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DRAFT REGULATORY GUIDE

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(Proposed Revision 1 of Regulatory Guide 1.11, dated March 1971)

INSTRUMENT LINES PENETRATING THE PRIMARY REACTOR CONTAINMENT

A. INTRODUCTION

General Design Criterion (GDC) 55, "Reactor Coolant Pressure Boundary Penetrating Containment," and GDC 56, "Primary Containment Isolation," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 CFR Part 50) (Ref. 1) establish that a plant's principal design criteria require, in part, that each line that penetrates the primary reactor containment and that is part of the reactor coolant pressure boundary or connects directly to the containment atmosphere has at least one locked, closed isolation valve or one automatic isolation valve inside containment, and at least one locked, closed isolation valve or one automatic isolation valve outside containment (a simple check valve may not be used as the automatic isolation valve outside containment) "unless it can be demonstrated that the containment isolation provisions for a specific class of lines, such as instrument lines, are acceptable on some other defined basis."

This guide defines a basis that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable to implement the intent of GDC 55 and 56 with regard to instrument lines. This guide applies to all types of nuclear power plants with a primary containment.

The NRC issues regulatory guides to describe to the public methods that the staff considers

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This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received final staff review or approval and does not represent an official NRC final staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rulemaking, Directives, and Editing Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; e-mailed to nrcrep.resource@nrc.gov; submitted through the NRC's interactive rulemaking Web page at http://www.nrc.gov; or faxed to (301) 492-3446. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by November 16, 2009.

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/doc-collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML090970530.

acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

This regulatory guide contains information collection requirements covered by 10 CFR Part 50 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Valves provided for each instrument line that penetrates the primary reactor containment and that is part of the reactor coolant pressure boundary or that penetrates the primary reactor containment and connects directly to the containment atmosphere should be chosen with consideration of the importance of the following two safety functions:

1. the function that the associated instrumentation performs, and
2. the need to maintain containment leak-tight integrity.

The likelihood of achieving the first function is enhanced by the presence of fewer valves (e.g., one valve rather than two), whereas the likelihood of achieving the second function is enhanced by having multiple valves in the line.

In the event of a rupture of any component in an instrument line outside of the primary containment, it is important to ensure that the integrity and functional performance of the secondary containment and its associated air treatment systems (e.g., filters and the standby gas treatment system) are maintained. For those instrument lines that are part of the reactor coolant boundary, it is also important to ensure that the rate and the extent of coolant loss from the ruptured component are within the capability of the normal reactor coolant makeup system. Because the likelihood of such a rupture is assumed to be high, the system is designed to result in calculated radiation doses from just such an instrument line failure during normal operation being substantially below the guidelines of 10 CFR Part 100, "Reactor Site Criteria" (Ref. 2) and GDC 19, "Control Room."

The rate of coolant loss from an instrument line rupture outside containment can be reduced by including flow restrictions, such as orifices, in the instrument line. These flow restrictions should be sized to reduce the potential rate of coolant loss to the extent practical without adversely affecting the capability of the connected instruments to perform their functions. In particular, the response time of connected instruments must remain acceptable, and the potential for obstruction of the flow restrictions must be kept very low. It is also desirable that instrument line flow restrictions be located as close as practical to where the instrument line connects to the reactor coolant system to reduce potential blowdown inside of the primary containment.

If the conditions presented in the two preceding paragraphs are satisfied, a single automatically operated isolation valve (i.e., no dependence on operator actions) or one that an operator can manually operate from a remote location (e.g. in the control room or in another appropriate location) can provide acceptable capability for isolating instrument lines that penetrate the primary reactor containment. A self-actuated excess-flow check valve is acceptable as an automatically operated valve if it has the other features needed for this service. It is desirable that the isolation valve be located outside containment for greater accessibility. Power-operated isolation valves that provide a safety function in both the open and closed position would likely afford greater safety if designed to remain “as is” (usually open) if power is lost.

Not having an isolation valve inside containment makes it even more important that there be a high degree of assurance that the instrument line from the containment out to and including the outside valve retains its integrity during normal reactor operation and under accident conditions. This assurance can be provided by taking the following four actions:

1. locating the valve as close to containment as practical,
2. adopting a conservative approach in the design of this section of the line,
3. implementing suitable quality assurance provisions, and
4. performing suitable visual inservice inspections.

Performing periodic visual inspections should not increase the probability of damaging the instrument lines. In addition, provisions may be needed to protect against accidental damage of the lines and to ensure that pipe whip, missiles, or other mechanisms created by the failures of one line will not induce failures of any other line.

Sufficient experience with valves of a similar type should be available that demonstrates a high likelihood a valve will not close when the instrument line is intact and its safety function is required but that it will close if the instrument line is ruptured downstream. In the event of a rupture downstream of the valve, the valve should close automatically or be capable of being readily closed during normal reactor operation and under accident conditions. In addition, the valve should reopen or be capable of being readily reopened under the conditions that prevail when reopening it is appropriate. It should not be necessary to externally backfill an instrument line to reopen a closed isolation valve with an intact downstream line.

It is desirable to have an indication of the valve position status (opened and closed) in the control room because without such an indication, a valve may remain closed, thus impairing instrument functions for an excessive period of time. For remotely operable valves, the operator needs sufficient information about the status of the valve and the condition of the line so that he or she can take proper, timely actions.

Lines connected to instruments that are part of the protection or safety systems are extensions of those systems and should satisfy the requirements for redundancy, independence, and testability for those systems to ensure that they accomplish their functions.

Lines connected only to instruments that are not part of the protection or safety systems do not need to meet the requirements of the protection or safety systems. For these lines, the assurance that isolation can be effected when required may be of greater importance to safety than the capability of the connected instrument function; therefore, more extensive valving may be preferable.

C. REGULATORY POSITION

1. Instrument lines penetrating the primary containment that are connected to instruments that are part of the protection or safety systems should satisfy the requirements for redundancy, independence, and testability of those systems.

2. Instrument lines penetrating the primary containment that are part of the reactor coolant boundary should be sized or orificed in such a manner as to ensure that the following occurs in the event of any breach of the line outside of the primary containment during normal reactor operation:

    a. The leakage is reduced to the maximum extent practical consistent with other safety requirements.
    b. The rate and extent of coolant loss are within the capability of the normal reactor coolant makeup system.
    c. The integrity and functional performance of the secondary containment air treatment systems will be maintained.
    d. The potential radiation doses will be substantially below the guidelines of 10 CFR Part 100 and GDC 19.

3. Instrument lines penetrating the primary containment should be provided with an automatically operated isolation valve or one that an operator can manually operate from a remote location (e.g., in the control room or in another appropriate location). The valve should be located in the line outside containment as close to containment as practical. Excess-flow check valves may provide acceptable automatic operation in this application. There should be a high degree of assurance that these valves will perform as follows:

    a. They will not close accidentally during normal reactor operation.
    b. They will close or can be readily closed if the integrity of the instrument line outside containment is lost during normal reactor operation or under accident conditions.
    c. They will reopen or can be readily reopened under the conditions that would prevail when reopening them is appropriate.

    Power-operated valves should remain "as is" upon loss of power. The status (opened and closed) of all such isolation valves should be indicated in the control room. If a remotely operated valve is provided, sufficient information should be available in the control room or other appropriate location to ensure that the operator can take timely and proper actions.

4. Instrument lines penetrating the primary containment that are connected to instruments that provide input signals to the protection or safety systems and are closed systems both inside and outside of containment (e.g., for containment pressure instrumentation) are acceptable without containment isolation valves if they meet the conditions specified in Section 3.6.2 of American National Standards Institute (ANSI) N271-1976, "Containment Isolation Provisions for Fluid Systems" (Ref. 3).

5. Instrument lines penetrating primary containment should be designed conservatively from containment out to and including the isolation valve and should be of a quality at least equivalent to that of containment. These portions of the lines should be located and protected so as to minimize the likelihood of their being accidentally damaged. They should be protected or separated to prevent the failure of one line from contributing to the failure of any other line.

Provisions should be included to permit periodic visual inspection during plant operation, particularly of those portions of the lines outside containment out to and including the isolation valve.

6. Instrument lines penetrating the primary containment should not be so restricted by components in the lines, such as valves and orifices, that the response time of the connected instrumentation could be increased unacceptably.

7. Instrument lines penetrating the primary containment that are not associated with protection or safety system instrumentation should meet the provisions of the following:

   a. positions 2, 3, 5, and 6 above, or
   b. Regulatory Guide 1.141, "Containment Isolation Provisions for Fluid Systems" (Ref. 4).

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC's plans for using this draft regulatory guide. The NRC does not intend or approve any imposition or backfit in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. The NRC will consider all public comments received in development of the final guidance document. In some cases, applicants or licensees may propose an alternative or use a previously established acceptable alternative method for meeting the intent of specified portions of the NRC's regulations. Otherwise, the methods described in this guide will be used in evaluating implementation of the applicable regulations for license applications, license amendment applications, and amendment requests.

REGULATORY ANALYSIS

Statement of the Problem

GDC 55 and 56 require, in part, that each line that penetrates the primary reactor containment and that is part of the reactor coolant pressure boundary or connects directly to the containment atmosphere has at least one locked, closed isolation valve or one automatic isolation valve inside containment, and at least one locked, closed isolation valve or one automatic isolation valve outside containment (a simple check valve may not be used as the automatic isolation valve outside containment) "unless it can be demonstrated that the containment isolation methods for a specific class of lines, such as instrument lines, are acceptable on some other defined basis." Regulatory Guide 1.141 describes the methods that the NRC staff considers acceptable for use in meeting the intent of the GDC and endorses, in large part, the provisions of ANSI N271-1976. That industry standard provides limited guidance for instrument lines and, in fact, defers in large part to Safety Guide 11 (Regulatory Guide 1.11) for guidance on the other defined basis for acceptable instrument line isolation methods.

Objective

The objective of this regulatory action is to update the NRC guidance on acceptable methods for the isolation of instrument lines that penetrate the primary containments of light-water-cooled reactors.

Alternative Approaches

The NRC staff considered the following alternative approaches:

Do not revise Regulatory Guide 1.11.
Revise Regulatory Guide 1.11.

Alternative 1: Do Not Revise Regulatory Guide 1.11

Under this alternative, the NRC would not revise this guide, and the current guidance would be retained. If the NRC does not take action, there would not be any changes in costs or benefit to the public, licensees, or the NRC. However, the "no-action" alternative would allow outdated and no longer applicable information to remain with the current version of the regulatory guide.

Alternative 2: Revise Regulatory Guide 1.11

Under this alternative, the NRC would revise Regulatory Guide 1.11, taking into consideration the efficiency improvement of providing guidance in a format consistent with that of other more recently issued regulatory guides and without the obsolete February 17, 1972 supplement to Safety Guide 11 (Ref 5) which describes possible backfitting considerations.

The benefit of this action is that an updated Regulatory Guide 1.11 provides licensees with the current staff positions on acceptable designs they may use to implement the intent of GDC 55 and 56 of Appendix A to 10 CFR Part 50 for the isolation of instrument lines that penetrate the primary containment of light-water-cooled reactors.

The impact to the NRC would be the costs associated with preparing and issuing the regulatory guide revision. The impact to the public would be the voluntary costs associated with reviewing and providing comments to the NRC during the public comment period. The additional impact on licensees and applicants is expected to be negligible. The value to the NRC staff, its licensees and its license and certification applicants would be the benefits associated with enhanced efficiency and effectiveness in using a common guidance document as the technical basis for license and design certification applications and other interactions between the NRC and its regulated entities.

Conclusion

Based on this regulatory analysis, the NRC staff recommends revision of Regulatory Guide 1.11. The staff concludes that the proposed action will enhance the overall efficiency of regulation implementation by providing guidance in a common format and without obsolete information.

REFERENCES[1]

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," U.S. Nuclear Regulatory Commission, Washington, DC.

2. 10 CFR Part 100, "Reactor Site Criteria," U.S. Nuclear Regulatory Commission, Washington, DC.

3. ANSI N271-1976, "Containment Isolation Provisions for Fluid Systems," American Nuclear Society, La Grange Park, IL, June 1976. [2]

4. Regulatory Guide 1.141, "Containment Isolation Provisions for Fluid Systems," U.S. Nuclear Regulatory Commission, Washington, DC.

5. Supplement To Safety Guide 11 (Regulatory Guide 1.11), "Instrument Lines Penetrating Primary Reactor Containment Backfitting Considerations," U.S. Nuclear Regulatory Commission, Washington, DC.

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1 Publicly available NRC published documents such as Regulations, Regulatory Guides, NUREGs, and Generic Letters listed herein are available electronically through the Electronic Reading room on the NRC's public Web site at: http://www.nrc.gov/reading-rm/doc-collections/. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone 301-415-4737 or (800) 397-4209; fax (301) 415-3548; and e-mail PDR.Resource@nrc.gov.

2 Copies of the non-NRC documents included in these references may be obtained directly from the publishing organization.