U.S. NUCLEAR REGULATORY COMMISSION

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# REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

**REGULATORY GUIDE 1.151**
**(Task IC 126-5)**

## INSTRUMENT SENSING LINES

### A. INTRODUCTION

Section 50.34, "Contents of Applications; Technical Information," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that design criteria be established for structures, systems, and components important to safety that will provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 requires, in part, that structures, systems, and components be erected (installed) to quality standards commensurate with the importance of the safety functions to be performed. Criterion 13, "Instrumentation and Control," of Appendix A to 10 CFR Part 50 requires, in part, that instrumentation be provided to ensure adequate safety. Criterion 24, "Separation of Protection and Control Systems," of Appendix A to 10 CFR Part 50 and Section 4.7.3, "Single Random Failure," of IEEE Std 279-1971 require, in part, that the interconnection of the protection and control systems be limited so as to ensure that safety is not significantly impaired.

This regulatory guide describes a method acceptable to the NRC staff for complying with the Commission's regulations with regard to the design and installation of safety-related instrument sensing lines in nuclear power plants. The term "safety-related" refers to those structures, systems, and components necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures of 10 CFR Part 100.

The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

Any guidance in this document related to information activities has been cleared under OMB Clearance No. 3150-0011.

### B. DISCUSSION

ISA-S67.02, "Nuclear-Safety-Related Instrument Sensing Line Piping and Tubing Standards for Use in Nuclear Power Plants,"* was prepared by Committee SP67-02 of the Instrument Society of America (ISA). It was approved by the ISA Nuclear Power Plant Standards Committee on October 19, 1978, and subsequently by the ISA Standards and Practices Board in June 1980. The standard provides design, physical protection, and installation requirements for instrument sensing line piping and tubing for nuclear power plant applications. It establishes the applicable ASME code requirements and boundaries for the design and installation of instrument sensing lines that interconnect safety-related piping and vessels with safety-related instrumentation and non-safety-related instrumentation.

### C. REGULATORY POSITION

The requirements of ISA-S67.02, "Nuclear-Safety-Related Instrument Sensing Line Piping and Tubing Standards for Use in Nuclear Power Plants," 1980, provide a basis acceptable to the NRC staff for the design and installation of safety-related instrument sensing lines in nuclear power plants subject to the following:

1. The requirements for instrument sensing lines in Section 4.1 of ISA-S67.02 should be supplemented with the following:

> A single instrument sensing line should not be used to perform both a safety-related function and a non-safety-related function unless it can be shown that:

*Copies are available from the Instrument Society of America, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, North Carolina 27709.

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This guide was issued after consideration of comments received from the public. 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.

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a. The failure of the common sensing line would not simultaneously (1) cause an action in a non-safety-related system that results in a plant condition requiring protective action and (2) also prevent proper action of a protection system channel designed to protect against the condition; or

b. If the failure of the common sensing line can cause an action in a non-safety-related system that results in a plant condition requiring protective action and can also prevent proper action of a protection system channel designed to protect against the condition, the remaining redundant protection channels are capable of providing the protective action even when degraded by a second random failure. The rupture of a second instrument sensing line need not be considered as a second random failure.

Provisions should be included so that this requirement can still be met if a channel is bypassed or removed from service for test or maintenance purposes. Acceptable provisions include reducing the required coincidence, defeating the signals taken from the same sensing line in non-safety-related systems, or initiating a protective action from the bypassed channel.

2. The mechanical design requirements in Tables 1 and 2 and Figures 1, 2, 3, 4, 7, and 8 of ISA-S67.02 for instrument sensing lines connected to ASME Class 1 and 2 process piping and vessels should be supplemented with the following:

a. Instrument sensing lines that are connected to ASME Class 1 or 2 process piping or vessels should not be less than ASME Class 2 Seismic Category I from their connections to the process piping or vessel to and including the accessible isolation valve.

b. Instrument sensing lines that are connected to ASME Class 1 or 2 process piping or vessels and that are used to actuate or monitor safety-related systems should not be less than ASME Class 2 Seismic Category I from their connections to the process piping or vessel to the sensing instrumentation.

3. The mechanical design requirements in Tables 1 and 2 and Figures 5, 6, and 9 of ISA-S67.02 for instrument sensing lines connected to ASME Class 3 process piping and vessels should be supplemented with the following:

Instrument sensing lines that are connected to ASME Class 3 process piping and vessels and that are used to actuate or monitor safety-related systems should not be less than ASME Class 3 Seismic Category I from their connection to the process piping or vessel to the sensing instrumentation.

4. Freezing temperatures should be added to the environmental and installation conditions listed in Section 5.2.1(5) of ISA-S67.02 that sensing lines should be able to withstand and continue to perform their function.

5. The special considerations in Section 5.2.2 of ISA-S67.02 that should be addressed in the design and installation of instrument sensing lines should be supplemented with the following:

a. Instrument sensing lines that can be exposed to freezing temperatures and that contain or can be expected to contain a condensable mixture or fluid that can freeze should be provided an environmental control system (heating and ventilation or heat tracing) to protect the lines from freezing during extremely cold weather.

b. The environment associated with those instrument sensing lines in a. that are safety related should be monitored and alarmed so that appropriate corrective action can be taken to prevent loss of or damage to the lines from freezing in the event of loss of the environmental control system.

c. The environmental control system recommended in a., and for which b. applies, should be electrically independent of the monitoring and alarm system so that a single failure in either system, including their power sources, does not affect the capability of the other system.

d. The environmental control and monitoring systems of a. and b. should be designed to standards commensurate with their importance to safety and with administrative controls that are implemented to address events or conditions that could render the systems inoperable.

6. The Summer 1981 Addenda to Section III of the ASME Boiler and Pressure Vessel Code deleted Paragraphs NB-3676, NC-3676, and ND-3676 in their entirety. References to these paragraphs in Section 4.2.1, Section 6.2, and Section 7 of ISA-S67.02 should be disregarded.

## D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described in this guide will be used by the NRC staff in its evaluation of the design and installation of safety-related instrument sensing lines for all construction permit applications issued after September 1, 1983. Licensees or other applicants may use this guide in discussions with the staff as justification for the adequacy of sensing line design and installation or for modifications to sensing line design and installation. However, the staff does not intend to recommend the systematic application of every aspect of this guide to plants currently operating or under review.

## VALUE/IMPACT STATEMENT

### 1. BACKGROUND

The licensee of a nuclear power plant is required by the Commission's regulations to provide principal design criteria for those structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. General guidance for the design and installation of instrument sensing lines is given in Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants." The Instrument Society of America (ISA) has developed more definitive guidance on instrument sensing lines in ISA-S67.02, "Nuclear-Safety-Related Instrument Sensing Line Piping and Tubing Standards for Use in Nuclear Power Plants." The action endorses this additional guidance, with appropriate supplementary material, in a regulatory guide.

### 2. VALUE/IMPACT ASSESSMENT

#### 2.1 General

The guidance for design and installation of instrument sensing lines in ISA-S67.02 is endorsed by this regulatory guide.

*2.1.1 Value*

The action should result in more effective design and installation of instrument sensing lines, thus providing more assurance that the sensing lines will perform their safety function under all service conditions. It establishes the NRC position on a national consensus standard and therefore reduces uncertainty as to what the staff considers acceptable in the area of sensing line design and installation.

*2.1.2 Impact*

Most of the impact on industry has already occurred during development, review, and approval of the consensus standard. Additional impact associated with the NRC endorsement of the standard should be minimal.

#### 2.2 Common Sensing Lines

Regulatory Position 1 was included to ensure that a single sensing line would not be used to perform a non-safety-related function and a safety-related function if the failure of the sensing line could cause a transient and at the same time prevent the mitigation of that transient unless the line meets provisions equivalent to the provisions of Sections 4.7.3 and 4.7.4 of IEEE Std 279-1971.

*2.2.1 Value*

Any design in which a single failure could cause an event and at the same time prevent mitigating action should be avoided or additional redundancy should be provided.

*2.2.2 Impact*

The avoidance of common-mode failures is a general design objective and consequently there should be no impact.

#### 2.3 Mechanical Design

Regulatory Positions 2 and 3 were included to modify the guidance to make it consistent with the guidance of Regulatory Guide 1.26.

*2.3.1 Value*

The regulations require that components of the reactor coolant pressure boundary be designed and erected in accordance with the requirements of ASME Class 1. After reviewing a number of applications for construction permits and operating licenses and after discussions with representatives of professional societies and industry, the NRC staff developed the classifications and guidance given in Regulatory Guide 1.26, thus providing the assurance that structures, systems, and components were designed and erected (installed) to quality standards commensurate with the importance of the safety functions to be performed.

*2.3.2 Impact*

There should be no impact since no new requirements are imposed.

#### 2.4 Environmental Conditions

Regulatory Position 4 was included to add freezing temperatures to the list of environmental conditions to be considered in the design of instrument sensing lines.

*2.4.1 Value*

Instrument sensing lines should remain functional under all environmental conditions. In the past, there have been many occurrences of frozen instrument lines because

extremely cold temperature was not given adequate consideration in the design. Consequently, special attention must be given to prevent such occurrences.

*2.4.2 Impact*

There is no impact since this is not a new requirement. IE Bulletin 79-24, "Frozen Lines," was issued requesting all licensees and construction permit holders to ensure that freezing temperatures are taken into the design considerations for instrument sensing lines.

**2.5 Environmental Control and Monitoring**

Regulatory Position 5 was included to provide guidance in the design and installation of instrument sensing lines to account for extremely cold weather conditions.

*2.5.1 Value*

The guidance provided is consistent with a technical position of the Instrumentation and Control Systems Branch (NRR) that was developed after it became evident that frozen instrument lines had become a problem. It ensures that the concerns of IE Bulletin 79-24, "Frozen Lines," were adequately addressed.

*2.5.2 Impact*

There should be no impact since no new requirements are imposed.

## 3. CONCLUSION

A regulatory guide endorsing ISA-S67.02 has been developed to provide guidance for the design and installation of instrument sensing lines.

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