Systems for Nuclear Power Generating Stations," is required only for protection systems, the criteria of ANSI/IEEE 279 and Reg. Guide 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety Systems," address considerations that may be used as guidance, where appropriate, for reviewing any DCS application.

This part of Section 7.9 highlights specific topics that should be emphasized in the DCS review. NUREG/CR-6082, "Data Communications," discusses data communication technology, the technical rationale for review issues specific to data communication, and includes background information to assist the reviewer in identifying critical technical features.

Major design considerations that should be emphasized in the review of all DCS are identified below.

- Quality of components and modules — See Appendix 7.1-B item 4 or Appendix 7.1-C item 8.
- DCS software quality — See BTP HICB-14.
- Performance — The review should verify that the protocol selected for the DCS meets the performance requirements of all supported systems. The real-time performance should be reviewed with BTP

HICB-21. This should include verification that DCS safety system timing is deterministic. Time delays within the DCS and measurement inaccuracies introduced by the DCS should be considered when reviewing the instrumentation setpoints (refer to Draft Reg. Guide DG-1045, the proposed revision 3 to Reg. Guide 1.105, "Instrument Setpoints for Safety Systems," and BTP HICB-12). Data rates, data bandwidths, and data precision requirements for normal and off-normal operation should be reviewed. The error performance should be specified. Vendor test data and in-situ test results should be reviewed to verify the performance. The interfaces with other DCSs or other parts of the I&C system should be reviewed to verify compatibility.

- Reliability — The potential hazards to the DCS and from the DCS should be reviewed. Unneeded but included DCS functions should be reviewed to ensure that they cannot be inadvertently activated and thereby prevent operation of the safety functions. The effects of error recovery should be reviewed. The reviewer should determine that the operating history of the DCS in similar applications is known and that it has been satisfactory. The reviewer should verify the existence and quality of maintenance and operator documentation and ensure that appropriate training has been or will be performed. The review should verify that any DCS safety system is deterministic. The DCS should be designed to support self-testing and surveillance testing (refer to BTP HICB-17).
- Control of access — The review should confirm that the DCS does not present an electronic path by which unauthorized personnel can change plant software or display erroneous plant status information to the operators. If computers or equipment outside of the control of the plant staff may be connected to the DCS (e.g., connections to remote data displays off-site) the connections should be through gateways that prevent unauthorized transactions originating from off-site. Such connections should be one-way communication paths as discussed in Annex G of IEEE Std 7-4.3.2, "IEEE Standard for Digital Computers in Safety Systems of Nuclear Power Generating Stations."

Additional major design considerations that should be emphasized in the review of DCS safety systems are identified below.

- Single-failure criterion — See Appendix 7.1-B item 3 or Appendix 7.1-C item 6. The use of DCSs as single paths for multiple signals or data raises particular concerns regarding extensive consequential failures as the result of a single failure. This review should confirm that channel assignments to individual communication subsystems are appropriate to ensure that both redundancy and diversity requirements (refer to BTP HICB-19) within the supported systems are met. NUREG/CR-6082 provides additional discussion of independence and failure modes.
- Independence — See Appendix 7.1-B items 7 and 8 or Appendix 7.1-C items 11 and 24.
- Failure modes — See Appendix 7.1-A item 2.i. RTS and ESFAS functions of the DCS should be reviewed to determine whether the selected protection system design strategy (fail-safe or fail-as-is) is carried through consistently from detection of DCS failures to final actuation devices. With regard to power supply requirements, the RTS functions of the DCS should be designed such that failure of a DCS power supply will result in reactor trip for that redundant protective channel (fail-safe design). The design of ESFAS functions of the DCS should ensure that failure of a DCS power supply will result in failure as-is of the related actuation channel (fail-as-is design) unless it is determined by analysis that a more appropriate strategy for the safety function in question is fail-safe.
- System testing and inoperable surveillance — See Appendix 7.1-B items 10 and 11 or Appendix 7.1-C items 12 and 27. Insofar as bypass or deliberate inoperability of a DCS may induce the same condition

upon the system of which it is a part, the review should confirm that the bypassed and inoperable indications for DCSs are consistent with those of the systems of which they are parts.

- EMI/RFI susceptibility — See Appendix 7.1-B item 5 or Appendix 7.1-C item 9. The review should confirm that data communication media do not present a fault propagation path for environmental effects, such as high-energy electrical faults or lightning, from one redundant portion of a system to another or from another system to a safety system. Fiber optics typically offer resistance to such effects, but have other attributes that prevent universal acceptability. For example, if the fiber-optic medium may be subject to radiation, fiber that does not become opaque or brittle under irradiation should be specified, or there should be a defined replacement schedule. NUREG/CR-6082 compares the qualities of optical and conductive media and provides guidance regarding environmental and performance criteria.
- Defense-in-depth and diversity (D-in-D&D) analysis — If one or more DCSs are parts of systems (RTS, ESFAS, anticipated transient without scram (ATWS), diverse I&C) for which a D-in-D&D analysis is required, the analysis should be performed by the applicant and the vulnerabilities to common-mode failure of all similar DCSs should be evaluated. Based upon the credibility of postulated failures, potential consequences, availability of diverse preventive or mitigatory responses, and the NRC's diversity requirements (see the Staff Requirements Memorandum (SRM) "SECY-93-087 — Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs"), the reviewer should determine that the design, including DCSs, has sufficient defense-in-depth and diversity. See BTP HICB-19 for guidance on reviewing D-in-D&D analyses.
- DCSs exposed to seismic hazard — The reviewer should determine whether the subject DCS equipment is located in seismic Category I structures. In certain designs, some connected data communication or multiplexer equipment may be located in non-seismic Category I structures. For these cases, the reviewer must assure that simultaneous seismic destruction or perturbation of the exposed equipment does not simultaneously render redundant DCSs ineffective.

It may be the reviewer's judgment that, for a specific case under review, emphasis should be placed on specific aspects of the design, while other aspects of the design need not receive the same emphasis and in-depth review. Typical reasons for such a non-uniform placement of emphasis are the introduction of new DCS designs, or the utilization in the design of DCSs previously found acceptable in similar circumstances. However, in all cases, the review must be sufficient to conclude conformance to the requirements of the NRC's regulations.

IV. Evaluation Findings

The Staff verifies that sufficient information has been provided and the review supports the following conclusions as stated in the SER. For any particular system, the evaluation findings should include the union of those findings below that are applicable to the system under review.

Evaluation findings applicable to any DCS:

The Staff conducted a review of these systems for conformance to the guidelines in the regulatory guides and industry codes and standards applicable to these systems. The Staff concluded that the applicant/licensee adequately identified the guidelines applicable to these systems. Based upon the review of the system design for conformance to the guidelines, the Staff finds that there is reasonable assurance that the systems fully conform to the guidelines applicable to these systems.

Therefore, the Staff finds that the requirements of GDC 1 and 10 CFR 50.55a(a)(1) have been met.

Additional evaluation findings applicable to all DCSs proposed in applications under 10 CFR 52:

The DCS design appropriately addresses the applicable unresolved and generic safety issues. Therefore, the Staff finds that the DCS satisfies the requirements of 10 CFR 52.47(a)(1)(iv).

The application for design certification does not seek certification for the following portions of the DCS [insert list]. Based upon review of the completed safety analysis and DCS, the Staff finds that the requirements for these portions of the design were sufficiently detailed. Therefore, the Staff finds that the design of the DCS satisfies the requirements of 10 CFR 52.47(a)(1)(vii).

The review of the DCS examined the proposed inspections, tests, analyses, and acceptance criteria (ITAAC). Based upon the review and coordination with those having primary responsibility for ITAAC, the Staff concludes that if the inspections, tests, and analyses are performed and the acceptance criteria met, the plant will operate in accordance with the (design certification OR combined license). Therefore, the Staff finds that the DCS satisfies the requirements of (10 CFR 52.47(a)(1)(vi) OR 10 CFR 52.79(c)).

The DCS contains the following elements which differ significantly from evolutionary changes in light water reactor designs of plants which have been licensed in commercial operation before April 18, 1989. [Insert list.] Based upon the review of [analysis OR test programs OR operating experience], the Staff concludes that the performance of these features has been demonstrated; interdependent effects among the safety features are acceptable; sufficient data exist to assess the analytical tools used for safety analysis; and the scope of the design is complete except for site-specific elements. Therefore, the Staff finds that the DCS satisfies the requirements of 10 CFR 52.47(b)(2)(i).

Based upon an initial review of the scope and content of the material submitted by the applicant, and completed review with respect to the technical items above, the Staff finds that the application contains appropriate detail about the DCS design to satisfy the requirements of 10 CFR 52.47(a)(2).

Additional evaluation findings applicable to all DCSs that support protection system functions (RTS — Section 7.2 or ESFAS — Section 7.3):

The review included the identification of those systems and components for the DCS which are designed to survive the effects of earthquakes, other natural phenomena, abnormal environments, and missiles. Based upon the review, the Staff concludes that the applicant/licensee has identified those systems and components consistent with the design bases for those systems. Sections 3.10 and 3.11 of the SER address the qualification programs to demonstrate the capability of these systems and components to survive these events. Therefore, the Staff finds that the identification of these systems and components satisfies the requirements of GDC 2 and 4.

Based on the review of system functions, the Staff concludes that the DCS conforms to the design basis requirements of IEEE Std 279 and 10 CFR 50.34(f). Setpoint analyses account for measurement inaccuracies attributable to the DCS in accordance with the guidance of Draft Reg. Guide 1.105. The Staff concludes that the DCS adequately supports RTS and ESFAS functions as necessary to sense accident conditions and anticipated operational occurrences in order to initiate protective actions consistent with the accident analysis presented in Chapter 15 of the SAR and evaluated in the SER. Therefore, the Staff finds that the DCS appropriately supports RTS and ESFAS compliance with the requirements of GDC 20.

The DCS conforms to the guidelines for periodic testing in Reg. Guide 1.22 and Reg. Guide 1.118. The bypassed and inoperable status indication conforms to the guidelines of Reg. Guide 1.47. The DCS conforms to the guidelines on the application for the single-failure criterion in IEEE Std 379 as supplemented by Reg. Guide 1.53. Based on the review, the Staff concludes that the DCS satisfies the requirement of IEEE Std 279 with regard to the system reliability and testability. Therefore, the Staff finds that the DCS satisfies these requirements of GDC 21.

Based on the review of software development plans and the inspections of the computer development process and design outputs, the Staff concludes that the computer systems conform to the guidance of Reg. Guide 1.152. Therefore, the special characteristics of computer systems have been adequately addressed, and the Staff finds that the DCS satisfies these requirements of GDC 21.

DCS functions were included in the Staff's review of defense-in-depth and diversity analysis for RTS and ESFAS. Based upon this review, the Staff concludes that the protection systems, including the DCS functions, comply with the criteria for defense against common-mode failure in digital I&C systems. Therefore, the Staff finds that adequate diversity and defense against common-mode failure has been provided to satisfy the diversity requirements of GDC 22 and the Staff Requirements Memorandum on SECY-93-087, item II.Q.

The staff has reviewed EMI/RFI susceptibility and seismically exposed portions of the DCS. Based upon this review and the finding that the requirements of GDC 2 are satisfied, the staff concludes that the DCS satisfies the requirement for independence from the effects of natural phenomena. The DCS conforms to the guidelines in Reg. Guide 1.75 for protection system independence. Based on the review of system independence and separation, the Staff concludes that the DCS satisfies the requirement of IEEE Std 279 or IEEE Std 603 with regard to systems independence. Therefore, the Staff finds that the DCS satisfies the requirements of GDC 22.

DCS failure modes were accounted for in the failure modes and effects analysis for the RTS and ESFAS. Based upon the Staff's review of these analyses, the Staff concludes that the protection systems, including the DCS, are designed to fail into a safe mode if a condition such as disconnection of the system, loss of energy, or postulated adverse environment is experienced. Therefore, the Staff finds that the DCS satisfies the requirements of GDC 23.

Based on the review of the interfaces between the DCS and plant operating control systems, the Staff concludes that the system satisfies the requirements of IEEE Std 279 or IEEE Std 603 with regard to control and protection system interactions. Therefore, the Staff finds that the DCS satisfies the requirements of GDC 24.

Based on the review of all the above, the Staff concludes that the DCS satisfies the requirements of GDC 29.

The Staff's conclusions noted above are based upon the requirements of IEEE Std 279 or IEEE Std 603 with respect to the design of the DCS. Therefore, the Staff finds that the DCS satisfies the requirement of 10 CFR 50.55a(h) with regard to IEEE Std 279.

Additional evaluation findings applicable to all DCSs that support the following functions: safe shutdown systems (Section 7.4), information systems important to safety (Section 7.5), or interlock systems important to safety (Section 7.6):

The review included the identification of those systems and components for the DCS which are designed to survive the effects of earthquakes, other natural phenomena, abnormal environments, and missiles. Based upon the review, the Staff concludes that the applicant/licensee has identified those systems and components consistent with the design bases for those systems. Sections 3.10

and 3.11 of the SER address the qualification programs to demonstrate the capability of these systems and components to survive these events. Therefore, the Staff finds that the identification of these systems and components satisfies the requirements of GDC 2 and 4.

Based on our review, we conclude that DCSs used in the [safe shutdown system, information systems important to safety, and interlock systems important to safety], taken in context with other provisions of the design, transmit the variables and commands necessary to maintain the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems within prescribed operating ranges during plant shutdown. Therefore, we find that the DCSs employed by the (safe shutdown system, information systems important to safety, or interlock systems important to safety) satisfy the requirements of GDC 13 and the Staff Requirements Memorandum on SECY-93-087 item II.T.

DCSs have been provided to support instruments and controls within the control room to allow actions to be taken to maintain the nuclear power unit in a safe condition during shutdown, including shutdown following an accident. Equipment at appropriate locations outside the control room is also supported by the DCS design to achieve (1) prompt, hot shutdown of the reactor, and (2) subsequent cold shutdown of the reactor. Therefore, we conclude that the DCSs employed by the (safe shutdown system, information systems important to safety, or interlock systems important to safety) satisfy the requirements of GDC 19.

Additional evaluation findings applicable to all DCSs that support control system functions (Section 7.7):

Based on our review, we conclude that DCSs used in the reactor control system, taken in context with other provisions of the design, transmit the variables and commands necessary to maintain the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems within prescribed operating ranges during plant shutdown. Therefore, we find that the DCSs employed by the reactor control system satisfy the requirements of GDC 13.

DCSs have been provided to support instruments and controls within the control room to allow actions to be taken to maintain the nuclear power unit in a safe condition during shutdown, including shutdown following an accident. Therefore, we conclude that the DCSs employed by the reactor control system satisfy the requirements of GDC 19.

Additional evaluation findings applicable to all DCSs that support diverse I&C systems functions (Section 7.8):

Based upon our review of DCS performance and diversity between the DCSs that support ATWS mitigation functions and DCSs that support RTS functions, the Staff finds that the DCS meets the requirements of 10 CFR 50.62.

Based on our review, we conclude that DCSs used in the diverse I&C system, taken in context with other provisions of the design, transmit the variables and commands necessary to maintain the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems within prescribed operating ranges during plant shutdown. Therefore, we find that the DCSs employed by the diverse I&C system satisfy the requirements of GDC 13.

DCSs have been provided to support instruments and controls within the control room to allow actions to be taken to maintain the nuclear power unit in a safe condition during shutdown, including shutdown following an accident. Equipment at appropriate locations outside the control room is also supported by the DCS design to achieve (1) prompt, hot shutdown of the reactor, and

(2) subsequent cold shutdown of the reactor. Therefore, we conclude that the DCSs employed by the diverse I&C system satisfy the requirements of GDC 19.

Note: the following conclusion is applicable to all applications.

The conclusions noted above for the DCS are applicable to all portions of the systems except for the following, for which acceptance is based upon prior NRC review and approval as noted [List applicable system or topics and identify references].

V. Implementation

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the NRC's regulations, as they regard the DCS, the method described herein will be used by the Staff in its evaluation of conformance with NRC regulations.

For implementation of a DCS via the design acceptance criteria (DAC) and ITAAC approach to design certification, see Chapter 14 of the SRP.

VI. References

ANSI/IEEE Std 279-1971. "Criteria for Protection Systems for Nuclear Power Generating Stations."

Draft Regulatory Guide DG-1045. Proposed Revision 3 to Regulatory Guide 1.105, "Instrument Setpoints for Safety Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1997.

IEEE Std 603-1991. "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

IEEE Std 7-4.3.2-1993. "IEEE Standard for Digital Computers in Safety Systems of Nuclear Power Generating Stations."

NUREG/CR-6082. "Data Communications." August 1993.

Regulatory Guide 1.22. "Periodic Testing of Protection System Actuation Functions." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1972.

Regulatory Guide 1.47. "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1973.

Regulatory Guide 1.53. "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1973.

Regulatory Guide 1.75. "Physical Independence of Electrical Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1978.

Regulatory Guide 1.118. "Periodic Testing of Electric Power and Protection Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1995.

Regulatory Guide 1.152. "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, January 1996.

Regulatory Guide 1.153. "Criteria for Power, Instrumentation, and Control Portions of Safety Systems." Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1996.

SECY-93-087. "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs." April 2, 1993.

Staff Requirements Memorandum on SECY-93-087. "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs." July 15, 1993.

