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DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1045
(Proposed Revision 3 to Regulatory Guide 1.105)

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 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 the licensee to notify the NRC of any automatic safety system malfunctions, to review the matter, and to 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 draft 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 1 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.

Regulatory guides are issued to describe and make available to the public such information as methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations, techniques used by the staff in evaluating specific problems or postulated accidents, and guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required.

The information collections contained in this draft 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 are problems that have led to a number of operational problems. Operating experience indicates that setpoints for safety-related instrumentation may allow plants to operate outside the limits 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 where procedures (the setpoint

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

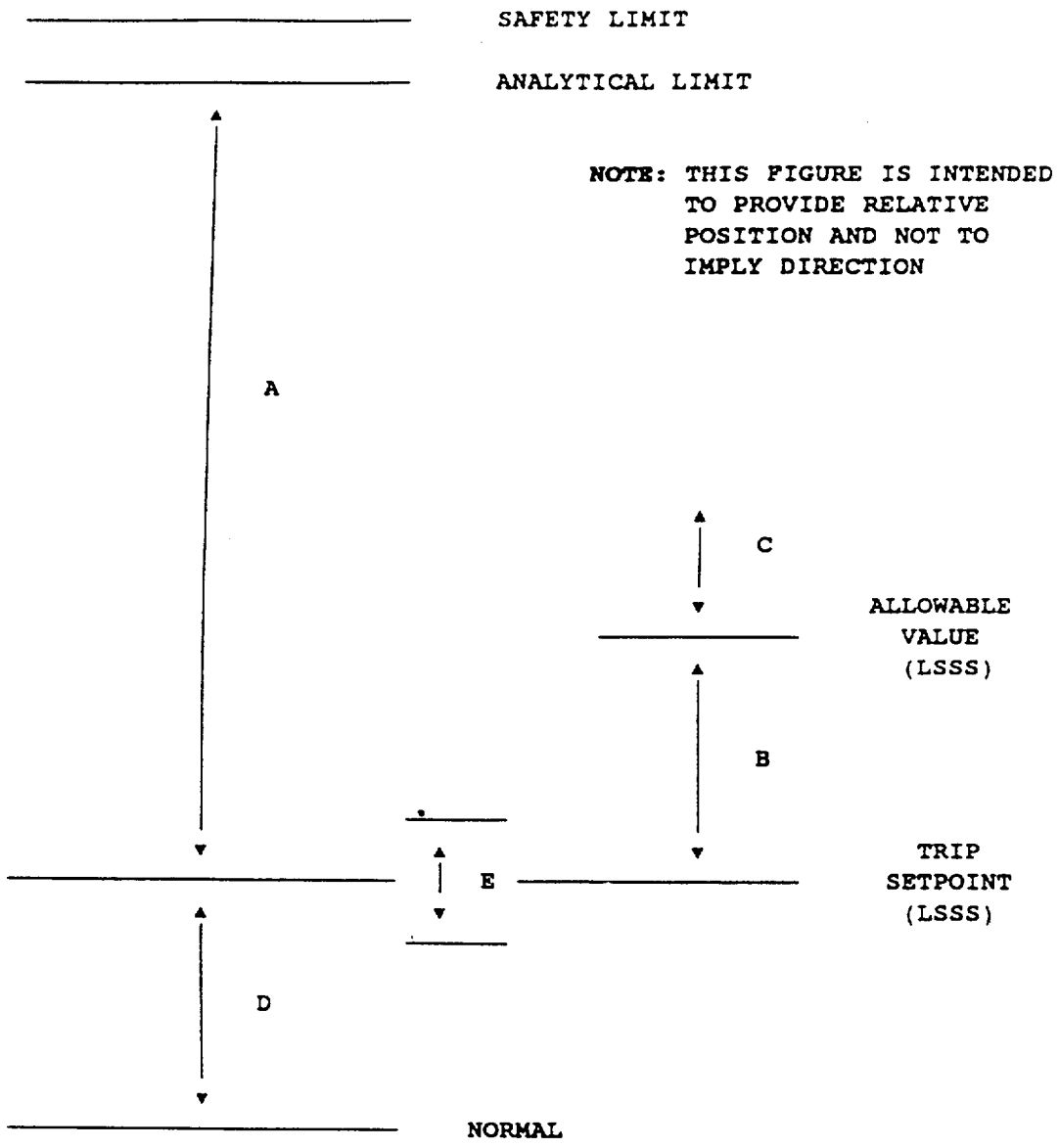
process) (1) failed to provide an adequate margin between the instrument as-left criteria and the values required per the technical specifications, (2) did not always reflect current design criteria, and (3) did not ensure that revised instrument loops were verified to the original design requirements or 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. Many of the changes provided in the 1994 version of Part 1 of ISA-S67.04 reflect 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 the 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 "E" should be defined and accounted for in the licensee's setpoint methodology. The trip setpoint value is generally represented by the upper limit identified in Figure 1 (acceptable as-left condition). A trip setpoint value identified to be outside region "E" requires readjustment to satisfy the setpoint methodology and uncertainties identified in Figure 1. 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.



A. ALLOWANCE DESCRIBED IN PARAGRAPH 4.3.1
B. ALLOWANCE DESCRIBED IN PARAGRAPH 4.3.2
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-S67.04-1994)

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 one may apply a less rigorous setpoint determination method 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," though not endorsed by the NRC, provides helpful information on the qualification of setpoint methodology software.

NRC's Generic Letter (GL) 91-04,[4] "Changes in Technical Specification Surveillance Intervals To Accommodate a 24-Month Fuel Cycle" (April 2, 1991), in its Enclosure 2, "Guidance for Addressing the Effects of Increased Surveillance Intervals on Instrument Drift and Safety Analysis Assumptions," provides the option to extend surveillance calibration intervals for licensees incorporating a 24-month fuel cycle. Enclosure 2 states, among other things, that an evaluation should be performed on instrument drift when developing a proposed 24-month surveillance interval. ISA-S67.04-1982 has been used by licensees to comply with Generic Letter 91-04 for setpoint methodology and instrument drift evaluations in

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[3]Single copies of regulatory guides, both active and draft guides, may be obtained free of charge by writing the Office of Administration, Attn: Distribution and Services Section, U.S. Nuclear Regulatory Commission, Washington, DC 20555, or by fax at (301)415-2260. 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.

[4]Copies are available for inspection and 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.

the development of such license amendments. ISA-S67.04-1994 provides limited guidance on drift evaluations and uncertainty term development for the extension of an instrument surveillance interval. The staff has generally accepted drift evaluations based on statistical prediction techniques. However, significant variability has been observed in licensees' 24-month surveillance interval requests with regard to drift evaluations, setpoint methodology, and completeness. Some of the concerns that the NRC staff reviews have identified include the following:

- 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 cannot be 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 acceptability of pooling generic drift data with plant-specific data or weighing the data according to the source of the data were not justified.

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

Section 4.3.2 of ISA-S67.04-1994 states that the assumptions, data, and methods used to determine the allowable value must be documented and consistent with those used to determine the trip setpoint. Section 5 of this standard also states that the various aspects of the uncertainty calculation must be documented. The NRC staff has generally required the methodology, assumptions, and data used to determine the trip setpoint and allowable value to be referenced or documented.

Measurement and test equipment (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. Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems,"[2] 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 the requirements of 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 Commission'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 Commission'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 Commission'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 discusses the limiting safety system setting (LSSS) and its relation to the analytical limit. The standard states that the LSSS may include a trip setpoint, an allowable value, or both, depending on the setpoint methodology employed. The standard also states that the LSSS may be maintained in TS or appropriate plant procedures. However, 10 CFR 50.36 states that the TS will include items in the categories of safety limits, limiting safety system settings, and limiting control settings. The allowable value, in conjunction with the trip setpoint, will determine the limits on instrument operability and must be specified in the TS in order to meet 10 CFR 50.36. The LSSS should be developed in accordance with the setpoint methodology based on the standard, with the allowable value listed in the TS and the relationship of the trip setpoint to the allowable value must be documented and controlled by the setpoint methodology.

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 TS corrective action must be taken. The allowable value relationship to the setpoint methodology and TS testing requirements 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.

This draft guide has been released to encourage public participation in its development. 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 methods to be described in the final guide reflecting public comments will be used in the evaluation of submittals in connection with applications for construction permits and operating 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

BACKGROUND

In response to the large number of the reported instances in which setpoints for safety-related instrumention drifted outside the limits specified in the technical specifications, Regulatory Guide 1.105 was issued in November 1975. Revision 1 to this regulatory guide was issued in November 1976 to provide additional guidance. The Instrument Society of America (ISA) sponsored a review of the setpoint drift problems in April 1975 by establishing the SP 67.4 Subcommittee. The Committee's review indicated that a more thorough consideration of setpoint drift was necessary in the design, test, purchase, installation, and maintenance of setpoints for safety-related instrumentation. In 1982, ISA developed a standard containing minimum requirements to be used for establishing and maintaining setpoints of individual instrument channels in safety systems. In February 1986, Revision 2 to this guide was issued to endorse ISA standard ISA-S67.04-1982. This Revision 2 provided more specific guidance on establishing and maintaining setpoints in response to (a) a continuing large number of reportable occurrences and (b) the licensing review of methodology for specifying allowable values and trip setpoints. The ISA standard was revised in 1988 and issued as ANSI/ISA-S67.04-1988 to provide clarification and to reflect current industry practice.

Many of the changes in the 1994 version of the standard reflect the Improved Technical Specification program (a cooperative effort between industry and the NRC staff).

VALUE

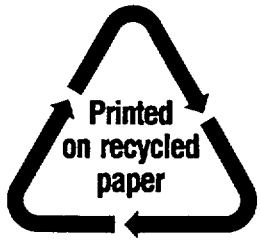
This regulatory guide endorses Part 1 of ISA-S67.04-1994. Revising Regulatory Guide 1.105 is consistent with the NRC policy of evaluating the latest versions of national consensus standards in terms of their suitability for endorsement by regulatory guides.

The value to NRC operations and industry is that there would be (1) a systematic method for specifying and reviewing technical specifications on allowable values and trip setpoints, (2) more sophisticated methods for specifying technical specifications, (3) a reduction in setpoint readjustments,

(4) less chance for unwarranted reactor shutdown, and (5) it is hoped, fewer LERs from the allowable limits of setpoints being exceeded.

IMPACT

ISA-S67.04-1994 provides clarifications (in many instances by redefining the technical terms used in the standard) and provides more specific guidance on establishing and maintaining setpoints. The 1994 version also reflects the improved technical specification program. It does not provide any new methodology for establishing setpoints as compared to the 1982 version. Thus the incremental cost should be negligible (or at most marginal) if an applicant or licensee complies with the guidance of ISA-S67.04-1994 as opposed to its 1982 version.



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