

REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.105

INSTRUMENT SETPOINTS

A. INTRODUCTION

Criterion 13, "Instrumentation and Control," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires, among other things, that instrumentation be provided to monitor variables and systems and that controls be provided to maintain these variables and systems within prescribed operating ranges.

Paragraph (c)(1)(ii)(A) of §50.36, "Technical Specifications," of 10 CFR Part 50 requires that, where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting be so chosen that automatic protective action will correct the most severe abnormal situation anticipated before a safety limit is exceeded.

This guide describes a method acceptable to the NRC staff for complying with the Commission's regulations with regard to ensuring that the instrument setpoints in systems important to safety initially are within and remain within the specified limits. The Advisory Committee on Reactor Safeguards has been consulted concerning this guide and has concurred in the regulatory position.

B. DISCUSSION

Operating experience has shown that there is need for guidance in the selection of required instrument accuracy and the settings that are used to initiate automatic protective actions and alarms.

Abnormal Occurrence Reports submitted by operating utilities between January 1972 and June 1973 record the most frequent abnormal occurrence as the drift of the protective instrument setpoint outside the limits specified in the technical specifications.

* Lines indicate substantive changes from previous issue.

Protective instruments and alarms in nuclear power plants are provided with adjustable setpoints where specific actions are either automatically initiated, prohibited, or alarmed. For example, pressure sensors typically are installed on main steam lines to measure steam pressure. These sensors initiate corrective action if the steam pressure decreases to the predetermined and preset value that would result, for example, from a steam line break. Setpoints (e.g., pressure, differential pressure, flow, level, temperature, power, radiation level, time delay) correspond to certain provisions of technical specifications that have been incorporated into the operating license by the Commission.

The single most prevalent reason for the drift of a measured parameter out of compliance with a technical specification is the selection of a setpoint that does not allow a sufficient margin between the setpoint and the technical specification limit to account for inherent instrument inaccuracy, expected vibration, and minor calibration variations. In some cases, the setpoint selected was numerically equal to the technical specification limit and stated as an absolute value, thus leaving no apparent margin for error. In other cases, the setpoint was so close to the upper or lower limit of the instrument's range that the instrument drift placed the setpoint beyond the instrument's range, thus nullifying the trip function. Other causes for drift of a parameter out of conformity with a technical specification have been instrumentation design inadequacies and questionable calibration procedures.

The following terms are listed with the definitions used in this guide:

1. **Instrument accuracy**—the degree to which an indicated value conforms to an accepted standard value or a true value.

USNRC REGULATORY GUIDES

Regulatory Guides are issued to describe and make available to the public methods acceptable to the NRC staff of implementing specific parts of the Commission's regulations, to delineate techniques used by the staff in evaluating specific problems or postulated accidents, or to provide guidance to applicants. Regulatory Guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions different from those set out in the guides will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a permit or license by the Commission.

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. This guide was revised as a result of substantive comments received from the public and additional staff review.

Comments should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Section.

The guides are issued in the following ten broad divisions:

- | | |
|-----------------------------------|------------------------|
| 1. Power Reactors | 6. Products |
| 2. Research and Test Reactors | 7. Transportation |
| 3. Fuels and Materials Facilities | 8. Occupational Health |
| 4. Environmental and Siting | 9. Antitrust Review |
| 5. Materials and Plant Protection | 10. General |

Copies of published guides may be obtained by written request indicating the divisions desired to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Director, Office of Standards Development.

2. **Drift**—a change in the input-output relationship of an instrument over a period of time.

3. **Margin**—the difference between a limiting condition and an operating condition.

4. **Range**—the region within which a quantity is measured, received, or transmitted.

5. **Safety limit**—a limit on an important process variable that is necessary to reasonably protect the integrity of physical barriers that guard against uncontrolled release of radioactivity.

6. **Setpoint**—a predetermined level at which a bistable device changes state to indicate that the quantity under surveillance has reached the selected value.

7. **Span**—the algebraic difference between the upper and lower limits of the range.

8. **Technical specification limit**—the limit prescribed as a license condition on an important process variable for safe operation.

9. **Systems important to safety**—those systems that are 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 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, "Reactor Site Criteria."

C. REGULATORY POSITION

The following are applicable to instruments in systems important to safety:

1. The setpoints should be established with sufficient margin between the technical specification limits for the process variable and the nominal trip setpoints to allow for (a) the inaccuracy of the instrument, (b) uncertainties in the calibration, and (c) the instrument drift that could occur during the interval between calibrations.

2. All setpoints should be established in that portion of the instrument span which ensures that the accuracy, as required by regulatory position 4 below, is maintained. Instruments should be calibrated so as to ensure the required accuracy at the setpoint.

3. The range selected for the instrumentation should encompass the expected operating range of the process variable being monitored to the extent that saturation does not negate the required action of the instrument.

4. The accuracy of all setpoints should be equal to or better than the accuracy assumed in the safety analysis, which considers the ambient temperature changes, vibration, and other environmental conditions. The instruments should not anneal, stress relieve, or work harden under design conditions to the extent that they will not maintain the required accuracy. Design verification of these instruments should be demonstrated as part of the instrument qualification program recommended in Regulatory Guide 1.89, "Qualification of Class 1E Equipment for Nuclear Power Plants."

5. Instruments should have a securing device on the setpoint adjustment mechanism unless it can be demonstrated by analysis or test that such devices will not aid in maintaining the required setpoint accuracy and minimizing setpoint changes. The securing device should be designed so that it can be secured or released without altering the setpoint and should be under administrative control.

6. The assumptions used in selecting the setpoint values in regulatory position 1 and the minimum margin with respect to the limiting safety system settings, setpoint rate of deviation (drift rate), and the relationship of drift rate to testing interval (if any) should be documented.

D. IMPLEMENTATION

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

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used in the evaluation of submittals in connection with construction permit applications docketed after December 15, 1976.

If an applicant wishes to use this regulatory guide in developing submittals for applications docketed on or before December 15, 1976, the pertinent portions of the application will be evaluated on the basis of this guide.