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# REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

## REGULATORY GUIDE 1.105
(Draft was DG-1045)

## SETPOINTS FOR SAFETY-RELATED INSTRUMENTATION

### A. INTRODUCTION

Criterion 13, "Instrumentation and Control,"[1] of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic 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.

Criterion 20, "Protection System Functions," of Appendix A to 10 CFR Part 50 requires, among other things, that the protection system be designed to initiate operation of appropriate systems to ensure that specified acceptable fuel design limits are not exceeded.

Paragraph (c)(1)(ii)(A) of § 50.36, "Technical Specifications," of 10 CFR Part 50 requires, in part, 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 abnormal situation before a safety limit is exceeded. It also requires, among other things, that the licensee notify the NRC if the licensee determines that an automatic safety system does not function as required. The licensee is required to then review the matter and record the results of the review.

[1]For the full text of the General Design Criteria and other sections of the regulations cited in this guide, see 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

This guide describes a method acceptable to the NRC staff for complying with the NRC's regulations for ensuring that setpoints for safety-related instrumentation are initially within and remain within the technical specification limits. The guide is being revised to endorse Part l of ISA-S67.04-1994, "Setpoints for Nuclear Safety-Related Instrumentation."[2] This standard provides a basis for establishing setpoints for nuclear instrumentation for safety systems and addresses known contributing errors in the channel.

The information collections contained in this regulatory guide are covered by the requirements in 10 CFR Part 50, which were approved by the Office of Management and Budget, approval number 3150-0011. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

## B. DISCUSSION

Instrument setpoint uncertainty allowances and setpoint discrepancies have led to a number of operational problems. Operating experience indicates that setpoints for safety-related instrumentation may allow plants to operate outside the limiting conditions of operation specified in their technical specifications. Licensees have discovered conflicts between existing setpoints and engineering calculations. The causes for these setpoint discrepancies were problems with industry practices that led to errors in calibration procedures and a lack of understanding of the relationship of the setpoint to the allowable value. Additional problems noted included varying setpoint methodologies for engineering calculations, a lack of a consistent definition of allowable value between different setpoint methodologies, and improper understanding of the relationship of the allowable value to earlier setpoint terminology, procedures, and operability criteria. Further problems were noted when procedures (the setpoint process) (1) failed to provide an adequate margin between the instrument as-left criteria and the values (trip set point or allowable values) required per the technical specifications, (2) did not always reflect current design criteria, and (3) did not ensure that revised instrument loops were verified to the original design requirements or that instrument modifications were evaluated for their effect on setpoint calculations. It has also been noted that licensees do not typically verify whether setpoint calculation drift assumptions have remained valid for the system surveillance interval.

ISA-S67.04 was revised in 1987 to provide clarification and to reflect industry practice. The term "trip setpoint" was made consistent with the terminology used by the NRC staff.

The standard was revised further in 1994. The effects of uncertainty allowances and discrepancies in setpoints, along with operational experience, were appropriately addressed during this revision of ISA-S67.04. This revision of the standard also reflects the Improved Technical Specification program (a cooperative effort between industry and the NRC staff) and reflect current industry practice. This standard provides a basis for establishing setpoints for nuclear instrumentation for safety systems and addresses known contributing errors in a particular channel from the process (including the primary element and sensor) through and including the final setpoint device.

The term "trip setpoint" is retained in ISA-S67.04-1994. However, Figure 1 in ISA-S67.04-1994 (for convenience, this figure has been reproduced as Figure 1 in this guide) has been revised to depict region "E," "a region of calibration tolerance." The calibration tolerance uncertainties depicted by region

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[2]Copies may be obtained from the Instrument Society of America, 67 Alexander Drive, Research Triangle Park, NC 20779.

"E" should be defined and accounted for in the licensee's setpoint methodology. A trip setpoint value identified to be outside region "E" regardless of direction requires readjustment to satisfy the setpoint methodology and uncertainties identified in Figure 1 (acceptable as-left condition). It should be noted that this standard does not define "nominal" trip setpoint. The trip setpoint as depicted in Figure 1 is consistent with the term "nominal" trip setpoint as shown about a defined calibration tolerance band.

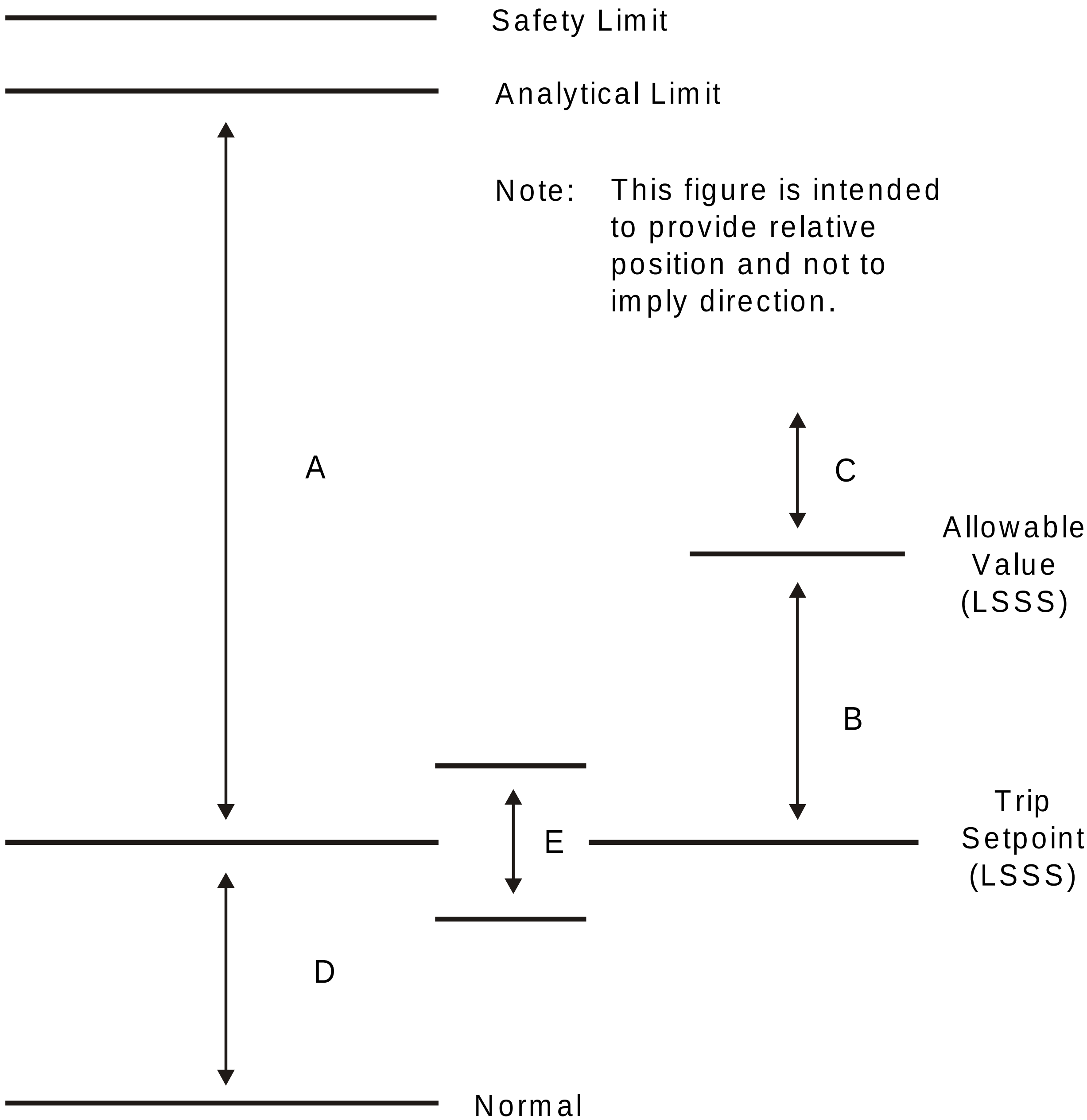
Figure 1 of the standard provides setpoint relationships for nuclear safety-related setpoints. The figure denotes relative position and not direction, but it should be noted that the uncertainty relationships depicted by Figure 1 do not represent any one particular method (direction, combination, or relationship of uncertainty groupings) for the development of a trip setpoint or allowable value.

Section 4 of ISA-S67.04-1994 states that the safety significance of various types of setpoints for safety-related instrumentation may differ, and thus a less rigorous setpoint determination method may be applied for certain functional units and limiting conditions of operation (LCOs). A setpoint methodology can include such a graded approach. However, the grading technique chosen by the licensee should be consistent with the standard and should consider applicable uncertainties regardless of the setpoint application. Additionally, the application of the standard, using a "graded" approach, is also appropriate for non-safety system instrumentation for maintaining design limits described in the Technical Specifications. Examples may include instrumentation relied on in emergency operating procedures (EOPS), and for meeting applicable LCOs, and for meeting the variables in Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants To Assess Plant and Environs Conditions During and Following an Accident."[3]

The industry consensus standard ANSI/ANS-10.4-1987, "Guidelines for the Verification and Validation of Scientific and Engineering Computer Programs for the Nuclear Industry," provides helpful information on the qualification of setpoint methodology software.

ISA-S67.04-1982 has been used by licensees for setpoint methodology and instrument drift evaluations. ISA-S67.04-1994 provides limited guidance on drift evaluations and uncertainty term development for the evaluation of an instrument surveillance interval. The

[3]Single copies of regulatory guides, both active and draft, may be obtained free of charge by writing the Office of Administration, Attn: Reproduction and Distribution Services Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555, or by fax to (301)415-2289, or by email to <DISTRIBUTION@NRC.GOV>. Copies are also available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC; the PDR's mailing address is Mail Stop LL-6, Washington, DC 20555; telephone (202)634-3273; fax (202)634-3343.




A. Allowance described in paragraph 4.3.1
B. Allowance described in paragraph 4.3.1
C. Region where channel may be determined inoperable
D. Plant operating margin
E. Region of calibration tolerance (acceptable as left condition) described in paragraph 4.3.1

Figure 1. Nuclear Safety-Related Setpoint Relationships

(Reproduced from ISA-67.04-1994)

staff has generally accepted drift evaluations based on statistical prediction techniques. However, significant variability has been observed in licensees' surveillance interval evaluations with regard to drift, setpoint methodology, and completeness. The following concerns were identified during the NRC staff review, but they have been resolved during the development of ISA-S67.04-1994.

- Limited instrument drift data were included in the licensee setpoint study.

- Drift data account for all data points from a surveillance calibration (i.e., nine-point check) as independent data, but inadequate justification is provided for this assumption. Drift data points also included interim calibrations.

- A large number of data points was provided for a limited number of instruments.

- Flawed outlier analysis resulted in valid data being removed from the data set.

- Drift dependency on time was assumed to be negligible over the interval selected, and inadequate justification was provided when extrapolating to an extended surveillance interval (e.g., 24 months).

- Setpoint methodology assumes normal distribution of data when such an assumption was not verified.

- Instrumentation evaluations (historical, maintenance, drift) were incomplete.

- Drift projections, including those based on regression analyses, may not account for penalties for uncertainty projection (extended surveillance interval-drift) beyond the time range for the data collected.

- Instrument application and process or installation variables were not evaluated.

- The uncertainties assumed for instrumentation, including primary elements, were subsequently not verified or controlled through surveillance testing, qualification, or maintenance programs.

- The acceptability of pooling generic drift data with plant-specific data or weighing the data according to the source of the data was not justified.

- All available applicable data were not utilized in the analysis.

Section 4.3 of ISA-S67.04-1994 states that the limiting safety system setting (LSSS) may be the trip setpoint, an allowable value, or both. For the standard technical specifications, the staff designated the allowable value as the LSSS. In association with the trip setpoint and limiting conditions for operation (LCOs), the LSSS establishes the threshold for protective system action to prevent acceptable limits being exceeded during design basis accidents. The LSSS therefore ensures that automatic protective action will correct the abnormal situation before a safety limit is exceeded. A licensee, with justification, may propose an alternative LSSS based on its particular setpoint methodology or license.

The standard provides for the accounting of measurement and test equipment (MTE) uncertainties, but MTE criteria are not specifically identified within the standard. Criteria XI and XII in Appendix B to

10 CFR Part 50 provide requirements for quality regarding testing. Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems,"[3] provides guidance on periodic surveillance testing.

Part II, "Methodologies for the Determination of Setpoints for the Nuclear Safety-Related Instrumentation," of ISA-S67.04-1994 is not addressed by this regulatory guide.

## C. REGULATORY POSITION

Conformance with Part 1 of ISA-S67.04-1994, "Setpoints for Nuclear Safety-Related Instrumentation,"[2] with the following exceptions and clarifications, provides a method acceptable to the NRC staff for satisfying the NRC's regulations for ensuring that setpoints for safety-related instrumentation are established and maintained within the technical specification limits.

**1.** Section 4 of ISA-S67.04-1994 specifies the methods, but not the criterion, for combining uncertainties in determining a trip setpoint and its allowable values. The 95/95 tolerance limit is an acceptable criterion for uncertainties. That is, there is a 95% probability that the constructed limits contain 95% of the population of interest for the surveillance interval selected.

**2.** Sections 7 and 8 of Part 1 of ISA-S67.04-1994 reference several industry codes and standards. If a referenced standard has been incorporated separately into the NRC's regulations, licensees and applicants must comply with that standard as set forth in the regulation. If the referenced standard has been endorsed in a regulatory guide, the standard constitutes a method acceptable to the NRC staff of meeting a regulatory requirement as described in the regulatory guide. If a referenced standard has been neither incorporated into the NRC's regulations nor endorsed in a regulatory guide, licensees and applicants may consider and use the information in the referenced standard if appropriately justified, consistent with current regulatory practice.

**3.** Section 4.3 of ISA-S67.04-1994 states that the limiting safety system setting (LSSS) may be maintained in technical specifications or appropriate plant procedures. However, 10 CFR 50.36 states that the technical specifications will include items in the categories of safety limits, limiting safety system settings, and limiting control settings. Thus, the LSSS may not be maintained in plant procedures. Rather, the LSSS must be specified as a technical-specification-defined limit in order to satisfy the requirements of 10 CFR 50.36. The LSSS should be developed in accordance with the setpoint methodology set forth in the standard, with the LSSS listed in the technical specifications.

**4.** ISA-S67.04-1994 provides a discussion on the purpose and application of an allowable value. The allowable value is the limiting value that the trip setpoint can have when tested periodically, beyond which the instrument channel is considered inoperable and corrective action must be taken in accordance with the technical specifications. The allowable value relationship to the setpoint methodology and testing requirements in the technical specifications must be documented.

## D. IMPLEMENTATION

The purpose of the 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 NRC's regulations, the methods described in this guide will be used in the evaluation of submittals in connection with applications for construction permits, operating licenses, and combined licenses.  It will also be used to evaluate submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and this guidance.

## VALUE/IMPACT STATEMENT

A draft value/impact statement was published with the draft proposed Revision 3 of this guide when it was published for public comment (DG-1045, October 1996). No changes were necessary, so a separate value/impact statement for the final guide has not been prepared. A copy of the draft value/impact statement is available for inspection or copying for a fee in the NRC's Public Document Room at 2120 L Street NW., Washington, DC under task DG-1045.