WCAP-17504-NP-A
Revision 1

October 2016

Westinghouse Generic Setpoint Methodology

Westinghouse

WCAP-17504-NP-A
Revision 1

Westinghouse Generic Setpoint Methodology

T. P. Williams*
Setpoints and Control Systems

October 2016

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*Electronically approved records are authenticated in the electronic document management system.

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October 14, 2016

Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

SUBJECT: FINAL SAFETY EVALUATION FOR WESTINGHOUSE ELECTRIC COMPANY TOPICAL REPORTS WCAP-17503-P/WCAP-17503-NP, REVISION 1, "WESTINGHOUSE GENERIC SETPOINT CONTROL PROGRAM RECOMMENDATIONS" AND WCAP-17504-P/WCAP-17504-NP, REVISION 1, "WESTINGHOUSE GENERIC SETPOINT METHODOLOGY" (TAC NO. ME8115)

Dear Mr. Gresham:

By letter dated February 20, 2012 (Agencywide Documents Access and Management System Accession (ADAMS) No. ML12058A448), Westinghouse Electric Company (Westinghouse) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review Topical Reports (TRs) WCAP-17503-P, Revision 0, and WCAP-17503-NP, Revision 0, "Westinghouse Generic Setpoint Control Program Recommendations" and WCAP-17504-P, Revision 0, WCAP-17504-NP, Revision 0, "Westinghouse Generic Setpoint Methodology." As a result of the NRC staff requests for additional information, Westinghouse prepared formal revisions to each TR, and submitted Revision 1 to WCAP-17503-P/NP and WCAP-17504-P/NP via letter to the NRC dated March 23, 2016 (ADAMS Accession ML16085A152).

The enclosed final SE addresses the applicability of the WCAP-17503-P/NP, "Westinghouse Generic Setpoint Control Program Recommendations," and WCAP-17504-P/NP, "Westinghouse Generic Setpoint Methodology," TRs.

The NRC staff has found that TR WCAP-17503-P/NP, "Westinghouse Generic Setpoint Control Program Recommendations" and WCAP-17504-P/NP, "Westinghouse Generic Setpoint Methodology," are acceptable for referencing in licensing applications provided that the limitations and conditions stipulated in the Section 4.0 and applicability defined in Sections 1.0 and 5.0 of the enclosed NRC final SE are met along with the proper documentation.

NOTICE: Enclosure 2 transmitted herewith contains proprietary information. When separated from Enclosure 2, this document is decontrolled.

Our acceptance applies only to material provided in the subject TRs. In accordance with the guidance provided on the NRC website, we request that Westinghouse publish accepted proprietary and non-proprietary versions of these TRs within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed final SE after the title page. Also, they must contain historical review information, including NRC requests for additional information (RAIs) and your responses. The accepted versions shall include an "-A" (designating accepted) following the TRs identification symbol.

As an alternative to including the RAIs and RAI responses behind the title page, if changes to the TRs were provided to the NRC staff to support the resolution of RAI responses, and the NRC staff reviewed and approved those changes as described in the RAI responses, there are two ways that the accepted version can capture the RAIs:

1. The RAIs and RAI responses can be included as an Appendix to the accepted version.
2. The RAIs and RAI responses can be captured in the form of a table (inserted after the final SE) which summarizes the changes as shown in the approved version of the TRs. The table should reference the specific RAIs and RAI responses which resulted in any changes, as shown in the accepted version of the TRs.

If future changes to the NRC's regulatory requirements affect the acceptability of this TR, Westinghouse will be expected to revise the TR appropriately or justify its continued applicability for subsequent referencing. Licensees referencing this TR would be expected to justify its continued applicability or evaluate their plant using the revised TR.

Sincerely,

/RA/

Kevin Hsueh, Chief
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700

Enclosures:
1. Final SE (Non-proprietary version)
2. Final SE (Proprietary version)

Our acceptance applies only to material provided in the subject TRs. In accordance with the guidance provided on the NRC website, we request that Westinghouse publish accepted proprietary and non-proprietary versions of these TRs within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed final SE after the title page. Also, they must contain historical review information, including NRC requests for additional information (RAIs) and your responses. The accepted versions shall include an "-A" (designating accepted) following the TRs identification symbol.

As an alternative to including the RAIs and RAI responses behind the title page, if changes to the TRs were provided to the NRC staff to support the resolution of RAI responses, and the NRC staff reviewed and approved those changes as described in the RAI responses, there are two ways that the accepted version can capture the RAIs:

1. The RAIs and RAI responses can be included as an Appendix to the accepted version.
2. The RAIs and RAI responses can be captured in the form of a table (inserted after the final SE) which summarizes the changes as shown in the approved version of the TRs. The table should reference the specific RAIs and RAI responses which resulted in any changes, as shown in the accepted version of the TRs.

If future changes to the NRC's regulatory requirements affect the acceptability of this TR, Westinghouse will be expected to revise the TR appropriately or justify its continued applicability for subsequent referencing. Licensees referencing this TR would be expected to justify its continued applicability or evaluate their plant using the revised TR.

Sincerely,

/RA/
Kevin Hsueh, Chief
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 700

Enclosures:
1. Final SE (Non-proprietary version)
2. Final SE (Proprietary version)

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ADAMS Accession Nos.: Pkg: ML16256A645; Cover letter: ML16256A788; Enc. 1: MLXXXXXXXXX; Att 1: ML16257A602; Enc. 2: ML16256A818; *via e-mail NRR-106

OFFICE	NRR/DPR/PLPB	NRR/DPR/PLPB*	NRR/DE/EICB	NRR/DPR/PLPB
NAME	ELenning	DHarrison	MWaters	KHsueh
DATE	9/14/16	9/14/16	/ /16	10/14/16

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U.S. NUCLEAR REGULATORY COMMISSION

FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR WESTINGHOUSE ELECTRIC COMPANY

TOPICAL REPORTS WCAP-17503-P/WCAP-17503-NP, REVISION 1,

"WESTINGHOUSE GENERIC SETPOINT CONTROL PROGRAM RECOMMENDATIONS,"

AND WCAP-17504-P/WCAP-17504-NP, REVISION 1,

"WESTINGHOUSE GENERIC SETPOINT METHODOLOGY"

PROJECT NO. 700

1.0 INTRODUCTION

By letter dated February 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML120580701), Westinghouse Electric Company (Westinghouse) submitted WCAP-17503-P/WCAP-17503-NP, Revision 0, "Westinghouse Generic Setpoint Control Program Recommendations," and WCAP-17504-P/WCAP-17504-NP, Revision 0, "Westinghouse Generic Setpoint Methodology," Topical Reports (TRs) for the U.S. Nuclear Regulatory Commission (NRC) review and approval. The NRC staff performed the acceptance review (ADAMS Accession No. ML121210716) of these documents, and began its detailed evaluation. The NRC staff and Westinghouse representatives met in November 2012 to discuss the level of detail the staff needed to make its "reasonable assurance" determination, and possible ways the NRC staff could receive access to summaries of Westinghouse and licensee evaluations of the raw data used for determining and combining instrument performance uncertainties (ADAMS Accession No. ML12346A132). As a follow-up to this meeting, the NRC staff provided comments to Westinghouse regarding the example Westinghouse calculation summary and the adequacy of detail the NRC staff would need to complete its review of the submitted calculation summaries. During this time, the NRC staff also developed a draft revision (DG-1141, ADAMS Accession No. ML081630179) to Regulatory Guide (RG) 1.105, "Setpoints for Safety-Related Instrumentation," which is one of the key regulatory guidance documents used for evaluating WCAP-17503-P/WCAP-17503-NP and WCAP-17504-P/WCAP-17504-NP.

The NRC staff prepared a set of requests for additional information (RAIs) pertaining to each TR (ADAMS Accession No. ML15033A187). Westinghouse provided RAI responses in LTR-NRC-5-37 dated June 25, 2015 (ADAMS Accession ML15183A246). Further, the NRC staff met with representatives of Westinghouse at the NRC Headquarters on September 16, 2015, to discuss the responses to RAIs. At that time, the NRC staff indicated to the Westinghouse representatives that the responses to the RAIs were adequate to enable completion of staff's evaluation. The NRC staff requested Westinghouse to incorporate clarifications resulting from these RAI responses into the TRs WCAP-17503-P/WCAP-17503-NP and WCAP-17504-P/WCAP-17504-NP as formal revisions to these TRs.

In response to this request, Westinghouse prepared formal revisions to both TRs, and submitted Revision 1 to WCAP-17503-P/WCAP-17503-NP and WCAP-17504-P/WCAP-17504-NP via letter to the NRC dated March 23, 2016 (ADAMS Accession No. ML16085A152), incorporating the resolutions to the NRC staff's RAIs into the text of each TR. This safety evaluation (SE) was prepared as an evaluation of Revision 1 to each of these TRs.

Westinghouse states the WCAP-17504-P/WCAP-17504-NP TR describes the Westinghouse Setpoint Methodology (WSM) and provides the basic uncertainty algorithms for the reactor trip system (RTS) trip functions, engineered safety features actuation system (ESFAS) protection functions, emergency operating procedure (EOP) operator action points, control system functions assumed as initial condition assumptions in the safety analyses, and control board and computer indication of plant parameters utilized by the plant operators to confirm proper operation of the control and protection instrumentation for a Westinghouse Nuclear Steam Supply System (NSSS). Westinghouse states that these algorithms, when supported by appropriate plant procedures and equipment qualification, provide total instrument loop uncertainties, termed Channel Statistical Allowance (CSA), at a 95 percent probability and 95 percent confidence level; in accordance with the guidance provided in NRC RG 1.105, Revision 3.

Westinghouse states the WCAP-17503-P/WCAP-17503-NP TR provides the Setpoint Control Program (SCP) characteristics that are necessary to control setpoint design input and methodology assumptions inherent in the WSM.

2.0 REGULATORY EVALUATION

The NRC staff evaluated the Westinghouse Generic Setpoint Methodology contained in WCAP-17504-P/WCAP-17504-NP TR submittal against the regulatory requirements and guidance listed below to ascertain whether there is reasonable assurance that the systems and components affected by setpoints calculated in conformance with the Westinghouse submittals listed in Section 1.0 will perform their required safety functions when called upon to do so. In addition, the submittals were reviewed to ensure that adequate design and document control measures, taken by licensees and applicants when implementing TR WCAP-17503-P/WCAP-17503-NP, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," will be in place to assure that appropriate data sources are identified, controlled, and maintained, and that instrument channel performance data will be controlled and evaluated in a manner that setpoints implemented in safety related functions will continue to be correctly selected and maintained.

2.1 Regulatory Requirements

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," establishes the fundamental regulatory requirements. Specifically, Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 provides, in part, that an application for a design certification, combined license, design approval, or manufacturing license, respectively, must include the principal design criteria for a proposed facility. The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety; that is, 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.

In 10 CFR 50.36, "Technical Specifications," the Commission established its regulatory requirements related to the contents of the technical specifications (TSs). Specifically, 10 CFR 50.36 states that "each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section." Specifically, 10 CFR 50.36(c)(1)(ii)(a) states, "Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded. If, during operation, it is determined that the automatic safety system does not function as required, the licensee shall take appropriate action, which may include shutting down the reactor." Additionally, 10 CFR 50.36(c)(3) states, "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions of operation will be met."

The regulation at 10 CFR 50.55a (h) Protection and Safety Systems, incorporates by reference the Institute of Electrical and Electronics Engineers (IEEE) Standard IEEE 279, "Criteria for Protection Systems for Nuclear Power Generating Stations," and the IEEE standard IEEE 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations." Clause 6.8, "Setpoints," of IEEE 603-1991 requires that the allowance for uncertainties between the process analytical limits and the device setpoint be determined using a documented methodology. The IEEE standard makes reference to the Industry Standard Instrument Society of America (ISA) (now referred to as the International Society of Automation--ISA) Standard S67.04-1987.

General Design Criterion (GDC) 13, "Instrumentation and Control," of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," requires that instrumentation be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, and that controls be provided to maintain these variables and systems within prescribed operating ranges.

GDC 20, "Protection System Functions," of Appendix A to 10 CFR Part 50 requires that the protection system be designed to initiate the operation of appropriate systems to ensure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences.

Appendix B of Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," is applicable, especially the following criteria:

Criterion III, Design Control

> Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in §50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled.

Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components.

Measures shall be established for the identification and control of design interfaces and for coordination among participating design organizations. These measures shall include the establishment of procedures among participating design organizations for the review, approval, release, distribution, and revision of documents involving design interfaces.

The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. The verifying or checking process shall be performed by individuals or groups other than those who performed the original design, but who may be from the same organization.

Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying or checking processes, it shall include suitable qualifications testing of a prototype unit under the most adverse design conditions. Design control measures shall be applied to items such as the following: reactor physics, stress, thermal, hydraulic, and accident analyses; compatibility of materials; accessibility for in-service inspection, maintenance, and repair; and delineation of acceptance criteria for inspections and tests.

Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and be approved by the organization that performed the original design unless the applicant designates another responsible organization.

Criterion VI, Document Control

Measures shall be established to control the issuance of documents, such as instructions, procedures, and drawings, including changes thereto, which prescribe all activities affecting quality. These measures shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the applicant designates another responsible organization.

Criterion XI, "Test Control," and Criterion XII, "Control of Measuring and Test Equipment"

Criteria XI and XII provide requirements for tests and test equipment used in maintaining instrument setpoints.

2.2 Regulatory Guides

Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentation," Revision 3, describes a

method that the NRC staff finds acceptable for use in complying with the NRC's regulations for ensuring that setpoints for safety-related instrumentation are initially within, and will remain within, the TS limits. RG 1.105, Revision 3, endorses Part I of ISA-S67.04-1994, "Setpoints for Nuclear Safety Instrumentation," which is subject to NRC staff clarifications. Regulatory Position 1 of this RG states that 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 NRC staff position states that the 95/95 tolerance limit is an acceptable criterion for uncertainties. That is, there is a 95 percent probability that the constructed limits contain 95 percent of the population of interest for the surveillance interval selected.

In June 2014, the NRC staff made available for public comment a draft revision to RG 1.105 DG-1141, "Setpoints for Safety-Related Instrumentation," that clarifies the NRC staff positions with regard to the application of the 95/95 criterion. In this draft revision to RG 1.105, in which the current version of the ISA standard ANSI/ISA 67.04.01-2006 is discussed, the NRC staff clarified that instrument performance uncertainty should be estimated using appropriate statistics. The estimate of total loop uncertainty should include all bias terms plus estimates of random uncertainties. The NRC staff position is that the estimate of random uncertainties should be based on population statistics based on the 95/95 criterion. The clarified NRC staff position states that it is generally assumed that random setpoint errors are distributed normally, such that they can be conservatively enveloped by a normal distribution with suitable parameters. When analyzing the expected instrument channel uncertainty performance, to verify the instrument channel will initiate its protective action before the analytical limit is reached, it is important that such distribution be estimated with a sufficiently large tolerance interval to ensure there is at least a 95 percent probability that the distribution of underlying data encompass at least 95 percent of all credible observations. The assumed or enveloping distribution affects the values of the uncertainty parameters and is affected by the amount and quality of the data on which the distribution is based. The draft revision to RG 1.105 also states that the use of statistical estimates or parameters that do not meet the 95/95 criterion should be justified, and the resulting setpoint limits should be shown to be consistent with the staff's intent to achieve assurance that the analytical limit will be protected. Data used in uncertainty analysis should be adjusted as appropriate to adequately represent population statistics. The draft revision to RG 1.105 also states that uncertainty data that cannot be based on a large number of observations should be based on bounding estimate values, accompanied by supporting analyses that demonstrate the bounding estimates to be appropriate. Such analyses should include a description of the reasoning behind the approach taken; a formal mathematical analysis is not required.

The NRC Regulatory Issue Summary (RIS) 2006-17, "NRC Staff Position on the Requirements of 10 CFR 50.36, 'Technical Specifications,' Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels," discusses issues that could occur during testing of limiting safety system setting (LSSS) (ADAMS Accession No. ML051810077). In a letter dated September 7, 2005, from Patrick L. Hiland (NRC) to the Nuclear Energy Institute's (NEI) Setpoint Methods Task Force, "Technical Specification for Addressing Issues Related to Setpoint Allowable Values" (ADAMS Accession No. ML052500004) footnotes are described that should be added to surveillance requirements related to setpoint verification for instrument functions on which a safety limit has been placed. This letter also addresses the information that should be included within TS to ensure operability of the instruments following surveillance tests related to instrument setpoint.

2.3 Supplemental Guidance

The Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) Owner's Groups' Technical Specification Task Force (TSTF) TSTF-493, Revision 4, dated January 5, 2010, (ADAMS Accession No. ML100060064) and an errata sheet, "Transmittal of TSTF-493, Revision 4, Errata," dated April 23, 2010 (ADAMS Accession No. ML101160026), clarify the application of setpoint methodology. The NRC approved TSTF-493, Revision 4, on May 11, 2010 (ADAMS Accession No. ML102601920). The TSTF-493 addresses the NRC staff concerns stated in RIS 2006-17. The NRC-approved TSTF was made available in *Federal Register* Notice, "Notice of Availability of the Models for Plant-Specific Adoption of Technical Specifications Task Force Traveler TSTF–493, Revision 4, 'Clarify Application of Setpoint Methodology for LSSS Functions,'" Vol. 75, No. 90/Tuesday, May 11, 2010 (ADAMS Accession No. ML093410581), which documents NRC's position on adoption of TSTF-493, Revision 4. In January of 2013, Office of Nuclear Reactor Regulation staff made available via the *Federal Register*, a Notice of Availability Supplement to NRC-2009-487, "NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program" (ADAMS Accession No. ML12342A157). This Supplemental Guidance for Option B outlined two portions of a license amendment request (LAR) submittal that would be needed by the NRC staff for the evaluation and approval of a proposed SCP. These were 1) a sufficiently detailed Setpoint Calculation Methodology description, and 2) a sufficiently detailed SCP description. The supplemental guidance contained in this document elaborated on the NRC staff's positions as to what constitutes a sufficiently detailed Setpoint Calculation Methodology description and a SCP description.

The NRC Office of New Reactors memorandum dated December 8, 2008 (ADAMS Accession No. ML083380666), contains Final Interim Staff Guidance (ISG), "Notice of Availability of the Final Interim Staff Guidance DC/COL-ISG-08 on Plant Specific Technical Specifications." Current and future COL applicants were directed to resolve all generic TS COL action (or information) items pertaining to 10 CFR 50.36 and 10 CFR 50.36a before COL issuance. This document provided guidance that allows COL applicant to choose how to resolve each such item using one of the proposed three options, listed in the order of preference:

(1) Provide a plant-specific value.
(2) Provide a value that bounds the plant-specific value, but by which the plant may be safely operated (i.e., a useable bounding value), or
(3) Establish a PTS Section 5.5 or 5.6 administrative controls program or report.

Such an administrative controls technical specification as described in option (3) shall require

(a) use of an NRC-reviewed and -approved methodology for determining the plant-specific value,
(b) establishment of an associated document, outside the PTS, in which the relocated plant-specific value shall be recorded and maintained, and
(c) any other information or restrictions the NRC staff deems necessary and appropriate to satisfy 10 CFR 50.36.

2.4 NRC Staff Review Guidance

Chapter 7 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (SRP) contains a Branch Technical Position (BTP), BTP 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints." This BTP provides guidelines for reviewing the process an applicant/licensee follows to establish and maintain instrument setpoints. These guidelines are based on reviews of applicant/licensee submittals and vendor TR submittals describing setpoint assumptions, terminology, methodology, and on experience gained from NRC inspections of operating plants.

The objectives of the review guidance as stated within BTP 7-12 are as follows:

- To verify that setpoint calculation methods are adequate to assure that protective actions are initiated before the associated plant process parameters exceed their analytical limits.
- To verify that setpoint calculation methods are adequate to assure that control and monitoring setpoints are consistent with their requirements.
- To confirm that the established calibration intervals and methods are consistent with safety analysis assumptions.

The review guidance in BTP 7-12 identifies certain industry standards and NRC generic communications that provide relevant guidance pertaining to setpoint methodology topics. Among these are:

> ISA-S67.04-1994, Part II, "Methodology for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," provides additional guidance, but RG 1.105, Revision 3, does not endorse or address Part II of ISA-S67.04-1994.
>
> IEEE Std. 498-1990, "IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities," and American National Standards Institute (ANSI)/National Conference of Standards Laboratories Std. Z540-1-1994, "Calibration Laboratories and Measuring and Test Equipment - General Requirements," provide guidance for the calibration and control of measuring and test equipment used in the maintenance of instrument setpoints.
>
> Generic Letter 91-04, "Guidance on Preparation of a Licensee Amendment Request for Changes in Surveillance Intervals to accommodate a 24-Month Fuel Cycle," provides guidance on issues that should be addressed by the setpoint analysis when calibration intervals are extended from 12 or 18 to 24 months.

The industry standards ISA-S67.04 Part II and IEEE 498-1990 also make reference to applicable portions of the industry standard ANSI/ISA 51.1-1979, "Process Instrumentation Terminology." This standard described the use, performance, operating influences, hardware, and product qualification of the instrumentation and instrument systems used for measurement, control, or both. It provides guidelines for a common vendor and user understanding when referring to terminology describing product specifications, performance, and operating conditions.

3.0 TECHNICAL EVALUATION

3.1 Westinghouse Topical Report WCAP-17504-P/WCAP-17504-NP

The NRC Office of Nuclear Reactor Regulation (NRR) staff performed the evaluation of Westinghouse TR WCAP-17504-P/ WCAP-17504-NP, Revision 1, using the review guidance contained in BTP 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints," of the NRC SRP, NUREG-0800, "Review of Safety Analysis Reports for Nuclear Power Plants." The technical evaluation provided below corresponds to the specific guidance and acceptance criteria contained in BTP 7-12. However, in the sections applicable to the evaluation of Channel Statistical Allowance, supplemental acceptance criteria as described within the NRC staff's proposed Draft RG DG-1141, "Setpoints for Safety-Related Instrumentation," were used by the NRC staff to compare the staff's proposed acceptance criteria against the performance criteria described in the Westinghouse TR. Full compliance with this supplemental guidance is not considered mandatory at this time, since the supplemental criteria described within the Draft RG is considered "Pre-Decisional." The next revision to RG 1.105 is expected to be issued within one year of the date of this SE. For completeness, the NRC staff included an evaluation of the TR against key supplemental criteria contained in this Draft RG, to ensure that the conclusions of this technical evaluation will remain valid in the event that the criteria discussed in the draft guide become part of the next revision to RG 1.105. (Note: Portions of the following technical evaluation are applicable to sections of WCAP-17504-P/WCAP-17504-NP, Revision 1, that have been identified as "Westinghouse Proprietary Class 2" information. These proprietary portions are enclosed in brackets marked as **[ ]**.)

Westinghouse stated that WCAP-17504-P/WCAP-17504-NP, Revision 1, is considered applicable to the following types of plants, when explicitly noted in the plant Updated Final Safety Analysis Report (UFSAR) referencing the equivalent of NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Vol. 2, Rev. 3.0, Sections B 3.3.1, B 3.3.2, B 3.3.3, and B 3.3.5, and References):

- Westinghouse-designed 2, 3, and 4 loop NSSS,
- Westinghouse-designed AP1000® plants,
- Toshiba-designed Advanced Boiling Water Reactors, and
- Combustion Engineering (C-E)-designed NSSS, with the exception of uncertainty calculations identified in the C-E document CEN-356(V)-P-A, "Modified Statistical Combination of Uncertainties," which are associated with the operation of the C-E designed digital monitoring and protection systems, i.e., Core Operating Limit Supervisory System (COLSS) and Core Protection Calculator System (CPCS). (This document was previously reviewed and approved by the staff. (See Letter, dated October 21, 1987, from Mr. E. A. Licitra, USNRC, to Mr. E.E. Van Brunt, Arizona Nuclear Power Project (ADAMS Accession No. 8809090159)).

Westinghouse also stated that it intends for the methodology to be applicable to the following specific types of functions, as follows:

> WCAP-17504-P/WCAP-17504-NP TR provides the basic instrument uncertainty algorithms for the RTS trip functions, ESFAS protection functions, EOP operator action points, control system functions assumed as initial condition assumptions in the safety analyses, and control board and computer indication of plant parameters utilized by the plant operators to confirm proper operation of the control and protection instrumentation. This includes the following:
>
> - RTS functions identified in Table 3.3.1-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
> - ESFAS functions identified in Table 3.3.2-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
> - Operator action points associated with instrumentation identified in Table 3.3.3-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
> - Setpoints associated with LCO 3.3.5," Loss of Power Diesel Generator Start Instrumentation" of NUREG-1431 (or equivalent for other NSSS vendor designs),
> - Instrumentation associated with the-control and indication functions identified in WCAP- 8567-P-A, "Improved Thermal Design Procedure" and
> - Instrumentation associated with the control and indication functions identified in WCAP-11397-P-A, "Revised Thermal Design Procedure."

In this evaluation, the NRR staff evaluates the setpoint analysis methodology and assumptions of WCAP-17504-P/WCAP-17504-NP, Revision 1, for any new safety related setpoints or setpoint changes for the reactor types and functions listed above that will be submitted to NRR as license applications or amendments, to confirm that an acceptable analysis method is being used and that the analysis parameters and assumptions are consistent with the safety analysis, system design basis, TS, plant design, and expected maintenance practices. The following factors were considered in the staff's review:

- Relationships between the safety limit, analytical limit, limiting trip setpoint, the allowable value, the setpoint, the acceptable as-found band, the acceptable as-left band, and the setting tolerance.
- Evaluation as to whether the setpoint TS meet the requirements of 10 CFR 50.36, as enhanced through the criteria within Regulatory Information Summary RIS 2006-17.
- Basis for selection of the trip setpoint.
- Uncertainty terms that are addressed.
- Method used to combine uncertainty terms.
- Justification of statistical combination.
- Relationship between instrument and process measurement units.
- Data used to select the trip setpoint, including the source of the data.
- Assumptions used to select the trip setpoint (e.g., ambient temperature limits for equipment calibration and operation, potential for harsh accident environment).
- Instrument installation details and bias values that could affect the setpoint.

- Correction factors used to determine the setpoint (e.g., pressure compensation to account for elevation difference between the trip measurement point and the sensor physical location).
- Instrument test, calibration or vendor data, as-found and as-left; each instrument should be demonstrated to have random drift by empirical and field data.
- Evaluation results should be reflected appropriately in the uncertainty terms, including the setpoint methodology.

3.1.1 Relationships Among Safety Limit, Analytical Limit, Limiting Trip Setpoint, Allowable Value, Setpoint, Acceptable As-Found Tolerance Band, Acceptable As-Left Tolerance Band, and Setting Tolerance.

In the current version of RG 1.105, Revision 3, issued in December 1999, the NRC staff endorsed the 1994 version of the ISA Standard 67.04, referred to at the time as Part 1 of ISA-S67.04-1994, "Setpoints for Nuclear Safety-Related Instrumentation." This standard defines the requirements for assuring that setpoints for nuclear safety-related instrumentation, are established and maintained within specified limits in nuclear power plants and nuclear reactor facilities. ISA-RP67.04.02-2000 is an industry consensus recommended practice that provides guidance for the implementation of ISA-S67.04.01-2000 (equivalent to Part 1 of ANSI/ISAS67.04, 1994). However, the NRC staff's endorsement of ISA Standard 67.04 in RG 1.105, Revision 3, does not extend to an endorsement of this recommended practice described in ISA RP67.04.02-2000.

The ISA 67.04 Standard contains requirements and the ISA RP67.04.02 Recommended Practice contains guidance for establishing and maintaining nuclear safety-related setpoints in the following areas:

- Methodologies, including sample equations, to calculate total channel uncertainty
- Common assumptions and practices in instrument uncertainty calculations
- Equations for estimating uncertainties for commonly used analog and digital modules
- Methodologies to determine the impact of commonly encountered effects on instrument uncertainty
- Application of instrument channel uncertainty in setpoint determination
- Sources and interpretation of data for uncertainty calculations
- Discussion of the interface between setpoint determination and plant-operating procedures, calibration procedures, and accident analysis, and
- Documentation requirements

The ISA standard provides definitions and describes relationships for the terms referred to in the standard as "Safety Limit," "Analytical Limit," "Trip Setpoint," and "Allowable Value." A figure in the ISA standard depicts the industry consensus relationships among these terms. Allowances for Channel Performance Uncertainty between the Analytical Limit and the Trip Setpoint are described in paragraph 4.3.1 of the ISA Standard. This allowance should account for uncertainties due to instrument calibration activities, normal operating performance, power supply voltage and frequency variations, ambient temperature, humidity, and pressure fluctuations, radiation exposure, analog-to-digital and digital-to-analog conversions, instrument drift under normal operations and normal range of ambient effects, and instrument uncertainties due to design-basis events, such as radiation, seismic, temperature, and pressure effects due to design-basis accident exposure. It should also account for uncertainties due to calculation

(modeling) effects (e.g., determination of primary side power via the use of secondary side power calorimetric), process dynamic effects, and calibration and installation bias effects.

The ISA standard also states that uncertainties to be accounted for between the Trip Setpoint and the "Allowable Value" should account for instrument calibration uncertainties, instrument uncertainties experienced due to normal operational effects, and instrument drift. If the instrument "as-found" condition during surveillance testing is determined to be outside (more non-conservative than) the Allowable Value, the channel is to be evaluated for operability in conformance with the plant TS requirements. The ISA standard identified that uncertainties occurring within the non-conservative direction from the trip setpoint toward the direction of the Analytical Limit are to be calculated and administratively limited. (However, it did not address uncertainties that could occur in the conservative direction. The ramifications of this are described in the next subsection, pertaining to compliance with NRC RIS 2006-17.)

The ISA standard also describes acceptable methods for combining uncertainties. Specifically, the standard states that square-root-sum-of-squares (SRSS) and algebraic methods may be employed. However, alternate methods, including probabilistic or stochastic modeling, or a combination of SRSS and algebraic methods may also be used. In general, random, independent, normally-distributed uncertainty terms are combined using SRSS combination. Dependent terms are generally to be first combined algebraically, and then combined in quadrature (i.e., via SRSS) with other independent terms. Uncertainty terms identified as biases, are generally combined algebraically with other bias terms and then algebraically with the resultant SRSS combination of random uncertainties. The sign (direction) of the bias term may be taken into account such that the resultant of positive and negative biases in the direction of interest may be used. If the sign of the bias term is not known, the absolute value of the bias term must be added to the resultant combination of biases in the direction of interest for which the sign is known.

The NRC staff guidance in RG 1.105 endorses the concepts of the ISA standard described above, but also provides further guidance regarding the acceptance criterion to be used for estimating the individual instrument channel uncertainties and total loop uncertainty when determining setpoints and allowable values. Specifically, the NRC staff position is that when estimating uncertainties, they should be evaluated as "95/95" tolerance intervals. As described in Section 2.2 above, appropriate statistical rigor should be employed such that there is a 95 percent confidence that the constructed limits of the tolerance interval contain 95 percent of the uncertainty population of interest.

Westinghouse WCAP-17504-P/WCAP-17504-NP, Revision 1, describes a generalized algorithm (Eq. 2.1 in the TR) that is used as the basis to determine the overall instrument uncertainty to be applied when determining appropriate setpoints and allowable setpoint margins for a RTS function and for an ESFAS function (i.e., Protection functions.) The WCAP-17504-P/ WCAP-17504-NP, Revision 1, TR also contains detailed descriptions of the uncertainty terms and values for typical RTS/ESFAS, control and indication function uncertainty calculations performed by Westinghouse. Function-specific uncertainty algorithms, noting the appropriate combination of instrument uncertainties to determine the CSA are also described within the TR. The generalized algorithm used for all protection functions includes the terms of the SAL, the Nominal Trip Setpoint (NTS), the Total Allowance (TA) (the difference between the SAL and NTS, in % of span), Margin and Operability criteria, As-Left Tolerance (ALT), and As-Found Tolerance (AFT), for both the sensor/transmitter and process racks. The relationship

of these terms among one another is illustrated in Figure 3-1 of WCAP-17504-P/WCAP-17504-NP, Revision 1, reproduced below.

Figure 3-1 Westinghouse Setpoint Parameter Relationship Diagram (Increasing Function)

Note: This figure is intended to provide relative position and not to imply direction.

<u>Nominal Trip Setpoint vs. Limiting Trip Setpoint</u>

The staff notes that Westinghouse does not employ the concept of a "Limiting Trip Setpoint" (LTSP) that is separate and distinct from a "Nominal Trip Setpoint" in its application of the methodology for RTS or ESFAS trip functions, as described in the ISA 67.04 Standard, and as is frequently employed in other licensee or vendor setpoint methodology programs approved by the NRC. Instead, the WSM ensures that the TA between the SAL and the NTS is inclusive of all CSA errors with a non-negative margin, i.e., ≥0% span. The staff agrees that estimating

individual uncertainty terms on a 95/95 basis or as bounding allowances provides sufficient assurance for protecting the analytical limit; hence, the safety limit will be protected as well.

Analytical Limit

The WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, defines the term SAL to be:

> The parameter value identified in the plant safety analysis or other plant operating limit at which a reactor trip or actuation function is assumed to be initiated. The SAL is typically defined in Chapter 15 of the UFSAR (current operating plants) or Tier 2, Chapter 15, Table 15.0-4a of Reference 14 (AP1000® plant). Actual SAL values are determined, or confirmed, by review of the plant safety analyses. The SAL is the starting point for determination of the acceptability of the CSA, see Figure 3-1.

The NRC staff finds that this definition corresponds to staff's understanding of "Analytical Limit," as defined in the endorsed ISA 67.04 Standard—namely, "the value of a given process variable at which the safety analysis models the initiation of the instrument channel protective action." This is the parameter value considered in modeling and analysis of nuclear plant safety systems for design-basis accidents, transients, and anticipated operational occurrences, such that if the initiation of a protective function occurs at a value more conservative than this limit, the safety analyses conclusions will demonstrate successful prevention or mitigation.

Channel Statistical Allowance

The Channel Statistical Allowance accounts for (includes among all other identified channel performance uncertainties) the uncertainty terms such as bistable calibration accuracy (the WSM refers to this as Rack Calibration Accuracy, RCA), bistable drift (the WSM calls it Rack Drift, RD), and Measurement and Test Equipment Accuracy, RMTE, which are terms that are, in some NRC staff-approved non-Westinghouse setpoint analysis methodologies, applied allowances that are often allocated between the Limiting Trip Setpoint and NTS. The NRC staff finds the Westinghouse-proposed practice to be acceptable, and conservative, in that the equivalent complete set of uncertainty terms are being accounted for between the nominal instrument setting for the channel and the SAL. This allows the WSM term "Nominal Trip Setpoint" to be designated as the "Limiting Trip Setpoint," or "Limiting Safety System Setting" as described in regulations and guidance pertaining to the establishment and maintenance of plant TS. (For more detail on this, see Section 3.1.2 below.)

Setting Tolerance/Calibration Tolerance for Sensors and Rack Equipment

The NRC staff notes that across the civilian nuclear industry there is a range of definitions associated with the use of the term "setting tolerance." In general, the term "setting tolerance" is equivalent to the term "calibration tolerance." This tolerance (sometimes referred to as an "allowance" or "setting allowance") represents the precision to which a module or transmitter is calibrated to (or is allowed to deviate from) values depicted on an ideal instrument channel calibration performance curve/line, and maintained through the application of a formal calibration procedure. This tolerance is applied to instrument channel settings, as in the setting of a bistable trip device, and to the establishment of the expected output signal value for

cardinal points along the span of an analog instrument loop, such as the measured parameter values corresponding to 0 percent, 20 percent, 40 percent, 60 percent, 80 percent, and 100 percent of an instrument channel measurement span.

The WCAP-17504-P/WCAP-17504-NP, Revision 1, describes the term Sensor Calibration Accuracy (SCA) as:

> The two-sided (+/-) calibration tolerance for a sensor or transmitter defined by the ALT in the plant calibration procedures. The SCA is defined at multiple points across the calibration range of the channel, e.g., 0%, 25%, 50%, 75%, and 100% span. [
>
>]

The text and accompanying figures and tables shown on pages 63-64 of ISA Standard 51.1-1979, "Process Instrumentation Terminology," describe the calibration methodology for observing the effects of conformance, hysteresis and linearity of a transmitter while evaluating the conformance of an instrument to an ideal, or desired, calibration curve. The process for determining the applicable tolerance is based on the method for determining hysteresis plus deadband. The standard describes how to utilize a minimum of three passes up, and three passes down to be able to observe the effects of conformance, hysteresis, and linearity. It also describes a method for recording and evaluating the band of data values observed.

Section 4 of the WCAP-17504-P/WCAP-17504-NP, Revision 1, discusses the Westinghouse proprietary methodology for evaluating the data taken during calibration surveillances when using this three pass up and three pass down calibration method. This methodology covers the data analysis techniques required to be applied to arrive at sufficient quality and quantity of data to meet the 95/95 criterion, including the normalization of data, establishment of criteria for meeting the required probability and confidence level, evaluation of the resulting distribution function, evaluation of outliers, identification of the resulting magnitude of drift, and a discussion of the impact of time dependence.

The WCAP-17504-P/WCAP-17504-NP, Revision 1, describes the term RCA as the calibration tolerance reflected in the plant calibration procedures, applied at the NTS for the bistable or trip module, or at multiple points across the calibration range of the channel, (e.g., 0%, 25%, 50%, 75% and 100% span for input modules.) This applied calibration tolerance is not simply the assignment of an assumed tolerance value which follows "rule of thumb" criteria (for example, one that is based on vendor reference accuracy or a fraction/multiple thereof), but rather it is an engineered tolerance based on a particular testing and documentation method that is proprietary to the WSM. The individual modules in a loop are to be calibrated to a particular tolerance and the process loop (as a string) is verified to be calibrated to a specific tolerance

(RCA). Specifically, regarding the magnitude of that tolerance, the WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

> RCA is the two-sided (±) calibration tolerance of the process racks as reflected in the plant calibration procedures. RCA is defined at multiple points across the calibration range of the channel, and specifically at the NTS for the bistable or trip module.
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Although the NRC staff notes that this method requires more calibration process effort than is currently considered normal practice for most plants, if performed properly the method is considered conservative, in that it has the benefit of improving safety through better maintenance of safety related instrument channel calibration settings and trip setpoints, and will enable the plant to experience fewer spurious protection system or ESF system actuations. If the three passes up and down method of calibration is employed, the band of data recorded at each calibration ordinal point should be tighter, while sufficiently accounting for the effects of sensor reference accuracy.

As-Found Tolerance and As-Left Tolerance

Branch Technical Position BTP 7-12, Revision 5, provides a description of the NRC staff understanding of the terms Acceptable AFT Band and Acceptable ALT Band. It enhances the definitions described in ISA Standard 67.04 and RG 1.105, Revision 3, as follows:

Acceptable as-found band: It is the band around the NTS or previous as-left setting of the instrument within which the as-found setpoint is expected to fall. The band accounts for the uncertainties associated with factors such as instrument reference accuracy, measurement and test equipment (MT&E), readability, normal environment effect, and drift of the instrument components that are being tested, and it accounts only for the duration between the tests. The width of the band is established by the Deviation Limit (DL), which may be asymmetrical relative to the reference value (NSP) or a previous as-left) and defines the deviation (from the previous as-left value or NSP) that is expected to occur during the test. It should be noted that the DL must not include the setting tolerance (ST).

As-left tolerance band or acceptable as-left band: It is the band around the NTS (LSP) - or around any value which is more conservative than the LSP - within which the as-left setpoint must fall at the conclusion of a channel test. The band accounts for the ALT, which some licensees define as leeway given to instrument technician or calibration tolerance or setting tolerance. Setting tolerance can be based upon particular uncertainties such as reference accuracy, MT&E, and readability, but the total loop uncertainty analysis must explicitly account for each of these uncertainty terms whether or not the ST incorporates these uncertainties. ST may also be a specified value selected on the basis of engineering judgment or other consideration. However, in that situation, the as-found value must be compared with the previous as-left value.

The NRC staff notes that the purpose of these bands is to provide a benchmark for constraining the safety system setting to within an acceptable band upon initial calibration and subsequently during a periodic surveillance, and establishing a reasonable deviation limit to which the channel performance may reach upon testing during the next calibration surveillance, and still be considered functioning as expected or required. Although the definitions provided in the BTP provide the NRC staff's positions with respect to determining the basis for these bands, the NRC staff position does not represent a requirement, and licensees and applicants may propose alternative ways to address the basis for such setting limits and deviation acceptance criteria.

WCAP-17504-P/WCAP-17504-NP, Revision 1, describes a method for identifying an appropriate AFT and defining an ALT. The magnitude of the AFT for the instrument process rack is defined to be the same as that of the ALT. The WSM defines the ALT to be the appropriate calibration accuracy in the uncertainty calculations for the sensor or associated instrument process rack string.

For process racks, the ALT is a two-sided parameter equal to the RCA (described above) about the NTS (see Figure 3-1). It is also reflected in process rack calibration procedures as the "as left limit," which is applied in both directions about the desired calibration points for racks (e.g., 0 %, 25 %, 50 %, 75 % and 100 % span for process measurement input strings). [

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Evaluation of the Westinghouse methodology for applying the As-left and AFT bands is discussed in a greater detail in Section 3.1.2 below.

<u>Rack Drift and Sensor Drift</u>

In the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, for Westinghouse process racks, the appropriate value for both ALT and AFT has been analyzed to be equal to the instrument process RCA, such that AFT= ALT= RCA, (see Figure 3-1 above for how it relates to the NTS). For process racks, the AFT is a two-sided parameter (±) about the NTS. It is also defined as encompassing the expected rack drift (RD), and is reflected in process rack surveillance procedures as the "as found limit," which is applied in both directions (±), initially in the field about the desired calibration point (which establishes RD as an absolute limit of drift parameter), and periodically verified thereafter to be accurate [ ] about the calibration As-Left point (which establishes RD as a relative drift parameter).

[ ]

Rack Drift is defined in the WSM as the change in input-output relationship (As Found-As Left) over a period of time at reference conditions, e.g., at constant temperature. Westinghouse notes that: [ ] In the WSM, it is necessary to record and trend the As-Found and As-Left conditions of the process racks (RD= (As Found-As Left)), to assure conformance with the uncertainty calculation basic assumptions and to address the supplemental guidance described in the DG-1141 Draft RG 1.105 (Revision 4) to achieve the required 95/95 basis. (As Found-As Left) is defined as [ ]

WCAP-17504-P/WCAP-17504-NP, Revision 1, also states that the terms AFT and ALT as applied to process racks, these are two-sided (±) parameter equal to the RCA about the calibration points across the instrument span, including about the NTS. For transmitters, the ALT is defined as the two-sided (±) SCA magnitude about the desired calibration points. The AFT for transmitters is a two-sided parameter (±) about the calibration points (absolute drift), or a two-sided parameter (±) about the calibration recorded [ ] (representing relative drift).

The method for defining/establishing AFT and ALT is acceptable to the NRC staff. The staff notes that in RIS 2006-17, it was found acceptable to define AFT as follows:

> Subsequently, the NRC staff investigated the acceptability of basing operability determinations for as-found instrument values on NSP (Nominal Setpoint) values. The NRC staff review concluded that if specific conditions are met, then the NRC staff would find a NSP-based assessment of as-found values acceptable. Those conditions are: (1) the setting tolerance band is less than or equal to the square root of the sum of the squares of reference accuracy, measurement and test equipment, and readability uncertainties; (2) the setting tolerance is included in the total loop uncertainty, and (3) the pre-defined test acceptance criteria band for the as-found value includes either, the setting

tolerance or the uncertainties associated with the setting tolerance band, but not both of these.

In meetings with Westinghouse held during the course of this TR review, the NRC staff learned that the WSM, described in WCAP-17504-P/WCAP-17504-NP, Revision 1, takes advantage of an extensive Westinghouse knowledge base regarding the operational performance history of the Westinghouse/Hagan, Foxboro, 7100, 7300, and Eagle-21 series of analog and digital process protection system equipment. This equipment is relied upon to perform or contribute to the reactor trip and essential safety features actuation functions. Westinghouse has performed analysis over the years and identified that the performance of this equipment is very stable when operating in environmentally-controlled plant areas, such as that found in control rooms and auxiliary electric equipment rooms of nuclear power plants. For the 7300 series equipment and later version board designs, special features have been incorporated into the design to keep the performance of electronic circuit cards stable and electronic drift to a minimum due to the normal variations of ambient temperature. Also, the uncertainty already included in the temperature effect of this normal ambient temperature fluctuation has been conservatively computed at the 120°F level, when the normal environment is expected to be at most 104°F. In particular, the overall drift performance of the equipment mounted on the racks in such control rooms and auxiliary equipment rooms is well-known, and found to be well bounded within the uncertainty allowance for total rack calibration accuracy. Nevertheless, while Rack Drift is expected to be negligible for this equipment, for the WSM uncertainty model to remain accurate, the WSM requires periodic verification of actual drift experienced over the course of time through the trending and analysis of As-found and As-left calibration performance data.

As existing plant equipment ages and is replaced with newer design equipment, Rack Drift and Sensor Drift for the newer equipment are expected to remain very small, in comparison with other terms such as rack calibration accuracy. In response to one of the NRC staff's RAIs regarding how Westinghouse intends to account for drift of rack components that are replaced with components that have not been used before, Westinghouse stated:

[

]

Regarding drift for transmitters or process racks, Westinghouse responded that the magnitude of drift:

[

]

The NRC staff finds that WCAP-17504-P/WCAP-17504-NP, Revision 1, adequately describes the important relationships among Safety Limit, Analytical Limit, Limiting Trip Setpoint, Allowable Value, Setpoint, Acceptable AFT Band, Acceptable ALT Band, and Setting Tolerance. Based on the discussion of terms and relationships presented in the WCAP-17504-P/WCAP-17504-NP, Revision 1, and the sample calculations, tables, and figures presented in WCAP-17504-P/WCAP-17504-NP, Revision 1, the NRC staff finds that the Westinghouse setpoint methodology demonstrates that the correct relationships between the SL, AL, NTSP, AFT, and ALT will be ensured, that the basis for the NTS is correct, and that the requirements of GDC 13 and 20 are met.

3.1.2 Evaluation of Compliance with Technical Specifications and RIS 2006-17

NRC RIS 2006-17 described a concern with verification of operability using only the TS "Allowable Value" (AV), or a "one-sided approach," during periodic testing (channel operational test, calibration test). The RIS states:

> As one measure of instrument operability, the NRC staff expects licensees to verify during testing or calibration that the change in the measured trip setpoint (TSP) since the last test or calibration is within predefined limits (double-sided acceptance criteria band) and to take appropriate actions if the change is outside these limits. The acceptance criteria band should be derived from the appropriate licensee/vendor setpoint methodology, including use of generic or plant-specific data. If the as-found TSP exceeds the AV in the plant Technical Specifications, the channel is declared INOPERABLE and the associated action requirements are followed. If the change in the measured TSP exceeds the predefined evaluation limits but the measured TSP is conservative with respect to the AV, and the licensee determines during the surveillance that the instrument channel is functioning as expected and can reset the channel to within the setting tolerance (amount by which as-left setting value is permitted to differ from the nominal setpoint), then the licensee may restore the channel to service and the condition is entered into the licensee's corrective action program for further evaluation. However, if during the surveillance the change in the measured TSP exceeds the predefined evaluation limits and the licensee cannot determine that the instrument channel is functioning as required, then the instrument is declared INOPERABLE and the associated TS actions are followed. It is NRC staff's position that verifying that the as-found TSP is within the acceptance band limits during test or calibration is part of the determination that an instrument is functioning as required.

As described within the WSM presented in WCAP-17504-P/WCAP-17504-NP, Revision 1, Westinghouse does not recommend use of the "Allowable Value" term for making operability decisions regarding instrument channels for plants proposing future changes to plant TSs when employing the use of the WSM as described in WCAP-17504-P/WCAP-17504-NP, Revision 1.

Instead, it is intended that licensees use the evaluation tolerance values "± ALT" and "± AFT" as the correct values on which to base decisions regarding channel operability. In a clarification provided in a response to one of the staff's RAIs on this subject, Westinghouse stated:
With respect to a normally operating instrument channel and an instrument technician driving the As Left condition to a near zero % span calibration error, the expected As Found condition would be within the (NTS ± As Left Tolerance), which the Westinghouse evaluation of plant data demonstrates. Thus, for Westinghouse specified process racks, OPERABLE is defined as:

> As Left condition ≤ (NTS ± As left Tolerance), where the ALT = RCA, and
>
> First Pass As Found condition ≤ (NTS ±As Found Tolerance), where the AFT = ALT (as initially evaluated in the field), and
>
> INOPERABLE process rack instrumentation is defined as a condition where the As Left condition or As Found condition is in excess of the above, i.e.,
>
> As Left condition > (NTS ± As Left Tolerance), where the ALT= RCA, and
>
> First Pass As Found condition > (NTS ± As Found Tolerance), where AFT= ALT

Therefore, the WSM described in the WCAP-17504-P/WCAP-17504-NP, Revision 1, uses double-sided evaluation acceptance criteria bands. Figure 3-1 (above) and the relationships described above illustrate how the operability of the instrument loop is evaluated. Exceeding the AFT in either high or low direction may indicate degraded performance and inability of the instrument channel to meet its intended function. Not being able to reset the setpoint to within the ALT at the conclusion of a channel calibration process also may indicate degraded performance and inability of the instrument channel to meet its intended function.

Based on the requirements of 10 CFR 50.36(c)(1)(ii)(A), the WSM defines the NTS as the LSSS for the RTS and ESFAS functions listed in the plant TSs, e.g., Tables 3.3.1-1 and 3.3.2-1 of NUREG-1431, the Westinghouse Owners Group standardized TSs.

Within TSTF-493 traveler (ADAMS Accession No. ML101160026), affected subsections of NUREG-1431, have been marked to show how a user adopting TSTF-493 Option A or Option B would modify their plant technical specifications to apply the provisions of Option A or Option B as agreed upon with the NRC staff. These markings identify the scope of limiting safety system functions covered by TSTF-493, and the application of the setpoint maintenance and control provisions that would apply. For those Westinghouse NSSS plants whose plant-specific TSs contain both Allowable Value and NTS columns, the NTS identified in the TSs is expected to represent the NTSP for the channel. TSs for plants adopting TSTF-493 Option A would have footnotes added to identify the applicability and use of the As-Found and As-Left values. TSs for plants adopting TSTF-493 Option B would have the Allowable Value and NTS columns removed, and a pointer or note would be placed within the Technical Specifications Administrative Programs section as to where the Licensee SCP information may be found.

The traveler for the NRC-approved TSTF-493 program states:

> In NUREG-1431, the option is given to list only the Allowable Value or to list the Allowable Value and the [Nominal Trip Setpoint (NTSP)]. This second option is referred to as the "multiple columns" format; in this presentation, the [NTSP] is

the LSSS. Those plants that utilize the "multiple column" format are not required to incorporate the NTSP value in the last sentence in Note 2 because any change to the value requires prior NRC review and the values cannot be changed by the licensee under 10 CFR 50.59. For plants that specify the [NTSP] or [LTSP] instead of the Allowable Value, the same restrictions apply and the identification of the [LTSP] or [NTSP] in the last sentence in Note 2 is not required.

The surveillance notes applicable to NUREG-1431 will state:

INSERT 1 (NUREG-1431)

If the as-found channel setpoint is outside its predefined AFT, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

INSERT 2 (NUREG-1431)

The instrument channel setpoint shall be reset to a value that is within the ALT around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided that the as-found and ALTs apply to the actual setpoint implemented in the Surveillance procedures (field setting) to confirm channel performance. The Nominal Trip Setpoint and the methodologies used to determine the as-found and the ALTs are specified in [insert the facility FSAR reference or the name of any document incorporated into the facility FSAR by reference].

The methodology described in WCAP-17504-P/WCAP-17504-NP, Revision 1, for applying the AFT and ALT terms serves to constrain the adjusted setpoint to within a small deviation from the ideal analyzed setting, and provides an adequate basis for monitoring any deviation of this setpoint from its As-left condition, thus providing a means by which excessive deviation may be identified for corrective action. The NRC staff finds that the methodology and use of the terms for AFT and ALT as described within the WCAP-17504-P/WCAP-17504-NP, Revision 1, addresses the concerns noted in RIS 2006-17, is compatible with the guidance provided in TSTF-493 for Westinghouse plants, and is consistent with the requirements of 10 CFR 50.36.

For licensees electing to implement TSTF-493 Options A or B, Westinghouse states:

Those plants that opt for Option A of TSTF-493 Revision 4 will have one of several parameters listed in the Technical Specifications for RTS/ESFAS functions. These options and the Westinghouse recommendations that address them are noted below.

1. Allowable Value only,
2. Nominal Trip Setpoint only and
3. Nominal Trip Setpoint and Allowable Value.

> Westinghouse recommends the Technical Specifications include the NTS only (Item 2--the Nominal Trip Setpoint only) as that places control on the parameter of primary interest, the NTS. As the WSM does not support the Allowable Value concept, for (1) and (3); Westinghouse will provide only the ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS.
>
> Those plants that opt for Option B of TSTF-493 Revision 4 (Reference 18) will relocate the RTS/ESFAS trip setpoints values from the Technical Specifications and utilize a Setpoint Control Program (SCP). The Westinghouse recommendations for an SCP based on the WSM are identified in WCAP-17503-P, Revision 1 (Reference 19). In this instance, the process rack ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS, for each protection function are defined in an administratively controlled document. If the protection function uncertainty calculations are performed by Westinghouse, this document would be a plant-specific WCAP providing a summary of the uncertainty calculations with tables identifying the process rack ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS.

It's the NRC staff understanding of the Westinghouse TSTF-493 Option B statement above that for future applications and license amendments where the applicant or licensee adopts the Westinghouse Setpoint Methodology or both the Westinghouse Setpoint Methodology and the Westinghouse SCP Recommendations for TSTF-493 Option B submittals, licensees may propose to revise their plant-specific TSs to remove references to use of the "Allowable Value" term for the specific functions covered by this methodology and consistent with the scope of LSSS identified in the TSTF-493 Traveler package described above. If it is found that an instrument channel has exceeded the AFT value, the channel is considered inoperable. In addition, those plants adopting TSTF-493 Option B will remove the setpoints from the TSs altogether, and place them into a licensee-controlled document consistent with the TSTF-493 Option B provisions.

The NRC staff understanding is that in the event when during a periodic TS surveillance test channel performance is found to be outside the designated AFT, the following actions are to be taken: 1) declare the channel inoperable due to the surveillance test failure, 2) bring the channel back to within the designated ALT, thereby restoring operability, and 3) perform an engineering evaluation of the channel based on its performance during previous surveillance intervals. If a channel is determined to be inoperable, the licensee will comply with the applicable Actions in the plant TSs, which may require that the channel be placed into Trip or Bypass.

The Westinghouse Setpoint Methodology does not support the concept of "Allowable Value" for TS operability determination. Therefore an "Allowable Value" is not calculated or determined from values used in the Channel Statistical Allowance (CSA) equation. The NRC staff requested Westinghouse to provide clarification regarding how licensees would implement the Westinghouse AFT values if they choose to retain the "Allowable Value" term values currently published in their plant-specific TSs of their current licensing basis. In a closed meeting held on September 16, 2015, at the NRC Headquarters between Westinghouse representatives and NRC staff, the Westinghouse representatives stated that the value corresponding to the AFT term would be used for determining whether the channel was "performing as expected." If the

as-found value for the instrument channel was found during a calibration surveillance to be outside of this AFT, but more conservative than the TS Allowable Value, the surveillance information for that channel would include a notation that the channel was able to be reset to within the ALT, and the channel was to be placed into a corrective action program, for which calibration results would be trended and an evaluation would be made concerning whether instrumentation within the channel should be considered for replacement with new equipment of the same type. If the calibration surveillance information revealed that the Allowable Value was exceeded, the channel would be declared INOPERABLE after evaluation of the data, and corrective action would be taken immediately to restore the channel to Operable status.

3.1.3 Basis for Selection of the Nominal Trip Setpoint

The WSM states that the TA for instrument channel performance uncertainty that must be present between the SAL and the NTS should consist of an evaluation of CSA plus some non-negative Margin. The WSM states that the NTS is the nominal value programmed into digital instrument process racks or the nominal value to which the bistable is set for analog instrument process racks. According to the WCAP-17504-P/WCAP-17504-NP, Revision1, the NTS is based on engineering judgement (to arrive at a Margin ≥0 % span), or at a historical value that has been demonstrated over time to result in adequate operational margin. The methodology described in WCAP-17504-P/WCAP-17504-NP, Revision 1, for estimating the CSA provides significant detail regarding the identification of uncertainties to be estimated, the types of uncertainties (e.g., random, dependent or independent, bias, known sign or unknown sign, etc.), and the method for combining these uncertainties. This methodology is consistent with the philosophy articulated in ISA Standard 67.04, endorsed by the NRC Regulatory Guide 1,105 Revision 3. For any protection function of existing plants, the application of this methodology is to compare the CSA magnitude with the TA to determine the magnitude of the Margin remaining. The WSM results in the total of uncertainties to be included in, and the conservatism of, the CSA algorithm should result in a CSA magnitude that is calculated on a two-sided(±) 95 percent probability with 95 percent confidence level (i.e., 95/95) basis. This guidance is consistent with the guidance contained in the NRC staff's Draft RG D1141.

Use of 95/95 statistical evaluation acceptance criteria is considered by the NRC staff as the generic acceptance criterion for nuclear safety evaluations for determining reasonable assurance. The NRC staff believes that such an acceptance criterion is considered adequate to assure that protective actions are initiated before the associated plant process parameters exceed their analytical limits. Therefore, the NRC staff finds that WCAP-17504-P/WCAP-17504-NP, Revision 1, provides an adequate methodology basis for selecting the NTS that is consistent with the philosophy identified in the NRC guidance and industry standards. This methodology is described in greater detail below in Sections 3.1.4 and 3.1.8.

3.1.4 Uncertainty Terms

WCAP-17504-P/WCAP-17504-NP, Revision 1, provides a specific list of uncertainty terms used in the WSM and provides definitions associated with each of them. These terms have been identified in previous white papers and descriptions of the WSM, or have been identified by licensees employing specific aspects of WSM as described in previously-published Westinghouse white papers, as a portion of their plant-specific setpoint methodologies.

The WSM identifies which terms may be considered to be independent and which terms are considered dependent on one or more of the other terms. The categorization as to whether the term is treated as dependent or independent is based, in part on how the performance of the instrument channel is periodically checked or on how the channel performance is evaluated. For example, WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

> Six parameters are considered to be sensor allowances: Sensor Calibration Accuracy (SCA), Sensor Measurement and Test Equipment Accuracy (SMTE), Sensor Drift (SD), Sensor Temperature Effect (STE), Sensor Pressure Effect (SPE) and Environmental Allowance (EA). Two of these parameters are considered to be independent, two-sided (±), unverified (by plant calibration or drift determination processes), vendor supplied terms (STE and SPE).
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> STE and SPE are considered to be independent due to the manner in which the instrumentation is checked; i.e., the instrumentation is calibrated and drift is determined under conditions in which pressure and temperature are assumed constant. For example, assume a sensor is placed in some position in the containment during a refueling outage. After placement, an instrument technician calibrates the sensor at ambient pressure and temperature conditions. Sometime later with the plant shutdown, an instrument technician checks for sensor drift using the same technique as was previously used for calibrating the sensor. The conditions under which this drift determination is made are again ambient pressure and temperature. The temperature and pressure should be essentially the same at both measurements. Thus, they should have no significant effect on the drift determination and are, therefore, independent of the drift allowance.

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Several of the uncertainty terms have been defined with specific precautions, limitations, or underlying assumptions associated with the proper estimation of the appropriate value and use of the term within the WSM. For example, the WSM describes specific ways for estimating the magnitude of some of these uncertainty terms. In particular, the WCAP-17504-P/WCAP-17504-NP, Revision 1, states that when identified through a measurement process, the uncertainty term will be quantified with sufficient measurements to enable use of a two-sided, 95/95 statistical approach. When an uncertainty allowance for the term is to be calculated, the methodology for this calculation will incorporate sufficient statistical conservatism for the term to be estimated at 95/95.

Some uncertainty terms can be estimated better than others, because there is an abundance of data demonstrating channel performance, or there is adequate vendor information. For example, in many cases, there is sufficient plant data to enable determination that the term may be treated as a random, independent variable with normal distribution, (or one whose distribution can be proven to be sufficiently normal) and that will support estimates of random uncertainty tolerance intervals, and combined with others using SRSS methods. However, other uncertainty terms cannot be estimated on the basis of adequate data supporting 95/95 tolerance intervals. According to WCAP-17504-P/WCAP-17504-NP, Revision 1, the WSM
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] The NRC staff finds this practice to be acceptable when there is insufficient data to support a rigorous statistical estimate of the uncertainty tolerance interval for such random independent terms at the 95 percent confidence level, and a reasonable engineering justification for the magnitude of the bounding estimate can be made.

Section 7.3 of the 1982 version of ISA Standard 67.04, which was endorsed in a previous version of Regulatory Guide 1.105, stated that:

> A system shall be established to ensure the accuracy and adequacy of the test equipment used to verify setpoints and tolerances of safety-related instrumentation.

In the NRC staff's Information Notice 96-22, "Improper Equipment Settings due to the use of Non-temperature-Compensated Test Equipment," the staff notes that: "measurement and test equipment accuracy directly affects setpoint calculations. Among the factors which affect the accuracy of measuring and test equipment is the temperature at which a calibration is actually performed."

With regard to the terms accounting for Sensor and Rack Measurement and Test Equipment Accuracy (SMTE and RMTE), the NRC staff did not clearly understand from the language in Revision 0 of WCAP-17504-P/WCAP-17504-NP TR whether Westinghouse intended to use the accuracy of the M&TE equipment specifically listed within the licensee calibration procedures combined with the accuracy of the equipment under test (being calibrated), or whether an assumption was being employed that the M&TE uncertainty was considerably smaller than the uncertainty of the equipment being tested, and therefore the contribution of this term was considered to be negligible in comparison to the other terms within the CSA calculation. However, this was clarified by Westinghouse in its responses to the staff's RAIs and in its descriptions of RMTE and SMTE in Revision 1 to the WCAP-17504-P/WCAP-17504-NP TR.

The NRC staff requested Westinghouse to clarify its approach to dealing with M&TE uncertainty for sensors and racks. Specifically, the staff noted that the Westinghouse approach to handling M&TE data in the SCP guidance contained within WCAP 17503-P/ WCAP-17503-NP, Revision 0, submittal seemed at odds with the description of M&TE uncertainty in the WSM TR contained within WCAP 17504-P/WCAP-17504-NP, Revision 0, where it appeared to the NRC staff that the Westinghouse uncertainty expressions assume that the accuracy rating of the reference measuring means for calibrating M&TE is always one-tenth or better than that of the M&TE device being calibrated, and the resulting M&TE uncertainty is always one-tenth or better than that of the sensor or group of rack devices under test. The NRC staff requested

Westinghouse to clarify whether the plant actual or worst-case M&TE uncertainty to be considered in the application of the WSM, or whether the WSM makes an assumption that the M&TE uncertainty is always 1/10 the uncertainty of the equipment being calibrated, and therefore may be ignored because it is much smaller than the device uncertainty. In the responses to NRC RAIs, submitted via letter LTR-NRC-15-37 dated June 25, 2015 (ADAMS Accession No. ML15183A244), Westinghouse stated regarding this request for clarification:

> When uncertainty calculations are performed by Westinghouse, the calibration and surveillance procedure worst case (limiting) M&TE are determined. Thus, the SCA:SMTE and RCA:RMTE limiting ratios are evaluated for each function. If the limiting ratio of SCA:SMTE (or RCA:RMTE) is less than 10:1; Westinghouse includes the magnitude of SMTE (or RMTE) in the uncertainty calculation.

The NRC staff found that this statement provides sufficient clarity for the staff to confirm that it is a requirement of the WSM that actual M&TE uncertainty is to be included in the estimate of RMTE and SMTE unless the ratio of SCA:SMTE or RCS:RMTE is 10-to-one or greater. If there is a 10:1 ratio or greater, the RMTE or SMTE uncertainty may be considered to be negligible when compared to the other uncertainty terms included in the calculation of CSA.

With regard to the question as to whether the WSM ensures that the effects of change in environment from calibration conditions to plant conditions for sensor or rack M&TE equipment, Revision 1 of WCAP-17504-P/WCAP-17504-NP states:

> Westinghouse recommends that RMTE should be as accurate as reasonably achievable. A ratio of RCA:RMTE or RD:RMTE of less than 10:1 must be explicitly included in the uncertainty calculation. Temperature effects on RMTE, as defined by the M&TE vendor, based on the location specific environment should be included when appropriate. This is consistent with NRC Information Notice 96-22 (Reference 31) and is included in the determination of the RCA:RMTE or RD:RMTE ratio. When the magnitude of RMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p.61), i.e., RCA:RMTE or RD:RMTE ≥ 10:1, RMTE may be considered an integral part of RCA or RD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and need not be included in the uncertainty calculations.

The NRC staff notes that Revision 1 of WCAP 17504-P/WCAP-17504-NP TR contains a similar statement with regard to the determination of Sensor M&TE (SMTE).

3.1.5 Method used for Combining Uncertainty Terms

The WCAP-17504-P/WCAP-17504-NP, Revision 1, TR defines the generalized equation for combining uncertainty terms for protection system functions (i.e., RTS and ESFAS for the determination of CSA. This generalized form (Equation 2.1 in WCAP-17504-P/WCAP-17504-NP, Revision1) takes into account that sensor and rack measurement and test equipment uncertainties (SMTE and RMTE, respectively) are treated as dependent parameters with their respective drift and calibration accuracy allowances. Environmental Allowances are generally treated a biases and algebraically summed along with other bias terms. By way of reasoning for this, Westinghouse states:

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The NRC staff agrees with this approach for algebraically combining the uncertainties with limited supporting data and unknown sign with the resultant of SRSS uncertainties where it is apparent that the performance is random and bi-directional, and where there is an abundance of data such that significant statistical inferences can be made.

The Westinghouse generalized equation for CSA may be applied to a large majority of plant safety functions. There are a few functions, however, that require a more detailed analysis to address function-specific uncertainties, and therefore, the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, provides for channel statistical uncertainty algorithms that are function-specific.

3.1.6 Justification of Statistical Combination

See above descriptions of "Uncertainty Terms" and "Method used for Combining Uncertainty Terms." As described above, the WCAP-17504-P/WCAP-17504-NP, Revision 1, provides significant discussion as to whether specific uncertainty terms should be considered as independent or dependent terms, and whether they should be treated as random, bi-directional or bias terms with or without known direction. In general, random independent terms are combined using SRSS methods, random dependent terms are first algebraically added and then combined with other random terms using SRSS methods, and bias terms are algebraically added in a manner consistent with their known signs.

3.1.7 Relationship Between Instrument and Process Measurement Units

While the raw data used for identifying the magnitude of uncertainty terms in the WSM are generally documented in instrument units (e.g., voltage (mV), current (mA), inches of water column, etc.) or process units (e.g., psig, gallons per minute, pounds mass per hour, etc.), the results of the channel performance analysis are provided in terms of percent of span (or, %span.) The Westinghouse Setpoint Methodology is dependent on having accurate scaling equations to translate instrument or process units into %span. The scaling process is outside the scope of the WSM, and has not been evaluated by the staff as part of this safety evaluation.

3.1.8 Data Used to Select the Trip Setpoint

WCAP-17504-P/WCAP-17504-NP, Revision 1, provides detailed discussions regarding the quality of the data used to estimate the uncertainty terms, and any limitations for combining such terms based on the quality. Westinghouse has stated that it intends for the WSM to provide uncertainty tolerance intervals meeting the 95/95 statistical criteria advocated in the NRC staff's DG-1141 released for public comment in 2015. As described above, when there is not sufficient data available for estimating uncertainty tolerance intervals at the 95/95 level,

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] The data used in these calculations are intended to be controlled via the Westinghouse SCP described in WCAP-17503-P/WCAP-17503-NP, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations."

For reactor trip and ESFAS initiation functions, the WSM evaluation of drift is based on a two-sided (±) 95 percent probability at a 95 percent confidence level. A significant volume of as-left and as-found data is collected over a minimum of [ ] to verify the magnitude of drift remains bounded along with reference accuracy and calibration accuracy in the allowance for AFT. To verify the randomness and distribution of the data, the WSM described in the WCAP-17504-P/WCAP-17504-NP, Revision 1, requires a demonstration that the sample distribution is normal or near-normal, which simplifies the ability to demonstrate that the 95/95 criterion is being met. Specifically, the WCAP-17504-P/WCAP-17504-NP, Revision 1, TR states:

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The WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, also describes how data outliers are evaluated and dealt with. Specifically, the WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

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Several paragraphs throughout Revision 0 of WCAP-17504-P/WCAP-17504-NP, used the words "believed to be" when discussing the probability and confidence levels associated with estimates of uncertainty at the 95/95 level, when accounting for uncertainties to be bounded by the Channel Statistical Allowance. The NRC staff requested Westinghouse to provide a clarification or elaboration over what is intended by using the words "believed to be."

In the response to the NRC staffs questions regarding this language, Westinghouse explained that plants using Westinghouse-specified equipment for process racks and for transmitters, and the plant calibration procedures are prepared in a manner that verifies the reference accuracy of sensor/transmitters and process rack instrument channels as described in the WSM, as well as performs calibration and drift evaluation by following the process described within the WSM, and includes SMTE and RMTE uncertainties in the CSA calculation, then the CSA equation will meet the two-sided 95/95 tolerance interval estimate prescribed by RG 1.105.

The term "believed to be," as used in the Revision 0 to WCAP-17504-P/WCAP-17504-NP was used specifically to address equipment not specified by Westinghouse when Revision 0 of the TR was submitted. However, in its response to the NRC staff's RAIs, Westinghouse notes the following:

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If a vendor states that the instrument uncertainties provided in the vendor documentation are two-sided 95/95 values, then Westinghouse does not see the need to perform any additional verification. That responsibility lies with the licensee. Westinghouse believes the trend program evaluating the As-Left and As Found data will confirm any claims with regards to the reference accuracy and drift characteristics. If those two parameters are satisfied, Westinghouse would expect the other parameters to also be acceptable.

The NRC staff notes that if the WSM is to be used in conjunction with any license amendment requests to implement WCAP-17504-P/WCAP-17504-NP, Revision 1, on plants with non-Westinghouse NSSS vendor specified equipment, the NRC staff should verify through an audit of the licensee's data analysis that the licensee has confirmed with the individual equipment vendors that the reference accuracy, drift, and other instrument channel component performance uncertainties have been estimated at the 95/95 two-sided statistical level. If the licensee has not been successful in confirming the vendor data was presented as 95/95 data, then the NRC staff should ensure through a review of evaluations conducted by the licensee (or Westinghouse, on behalf of the licensee) that the available vendor data has been appropriately adjusted so that it is representative of high confidence (i.e., 95/95) information.

3.1.9 Assumptions Used to Select the Trip Setpoint

The WCAP-17504-P/WCAP-17504-NP, Revision 1, TR describes the basis for evaluating the Channel Statistical Allowance used for selecting the NSP in significant detail. This description elaborates on several areas where certain assumptions are made concerning the initial conditions of the plant at the onset of anticipated operational conditions or upset conditions during which the safety function performed by the instrument channel may be needed, and the conditions of the plant environment in the vicinity of the safety related instrument channel equipment when it is needed versus when it is being calibrated. Further, there are several assumptions regarding the appropriate application of several of the uncertainty terms used in the determination of the CSA. In addition, WCAP-17504-P/WCAP-17504-NP, Revision 1, describes programmatic steps to take to continually verify that assumptions made regarding uncertainty characteristics are verified to assure that the methodology is still applicable. Such verification requires data trending and analysis of channel calibration performance data to ensure that data distribution functions assumed by the methodology are still consistent with the methodology. For example, the WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

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In another example, regarding verifying the assumption that the magnitude of drift is still small, the WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

> Recording and trending of the As Found condition of the process racks (RD = (As Found – As Left)) consistent with the process described in Section 4 is necessary to assure conformance with the uncertainty calculation basic assumptions and the DG-1141 Draft Regulatory Guide 1.105 (Revision 4) required 95/95 basis. (As Found – As Left) is defined as [
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The NRC staff finds that use of assumptions within the WSM is reasonable, and that when appropriate, the WSM provides for programmatic verification as to whether the assumptions are still valid.

3.1.10 Instrument Installation Details and Bias Values Affecting Selection of Setpoint

As described above, for the WSM to provide appropriate safety function trip setpoints, it is dependent on having accurate scaling equations and accurate information concerning process and ambient effects on the instrument channel equipment performing the safety functions. Specific details regarding the instrument installation are needed to develop accurate instrument channel scaling equations, and to determine the magnitude of process and ambient effects on channel performance. The scaling process is largely based on plant installation-specific configuration information. Therefore, it is outside the scope of the WSM, and has not been evaluated by the NRC staff as part of this SE. However, for the NRC staff to be able to make its reasonable assurance determination regarding the suitability of a licensee-proposed implementation of new plant TSs based on any new methodology (including the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1), it is prudent for the NRC staff to perform evaluations of a sample of instrument channel setpoints proposed by licensees and applicants using the new methodology, including an evaluation of the scaling information and equations used for identifying performance effects on the equipment performing the safety functions. For example, scaling equations are needed to translate the range of process variable to be measured from process units into instrument measurement units. Some processes take place at hydraulic pressures and temperatures considerably higher than the ambient temperatures and pressures at which instruments are calibrated. The scaling for an instrument channel may be adjusted to address the predicted effects of operations at elevated static pressure (e.g., instrument span effect and instrument zero offset effect.) Also, the sensing line portion of an instrument channel may be exposed to ambient temperatures that vary significantly from

normal conditions to anticipated operational occurrence conditions. The magnitude of the effects of such ambient temperature changes affecting the density of the sensing fluid, and therefore the uncertainty of the channel performance is dependent on site-specific installation details. The WSM describes how such effects may be accounted for, but the methods for deriving the magnitude of such effects based on plant-specific installation information is considered outside the scope of the WSM.

3.1.11 Correction Factors Applied to Determine Setpoints

The WCAP-17504-P/WCAP-17504-NP, Revision 1, identifies the use of correction factors in the context of scaling equations and when discussing the term Sensor Pressure Effects (SPE). The NRC staff notes that channel performance uncertainty estimates for instrument channels using differential pressure measurement at high (elevated) static head conditions, there is typically a correction needed to account for the change in performance of the differential pressure transmitter from calibration conditions, when it is valved out of service and brought to ambient pressure conditions for calibration, to when it is valve back in service and exposed to the elevated static pressure conditions present in the process being monitored. The WSM accounts for this change in performance through the SPE term. In some setpoint methodologies evaluated by the NRC staff, this term is treated as a bias value, while in others, this term is bounded as a limit of error applied to a random uncertainty with limited data.

The WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

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The NRC staff does not have a stated position as to whether this term should be treated as a bias or as a random uncertainty. However the staff notes that it is not considered to be a term small enough to be ignored, and must be accounted for in determining the total loop uncertainty. The WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, does account for this term.

WCAP-17504-P/WCAP-17504-NP, Revision 1, also describes the use of the WSM for instrument channels where it is beneficial to register the calibration of a particular instrument channel output to a process-related benchmark parameter. Westinghouse refers to this process as "normalization." In contrast to the calibration process, which is performed using equipment adjusted for accuracy against calibration standards to independently determined known values, Normalization is used to establish/register a link between a process parameter and an instrument channel performance range. The WCAP-17504-P/WCAP-17504-NP, Revision 1, states:

A normalization process typically involves an indirect measurement, [

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The NRC staff recognizes that such methods for normalizing the calibrated range of an instrument channel device against a range of values determined from accurate calculation/measurements of a process parameter can be used to ensure protective actions can be made at appropriate process parameter values, provided the data used to perform the registration (normalization) of the instrument channel device was taken from source instrument channel equipment that was calibrated against independently-determined known values, such as those based on calibration standards. It should also be recognized that the uncertainty in the performance of such devices encompasses the contributions from the uncertainties in each of the source instruments used in the calculation, and that an evaluation of the total uncertainty contribution needs to be made and found to be acceptable. However, once this uncertainty is found to be acceptable and accounted for in the setpoints of the normalized device instrument channel, this methodology can be used to establish limiting safety settings.

3.1.12 Instrument Test, Calibration or Vendor Data, and Demonstration of Random Drift

The guidance in BTP 7-12 of NUREG-0800, Chapter 7, states that instrument test, calibration, vendor, and as-found and as-left data should be evaluated using field data and empirical data to demonstrate that each instrument should be demonstrated to have random drift. The NRC staff's evaluation as to how WCAP-17504-P/WCAP-17504-NP, Revision 1, addresses the evaluation of the instrument vendor data, instrument calibration process data, the magnitude of uncertainty introduced by measurement and test equipment used during the calibration process, and the identification of the magnitude of drift" is described in the applicable sections above (see Section 3.1.1 subsection on Rack Drift and Sensor Drift). The WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, uses a proprietary methodology to evaluate rack drift and sensor drift, and uses a periodic verification method to ensure that observed magnitudes of drift remain bounded within the uncertainty allowance for total rack calibration accuracy. The WSM uncertainty model requires periodic verification of actual drift experienced over the course of time through the trending and analysis of As-Found and As-Left calibration performance data. Initial estimates of drift for new installations of instrumentation equipment are based on vendor data, but once enough calibration performance data is gathered, the trending and evaluation process is used to confirm that the original values of rack drift and sensor drift remain bounded within the engineered allowances for as-found and ALTs.

3.1.13 Uncertainty Terms and Setpoint Methodology Reflected in Evaluation Results

The guidance in Branch Technical Position BTP 7-12 of NUREG-0800, Chapter 7, also states that results for the evaluation of instrument test, calibration or vendor data, and as-found and

as-left data should be reflected appropriately in the uncertainty terms, including the setpoint methodology. As described above in Sections 3.1.1, 3.1.4, 3.1.9, and 3.1.11, the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, provides for periodic evaluation of the instrument channel performance data, and evaluation of the as-found minus as-left data to verify that the as-found and as-left data is reflected appropriately in the magnitude of the uncertainty terms, and is consistent with the WSM.

3.1.14 WCAP-17504-P/WCAP-17504-NP, Revision 1, Technical Evaluation Summary

The NRC staff finds that the WSM provides for a minimum set of assumptions made in the definitions and methods for determining individual uncertainty terms (refer to Section 3 of WCAP-17504-P/WCAP-17504-NP, Revision 1), which the NRC staff finds reasonable and acceptable. The methodology provides for these assumptions to be verified as technically appropriate through the required periodic process of formally evaluating calibration (as-found minus as-left data) as described above. The implementation and periodic verification of the appropriateness of these assumptions will yield conservative uncertainties used in the calculations of the Channel Statistical Allowance while still constraining instrument channel performance deviation from desired nominal calibration values to a within a reasonable maximum as-found and ALT band, which the NRC staff finds reasonable and acceptable.

Following the Calibration and Drift Data Evaluation Process Diagram flow depicted in the Proprietary Figure 4-1 in WCAP-17504-P/WCAP-17504-NP, Revision 1, the pertinent information required to be documented and evaluated for the analysis of sensor calibration accuracy, sensor drift, rack calibration accuracy, rack drift, and resultant drift over the analyzed time interval will yield an evaluation methodology that can be consistently applied to verify that the currently implemented as-left and AFT levels are still reasonable or whether changes are needed. The results of these analyses support verification of the data used in the setpoint the calculation, and are documented in accordance with controlled plant procedures and programs (such as the SCP) with adequate detail so that all bases, equations, and conclusions are fully understood and documented.

The Tables in Section 3 WCAP-17504-P/WCAP-17504-NP, Revision 1, depicting the generalized equations for CSA and example protection and control function uncertainties used to compute CSA includes a list of uncertainties that must be considered for inclusion in the computation of CSA. The surveillance and calibration intervals are determined in part by the plant TSs. Determination of surveillance and calibration intervals takes into account the uncertainty due to instrument drift as described in this report such that there is reasonable assurance that the plant protection system instrumentation is functioning as expected between the surveillance intervals. Plant-specific procedures will include required methods to evaluate the historical performance of the drift for each instrument channel and confirm that the surveillance and calibration intervals do not exceed the assumptions in the Westinghouse methodology and in the plant safety analysis.

As described above in Section 3.1.8, for any license amendment requests to implement WCAP-17504-P/WCAP-17504-NP, Revision 1, on plants with non-Westinghouse NSSS vendor specified equipment, the NRC staff should verify through an audit of the licensee's data analysis whether the licensee has successfully confirmed with the individual equipment vendors that the reference accuracy, drift, and other instrument channel component performance uncertainties have been estimated at the 95/95 two-sided statistical level. If the licensee has not been able to confirm whether the data was presented as 95/95 data, then the NRC staff should review the

evaluations conducted by the licensee (or Westinghouse, on behalf of the licensee) for adjusting the available vendor data so that it is representative of high confidence (i.e., 95/95) information.

For these reasons the NRC staff finds that the WSM conforms to ANSI/ISA-67.04.01-2000 and RG 1.105, Revision 3, with respect to assumptions and data used to determine the uncertainties and select the trip setpoint. Further, the methodology conforms to the NRC staff's positions identified in Draft RG DG-1141, published for comment in June 2015, regarding the estimation of uncertainty tolerance intervals using two-sided (±) statistics at 95 percent probability and 95 percent confidence.

The WSM combines the uncertainty of the instrument loop components to determine the CSA for the functions of the reactor protection system and other important instrument setpoints. All appropriate and applicable uncertainties are considered for each reactor protection system and other important instrument setpoint functions.

The responses to the NRC staff's RAIs (ADAMS Accession No. ML15005A227) have been addressed and incorporated into Revision 1 of WCAP-17503-P/WCAP-17503-NP and WCAP-17504-P/WCAP-17504-NP.

Based on the discussion above, the NRC staff finds that WCAP-17504-P/WCAP-17504-NP, Revision 1, follows the guidance of RG 1.105, Revision 3, RIS 2006-17, ANSI/ISA-S67.04 Part 1-1994, and ANSI/ISA-67.04.01-2006 with regard to setpoint methodology and therefore complies with the NRC regulations for ensuring that setpoints for safety-related instruments are initially within and remain within the TS limits.

3.2 Westinghouse Topical Report WCAP-17503-P/WCAP-17503-NP

To the extent practicable, the NRC staff performed evaluation of Westinghouse TR WCAP-17503-P/WCAP-17503-NP, using the review guidance contained in BTP 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints," of the NRC Standard Review Plan, NUREG-0800, "Review of Safety Analysis Reports for Nuclear Power Plants." However, the NRC staff does not currently have formal staff review guidance specifically prepared for the evaluation of licensee-developed SCPs. To supplement the staff's evaluation of WCAP 17503-P/WCAP-17503-NP, Revision1, the staff considered the content of the PWR and BWR Owner's Groups' TSTF-493, Revision 4, dated January 5, 2010 (ADAMS Accession No. ML100060064) and an errata sheet, "Transmittal of TSTF-493, Revision 4, Errata," dated April 23, 2010 (ADAMS Accession No. ML101160026), which clarifies the application of setpoint methodology. The NRC approved TSTF-493, Revision 4, on May 11, 2010 (ADAMS Accession No. ML102601920).

The NRC-approved TSTF was made available in Federal Register Notice, "Notice of Availability of the Models for Plant-Specific Adoption of Technical Specifications Task Force Traveler TSTF–493, Revision 4, 'Clarify Application of Setpoint Methodology for LSSS Functions,'" Vol. 75, No. 90/Tuesday, May 11, 2010 (ADAMS Accession No. ML093410581), which documents NRC's position on adoption of TSTF-493, Revision 4.

TSTF-493 clarifies the NRC staff's positions regarding TSs for safety-related instrumentation, to ensure compliance with 10 CFR 50.36, "Technical Specifications." It was developed to reduce regulatory uncertainty involving license amendment changes to instrumentation performing limiting safety system setting functions. Licensees of nuclear power plant facilities making

changes to Section 3.3 of the TSs after the issuance of the notice of availability for TSTF-493 are expected to implement the TSTF-493 criteria for TSs trip setpoints and allowable values regarding the implementation of testing requirements to applicable instrument functions. Two strategies were outlined for adopting TSTF-493: Under Option A, Surveillance notes are added to required TS instrumentation functions as delineated by 10 CFR 50.36(c)(1)(ii)(A), and license applications may involve changes to single or multiple setpoint values. License applications can apply surveillance notes without making changes to setpoint values. Under Option B, a SCP is added to Administrative Controls TS. The SCP requires an NRC staff approved setpoint methodology. TS trip setpoints and allowable values within the scope of functions agreed-upon among the BWR and PWR Owners groups and the NRC staff are relocated from TS to a licensee controlled document. The SCP contains equivalent requirements to surveillance notes under Option A.

The SCP establishes the TS requirements for ensuring that setpoints for automatic protective devices are initially within and remain within the assumptions of the applicable safety analyses. The program provides a means for processing changes to instrumentation setpoints, and identifies setpoint methodologies to ensure instrumentation will function as required. The program ensures that testing of automatic protective devices related to variables having significant safety functions as delineated by 10 CFR 50.36(c)(1)(ii)(A) verifies that instrumentation will function as required.

In response to experience gained by the NRC staff in evaluating a LAR submitted for the implementation of Option B of TSTF-493, the NRC staff recognized that additional guidance was needed so that licensees could prepare LARs for Option B of TSTF-493 which include adequate descriptions of the proposed SCP for the staff to identify how critical elements of the program will be implemented at their facility. In January of 2013, the NRC staff made available via the *Federal Register*, a Notice of Availability Supplement to NRC-2009-487, "NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program" (ADAMS Accession No. ML12342A157). This Supplemental Guidance for Option B outlined two portions of a LAR submittal that would be needed by the staff for its evaluation and approval of a proposed SCP. These were: 1) a sufficiently detailed Setpoint Calculation Methodology description, and 2) a sufficiently detailed SCP description.

The NRC staff's expectations regarding the performance objectives of a SCP include:

- Ensuring configuration management of the design basis information depicting the safety analysis basis, instrument channel engineering design, monitored and controlled process design, instrument hardware performance specifications, instrument scaling, instrument calibration and maintenance methods information, and setpoint and AFT and ALT determination algorithm information/data, to result in the current design basis functional control requirements being continually maintained, and

- Ensuring that instrument channel performance information is continually evaluated to identify trends in deviations from expected performance, and to ensure that the assumptions, inputs, and conclusions for establishing the AFT and ALT are still valid. If needed, this performance data should be used to establish changes in the corrective actions being taken, re-computation of the appropriate tolerance, or replacement of the hardware performing the safety function with better performing hardware.

Further, the staff noted that several key elements of Appendix B to 10 CFR Part 50 apply to the control of setpoint-related information.

Specifically, Appendix B, Criterion III, "Design Control" states:

> Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design and be approved by the organization that performed the original design unless the applicant designates another responsible organization.

Also, Criterion VI, "Document Control" of Appendix B states:

> Measures shall be established to control the issuance of documents, such as instructions, procedures, and drawings, including changes thereto, which prescribe all activities affecting quality. These measures shall assure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless the applicant designates another responsible organization.

The section of the supplemental guidance pertaining to the description of the SCP stated that the licensee's Administrative Control TS should point to a controlled licensee document (such as the FSAR, or a Technical Requirements Manual (TRM)), where the complete description of the SCP will be maintained. The description in the licensee's TSTF-493 Option B program submittal should clearly describe how the licensee will ensure that various aspects of instrument channel setpoint control will be continually maintained to address changes that can occur in input data, source documentation, hardware changes, and assumptions. The description of the licensee's SCP should include:

- Setpoints (NTSPs and LTSPs, as appropriate) that are based on analytical limits or other limits derived from current versions of plant safety analyses, or that are demonstrated to be conservative with respect to the current versions. There are occasions when such safety analyses are updated to accomplish related plant activities. A licensee's TSTF 493 Option B SCP should clearly describe how the program ensures that official plant records establishing instrument safety settings reflect the appropriate source and revision of updated safety analyses from which analytical limits are derived.

- Instrument channel total loop uncertainty calculations that take into account the differences in channel performance under operating conditions versus those present under plant testing and maintenance conditions, including the loop configuration used during the performance of calibration and functional test procedures. On occasion, changes are made to plant calibration, functional test, or other periodic test procedures. Licensee's SCPs should ensure that official plant records establishing instrument safety settings reflect the appropriate source and revision of current calibration and functional test procedures. They

should also reflect currently approved maintenance practices and the associated measurement and test equipment for performing such procedures.

- Instrument channel total loop uncertainty calculations that are based on appropriate vendor range, accuracy, and performance data pertinent to the currently-installed instruments. On occasion, installed instruments are found to be inoperable or no longer maintainable. Due to obsolescence, the replacement component may be of a different manufacturer or model number. The safety related instrument settings should be based on current information. Licensee's SCPs should ensure that the official plant records establishing instrument safety settings reflect the appropriate source and revision of manufacturer performance data for the currently-installed equipment.

- Instrument setpoints are based on appropriate and correct scaling information pertinent to the current installation. On occasion, plant configurations change due to equipment replacement or other reasons (Example: Steam generators are upgraded with newer models). The information used to scale the instruments performing safety related functions must be kept current.

- Controlled procedures implementing the calculation methodology for safety related settings. Typically, the maintenance of these procedures is covered under a licensee configuration control process. This may be accomplished by making reference to the existing plant configuration control process and governing procedures and programs.

- The corrective action program steps applied to a finding, during the performance of a calibration or functional test procedure, that address and clearly document why an instrument channel may be performing outside its anticipated "normal performance" AFT band. The corrective actions may include re-evaluating the AFT band through formal engineering analyses, implementing the use of more accurate measurement and test equipment, increasing the required surveillance frequency, or replacing the equipment with new or better performing equipment. In addition to a description of how the licensee implements each of these activities, the SCP must describe how the resulting action will include configuration control for all setpoint calculations, plant configuration documentation, calibration and functional test procedure information, and surveillance frequency control program.

The maintenance of the SCP is a continuous configuration management process that must keep up with changes in the plant licensing basis and physical configuration. The licensee's submittal for approval of a TSTF-493 Option B SCP should conform to the guidance contained in the staff's January of 2013 *Federal Register* Notice of Availability Supplement to NRC-2009-487, "NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program" (ADAMS Accession No. ML12342A157).

3.2.1 Purpose and Scope of WCAP-17503-P/WCAP-17503-NP, Revision 1

Westinghouse states in WCAP-17503-P/WCAP-17503-NP, Revision 1, that the TR provides SCP characteristics Westinghouse believes are necessary to control setpoint design input and methodology assumptions inherent in the WSM. The SCP and WSM specifically address the functions identified in plant TSs, such as described within NUREG-1431, Tables 3.3.1-1, 3.3.2-1, and 3.3.3-1.

The document points out that a plant-specific implementation of the WSM contains either: a) a determination of the NTS for a protection function, given a SAL defined in the plant safety analyses, documented in the plant UFSAR or DCD, or b) a demonstration of the adequacy of an existing NTS for a given SAL. This demonstration is accomplished by accounting for all appropriate instrument uncertainties, both sensor and process racks, process effects (PMA terms) and demonstrating margin between the NTS and the SAL. However, in order to make such determinations, there are inherent assumptions built-in to the setpoint methodology that must be periodically validated to ensure the WSM has developed the appropriate setpoint and allowable tolerance values establishing desired instrument channel performance limits. Westinghouse provided a list of documents and design basis inputs, operational performance data, and plant maintenance and operating activities that contribute to the assurance that the methodology consistently results in appropriate instrument channel setpoint performance. Changes in such documents and performance measurement indicators can occur that need to be evaluated for their potential impact on the output of the WSM. Among these are:

[

]

According to Westinghouse, the purpose of the Westinghouse SCP is to assure the control of critical instrumentation design input parameters such that the plant remains within the design constraints and safety analyses assumptions during all modes of plant operation, both normal and expected transient conditions, and to assure compliance with regulatory requirements and staff expectations. Westinghouse states that the SCP provides a means of continuous evaluation of changes to equipment, procedures and processes that provide design input to the WSM.

The NRC staff finds that these objectives are in line with the staff's expectations regarding the performance objectives of a SCP, as described above.

3.2.1 Role of the Setpoint Control Program in the Control of Inputs

The Westinghouse WCAP-17503-P/ WCAP-17503-NP, Revision 1, identifies the need to evaluate and control the inputs pertaining to the design basis for the setpoints and allowable tolerances associated with the WSM. Among the types of design input information that needs to be evaluated and/or controlled are:

- Industry Standards, such as ISA 67.04.01 and its Recommended Practice ISA 67.04.02
- ISA 51.1-1979
- ISA 67.06
- IEEE Standards IEEE-279-1971, IEEE 338-2006, IEEE-498-1990, IEEE 603-2009
- Industry Documents, such as the TSTF-493 Traveler, Revision 4
- PWROG Emergency Response Guidelines
- USNRC Guidance contained in RG 1.105 Rev 3, Draft RG DG-1141, RG 1.97, Branch Technical Position BTP 7-12 of the SRP NUREG-0800, DC/COL-ISG-08, Generic Letter GL 91-04, RIS 2006-17, Supplemental Guidance to TSTF-493 Option B SCP
- Vendor Product Manuals and Performance Specifications associated with safety related instrument channel hardware used in TS functions covered within the scope of the SCP
- Plant-specific Scaling procedures and calculations, Calibration Procedures, Surveillance Procedures, Corrective Action Program, Maintenance Procedures, plant operations information, Change control processes, plant administrative controls
- Plant Safety Analyses Information
- Instrument environmental qualification testing data
- Plant Calibration and Surveillance Testing Data, and
- [ ]

The NRC staff evaluated description of the inputs to the SCP that need to be controlled contained within the WCAP-17503-P/WCAP-17503-NP, Revision 1, TR, and agrees with the Westinghouse determination that the described inputs comprise the set of inputs that play a key role in assuring appropriate safety related setpoints and allowable performance tolerances are established (calculated), and need to be considered in the process for continual evaluation of the appropriateness of the setpoints. Documents and data under the control of the licensee, particularly the plant-specific calculations, procedures, programs, and operating data need to be considered in any configuration management process to ensure that the latest (current version) information is being incorporated into the development of the safety related setpoints. Plant calibration and surveillance test data needs to be continually evaluated, through a controlled trending and analysis process, and engineering decisions regarding the setpoint, as-found, and ALTs should factor in results of this analysis.

Figures within the WCAP-17503-P/WCAP-17503-NP, Revision 1, TR help to illustrate the relationships of these data sources and the hierarchy of documents that apply to the determination of appropriate setpoints and tolerances.

3.2.2 Role of the Setpoint Control Program in the Evaluation of Test Information

The WCAP-17503-P/WCAP-17503-NP, Revision 1, describes the need to factor into the control of information used for determining instrument channel safety function setpoints and allowable tolerances the use of key test data pertaining to instrumentation performance under anticipated extreme conditions, such as those that would be present under anticipated transients and

design basis accidents. Specifically, WCAP-17503-P/WCAP-17503-NP, Revision 1, identifies the need to control documents containing evidence of device behavior under off-normal ambient environmental conditions, such as ambient temperature, humidity, radiation, aging drift, and seismic performance data gathered from instrument qualification tests. Additionally, Westinghouse identified the need to evaluate and/or confirm instrument performance data gathered during [ ]

The NRC staff agrees with this need for a SCP to ensure control of information providing input to setpoint uncertainty terms used to estimate channel performance under abnormal and design-basis accident conditions.

3.2.3 Role of the Setpoint Control Program in the Evaluation of Performance Data

Westinghouse states in WCAP-17503-P/WCAP-17503-NP, Revision 1, that the assessment of the Calibration Accuracy term is an important input to determining/confirming the ALT value, and that the assessment of Drift is an important input for determining/confirming the correct AFT value. Both of these terms are determined, in part, through proper procedures, data taking, trending, and assessment of periodic channel calibration and surveillance data. Correct analysis of these values serves to confirm the WSM assumptions remain valid. In particular, both of these assessments are needed to help plant operators to establish the operability condition for the instrument channel.

The NRC staff agrees with this need for a SCP to ensure that instrument channel performance data is continually evaluated and the results of this evaluation are needed to ensure appropriate assumptions made within the setpoint methodology remain valid.

The Westinghouse SCP also describes how instrument performance data is to be used in the determination of Channel Operability. The description is consistent with the guidance for determining As-Found and ALT allowances in the WSM in WCAP-17504-P/WCAP-17504-NP, Revision 1. A specific example is provided below:

> If a device is found outside of the AFT, it is identified (via entry into the plant corrective action program) for further evaluation, as this is an indication of drift greater than that assumed in the WSM uncertainty calculation. It may be concluded that the device is not operating within design and must be investigated for repair or replacement. It may be concluded that the surveillance interval is too long and should be decreased. It may be concluded that the drift magnitude is characteristic of the device, found to be consistent with the design, and that the uncertainty calculation should be revised.

This is consistent with the NRC staff's expectations for appropriate objectives for a SCP.

3.2.4 Role of the Setpoint Control Program regarding Outputs of the Setpoint Methodology

The WCAP-17503-P/WCAP-17503-NP, Revision 1, identifies how the output of calculations resulting from application of the WSM is used to ensure proper scaling information is factored into the establishment of appropriate instrument calibration procedures. It also describes how information resulting from the application of properly developed calibration and surveillance procedures is used to ensure that calibration surveillance intervals and allowable as-found and ALTs confirm that the hardware is performing properly. Similarly, following the installation of

new equipment for which there is no performance history to rely upon for the determination of allowances for drift, for example, and is evaluated to determine the magnitude if drift and establish the initial conditions for the next operating/surveillance interval. As-left and As-found data are evaluated to confirm that the device drift magnitude is within limits and that no calibration biases become evident. The As-Found and As-Left data recorded while administering the surveillance form the basis for future re-evaluation of the drift magnitude used in the uncertainty calculations and NTS determination.

The NRC staff agrees that the calculation outputs from the setpoint methodology (i.e., As-Left and AFT allowances and NTS) and the recording and trending of the as-found and as-left performance data in successive periodic instrument channel surveillances play an important role in verifying assumptions made in applying the WSM.

3.2.5 WCAP-17503-P/WCAP-17503-NP, Revision 1, Technical Evaluation Summary

As described above, SCP establishes the TS requirements for ensuring that setpoints for automatic protective devices are initially within and remain within the assumptions of the applicable safety analyses. The SCP provides means for processing changes to instrumentation setpoints, and identifies setpoint methodologies to ensure instrumentation will function as required. The program ensures that testing of automatic protective devices related to variables having significant safety functions as delineated by 10 CFR 50.36(c)(1)(ii)(A) verifies that instrumentation will function as required.

The NRC staff finds that the Westinghouse Generic SCP recommendations described in WCAP-17503-P/WCAP-17503-NP, Revision 1, are consistent with its expectations for compliance with TSTF-493 Option B, as outlined in its supplemental guidance, and provide a reasonable analysis of the activities a licensee would need to include within a proposed SCP for establishing and maintaining safety related setpoints using the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1. The NRC staff also finds that considerations have been made within these recommendations to identify the means by which key assumptions embedded within the WSM are continually validated through an instrument channel performance evaluation process, and that the evaluation process considers the need for engineering analyses supporting a change in the performance acceptance limits, if appropriate. Licensees adopting the Westinghouse recommendations within their plant-specific SCPs will be able to provide assurance that critical instrumentation design input parameters will remain controlled such that the plant remains within the design constraints and safety analyses assumptions during all modes of plant operation. The Westinghouse SCP recommendations ensure continuous evaluation of changes to equipment, procedures, and processes that provide design input to the WSM.

It is the NRC staff's expectation that licensees or applicants, planning to adopt the Westinghouse Generic Setpoint Methodology and Generic SCP recommendations as a way for adopting TSTF-493 Option B, will submit: 1) a Setpoint Calculation Methodology description, and 2) a sufficiently detailed SCP description, as outlined above and in the supplemental guidance for TSTF-493 Option B described in the NRC Notice of Availability Supplement to NRC-2009-487, "NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program," (ADAMS Accession No. ML12342A157). If a licensee maintains an overall corporate, fleet-wide, or plant-specific setpoint methodology, licensees or applicants must describe how the elements of the Westinghouse Generic Setpoint Methodology have been incorporated into their formal setpoint methodology and/or setpoint

calculation procedures, but do not need to repeat in detail the WSM algorithms and terms used, unless there are any differences from those outlined in WCAP-17504-P/WCAP-17504-NP, Revision 1. Licensees and applicants must identify whether the term "Allowable Value" is to be retained as the limiting threshold for determination of OPERABLE versus INOPERABLE instrument channels, or whether such determination will be made using the Westinghouse-specified "As-Found Tolerance" (AFT) value. However, within their submittals for a LAR to implement a SCP under TSTF-493 Option B, licensees or applicants must provide a detailed description regarding how each element of the Westinghouse Generic SCP will be addressed in the licensee's SCP. The licensee or applicant must identify the plant-specific policy, process, and procedure documents that will be used to implement the proposed SCP for their facility, and make these documents available for the NRC staff evaluation and/or audit. The NRC staff will evaluate proposed Option B programs using its SRP, BTPs, regulatory guidance, and other NRC staff review guidance consistent with the licensing basis of the facility, and the WSM and SCP recommendations to make a determination of reasonable assurance that the licensee proposed plant-specific SCP, as documented in the LAR, ensures adequate protection of the health and safety of workers and the public, and adequately protects the environment.

Once a proposed plant-specific SCP is approved for use by the NRC staff, licensees would be permitted to relocate the AVs and NTSPs of instrument channels performing certain LSSS safety functions from the TS Section 3.0 tables to the FSAR or TRM (TRM) via license amendment. Following relocation, subsequent changes to the nominal TS setpoint (NTSP), AFT, ALT and AV (if appropriate) would be controlled in accordance with the requirements of 10 CFR 50.59. Provided that all elements of the NRC staff's positions regarding the establishment and maintenance of safety related instrument channel settings as described in the NRC regulations and guidance, and as identified within the Westinghouse WCAP-17503-P/WCAP-17503-NP, Revision 1, are adequately described in the licensee's 10 CFR 50.90 submittal and supporting documentation describing its proposed SCP, the NRC staff would find such SCPs to be adequate to ensure that proposed changes to safety related instrument channel settings will continue to meet the NRC regulations and NRC staff's guidance, and thus provide reasonable assurance that the licensee's program will continue to protect the health and safety of the public, and the environment.

4.0 CONDITIONS/LIMITATIONS

NRC Staff Evaluation of WCAP-17504-P/WCAP-17504-NP, Revision 1, "Westinghouse Generic Setpoint Methodology"

The NRC staff finds WCAP 17504-P/WCAP-17504-NP, Revision 1, acceptable for referencing by licensees in their descriptions of the setpoint methodology applied for the establishment of Limiting Safety System Settings in accordance with the requirements in 10 CFR 50.36, and the guidance provided in RG1.105 Revision 3 and Draft RG DG-1141, subject to the following condition:

As described above in Section 3.1.8, for any LARs to implement WCAP-17504-P/WCAP-17504-NP, Revision 1, for plants with non-Westinghouse NSSS vendor specified equipment, the licensee should state whether it has confirmed with the individual equipment vendors that the reference accuracy, drift, and other instrument channel component performance uncertainties have been estimated at the 95/95 two-sided statistical level. If the licensee has not been able to confirm whether the data was presented as 95/95 data, then the

staff shall audit the licensee's data analysis to verify the licensee (or Westinghouse, on behalf of the licensee) has appropriately adjusted the available raw vendor data so that it is representative of high confidence (i.e., 95/95) tolerance interval information.

<u>NRC Staff Evaluation of WCAP 17503-P/WCAP-17503-NP, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations"</u>

The NRC staff finds that the recommendations contained within WCAP-17503-P/WCAP-17503-NP, Revision 1, are acceptable for use in referencing within LARs to adopt TSTF-493 Option B, subject to the following conditions and limitations:

Provided that all elements of the NRC staff's positions regarding the establishment and maintenance of safety related instrument channel settings as described in the NRC regulations and guidance, and as identified within the Westinghouse WCAP-17503-P/WCAP-17503-NP, Revision 1, are adequately described in the licensee's 10 CFR 50.90 submittal and supporting documentation describing its proposed SCP, the NRC staff would find such SCPs to be adequate to ensure that proposed changes to safety related instrument channel settings will continue to meet the NRC regulations and NRC staff's guidance and thus provide reasonable assurance that the licensee's program will continue to protect the health and safety of the public and the environment.

However, licensees must provide in their LARs adequate descriptions of their commitments to the approved TSTF-493 Option B traveler, NRC model LAR/model SE, and the NRC supplemental guidance as described in the Notice of Availability Supplement to NRC-2009-487, "NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program" (ADAMS Accession No. ML12342A157). This supplemental guidance for Option B outlined two portions of a LAR submittal that would be needed by the NRC staff for its evaluation and approval of a proposed SCP. These were: 1) a sufficiently detailed Setpoint Calculation Methodology description, and 2) a sufficiently detailed SCP description. The supplemental guidance contained in this document elaborated on the staff's positions as to what constitutes a sufficiently detailed Setpoint Calculation Methodology description and a SCP description.

5.0 CONCLUSIONS

The NRC staff has reviewed Westinghouse TR WCAP 17504-P/WCAP-17504-NP, Revision 1, "Westinghouse Generic Setpoint Methodology," and found that (1) the setpoint calculation methods described therein are adequate to assure that protective actions are initiated before the associated plant process parameters exceed their analytical limits, (2) the setpoint calculation methods are adequate to assure that control and monitoring setpoints are consistent with their requirements, and (3) the established calibration intervals and methods are consistent with safety analysis assumptions.

The NRC staff has also reviewed Westinghouse TR WCAP-17503-P/WCAP-17503-NP, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," and found that: (1) the TR identifies and recommends the appropriate set of design documents, performance data, specifications, scaling and setpoint calculations, and performance monitoring data analysis needed to ensure configuration control of instrument channel setpoints determined using the WSM described in WCAP-17504-P/WCAP-17504-NP, Revision 1, and (2) instrument channel performance information will be continually evaluated to identify trends in

deviations from expected performance, to ensure that the assumptions, inputs, and conclusions for establishing the As-Found and ALTs are still valid. A licensee developing a SCP using all the recommendations provided within the Westinghouse SCP will evaluate the instrument channel performance data to establish whether changes in surveillance process are needed, appropriate as-found or ALTs need to be re-computed, or surveillance intervals need to be adjusted.

Therefore, the NRC staff concludes, subject to the conditions outlined in Sections 3.1.14 and 3.2.5 above, the following:

a) The proposed Westinghouse Generic Setpoint Methodology described in WCAP-17504-P/WCAP-17504-NP, Revision 1, is an acceptable methodology for satisfying the requirements of 10 CFR Part 50, Appendix A, GDC 13 and 20, of 10 CFR Part 50, 10 CFR 50.36(c)(1)(ii)(A), 10 CFR 50.36 (c)(3), and of 10 CFR 50.55a(h), which requires compliance with IEEE Std. 603-1991.

   The WCAP-17504-P/WCAP-17504-NP, Revision 1, meets the criteria in 10 CFR 50 Appendix A GDC 13, because the methodology enables the safety related instrument channels to perform safety actions while remaining functionally capable of monitoring variables and systems over their anticipated ranges for normal operation, anticipated operational occurrences, and accident conditions since it establishes setpoints that are conservative with respect to the SALs and accounts for the instrument channel performance uncertainties present under such conditions. WCAP-17504-P/ WCAP-17504-NP, Revision 1, also meets the criteria in 10 CFR 50 Appendix A GDC 20: the proposed Westinghouse Generic Setpoint Methodology ensures that setpoints for safety related instrument channels will initiate the operation of appropriate systems at values conservative to SALs that were determined to ensure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences.

   Further, the methodology described in WCAP-17504-P/WCAP-17504-NP, Revision 1, satisfies the requirements within 10 CFR Part 50, 10 CFR 50.36(c)(1)(ii)(A) and 10 CFR 50.36 (c)(3) because for safety related instrument channels whose setpoints are determined using this methodology, the setting derived using this methodology accounts for all anticipated uncertainties such that the protective action will correct the abnormal situation before a safety limit is exceeded. Also, the proposed Westinghouse Generic Setpoint Methodology provides for the establishment of AFT values that are used to identify whether automatic protective instrument channels are functioning as required. During periodic surveillances of the performance of these instrument channels, if it is determined that the protection channel setting deviates outside this AFT, such deviation will be apparent to the licensee such that he can take appropriate corrective or remedial action, which may include shutting down the reactor. Also, the methodology within the WCAP-17504-P/WCAP-17504-NP, Revision 1, allows licensees to meet the requirements of 10 CFR 50.36(c)(3) because such surveillances adopting the AFT values determined by the methodology assure that the necessary quality of the instrument channel is maintained, and that facility operation will remain within safety limits, and that the limiting conditions of operation will be met.

   Finally, the methodology described in WCAP 17504-P/WCAP-17504-NP, Revision 1, enables licensees to satisfy the requirements within 10 CFR Part 50 50.55a (h), "Protection and Safety Systems," because the methodology requires that the allowance for uncertainties

between the process analytical limits and the device setpoint is documented in controlled plant calculations.

b) The proposed WCAP-17503-P/WCAP-17503-NP, Revision 1, is an acceptable set of recommendations for licensees to follow when developing and implementing a SCP to maintain setpoints determined through an approved Westinghouse setpoint methodology. This set of recommendations satisfies the requirements of 10 CFR 50.36(c)(1)(ii)(A) and 10 CFR 50.36(c)(3), as well as Appendix B, Criterion III, Criterion VI, and Criterion XI of 10 CFR Part 50.

10 CFR 50.36

The recommendations described in WCAP 17503-P/WCAP-17503-NP, Revision 1, will assist licensees in satisfying the requirements within 10 CFR Part 50, 10 CFR 50.36(c)(1)(ii)(A) and 10 CFR 50.36 (c)(3) because information used for deriving the settings, and allowable tolerances using Westinghouse Generic Setpoint Methodology in WCAP-17504-P/WCAP-17504-NP, Revision 1, will be controlled to account for any pertinent changes in safety analyses, instrument channel hardware, or performance, in a way that any changes in the anticipated uncertainties will be factored into the controlled setpoint and the protective action will continue to correct the abnormal situation before a safety limit is exceeded. In addition, the methodology described in the WCAP-17503-P/WCAP-17503-NP, Revision 1, allows licensees to meet the requirements of 10 CFR 50.36(c)(3) because the continual analysis of performance data collected during periodic surveillances, while adopting the AFT values as acceptance criteria, will assure that the necessary quality of the instrument channel is maintained, facility operation will remain within safety limits, and limiting conditions of operation will be met.

10 CFR Part 50, Appendix B, Criterion III

The recommendations described in WCAP-17503-P/WCAP-17504-NP, Revision 1, will assist licensees in satisfying the requirements within 10 CFR Part 50, Appendix B, Criterion III, "Design Control." Recommendations are included to ensure that measures are established to assure that applicable regulatory requirements and the design basis, as defined in Section 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions. The recommended measures include provisions to assure that appropriate quality standards are specified and included in design documents, while ensuring that the deviations from such standards are controlled.

10 CFR Part 50, Appendix B, Criterion VI

The recommendations described in WCAP-17503-P/WCAP-17503-NP, Revision 1, will assist licensees in satisfying the requirements within 10 CFR Part 50, Appendix B, Criterion VI, "Document Control." The recommendations state that licensees need to control the issuance and changes to documents, procedures, and drawings prescribing activities affecting quality.

10 CFR Part 50, Appendix B, Criterion XI and XII

Finally, the recommendations described in WCAP 17503-P/WCAP-17503-NP, Revision 1, will assist licensees in satisfying the requirements within 10 CFR Part 50, Appendix B, Criterion XI,

"Test Control," and Criterion XII, "Control of Measuring and Test Equipment," since the SCP provides appropriate recommendations requiring the maintenance of quality applicable to tests and test equipment used in maintaining instrument setpoints.

6.0 REFERENCES

1. ANSI/ISA 51.1-1979, (reaffirmed 1993), "Process Instrumentation Terminology."

2. Draft Regulatory Guide DG-1141, "Setpoints For Safety-related Instrumentation," released for public comments (ADAMS Accession No. ML081630179)

3. Federal Register Notice, "Transmittal of Final Interim Staff Guidance - Notice Of Availability of the Final Interim Staff Guidance DC/COL-ISG-08 on the Necessary Content of Plant-Specific Technical Specifications for a Combined License," December 8, 2009 (ADAMS No. ML083380666).

4. Federal Register Notice, "Notice of Availability of the Models for Plant-Specific Adoption of Technical Specifications Task Force Traveler TSTF–493, Revision 4, 'Clarify Application of Setpoint Methodology for LSSS Functions,'" Vol. 75, No. 90 / Tuesday, May 11, 2010 (ADAMS Accession No. ML093410581)

5. Industry Standard ANSI/ISA-S67.04-1994, "Setpoints for Nuclear Safety Related Instrumentation."

6. Industry Recommended Practice, ISA-S67.04-1994, Part II, "Methodology for the Determination of Setpoints for Nuclear Safety Related Instrumentation."

7. Industry Standard IEEE Std 498-1990, "IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities."

8. ISA-RP67.04.02-2000 "Methodology for the Determination of Setpoints for Nuclear Safety Related Instrumentation."

9. Letter from J. A. Gresham (W) to U.S. Nuclear Regulatory Commission, "Submittal of WCAP-17503-P, Revision 0 and WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations,' and WCAP-17504-P, Revision 0 and WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology,' (Proprietary/Non-Proprietary)," LTR-NRC-12-14, February 20, 2012 (ADAMS Accession No. ML12058A448)

10. Letter from J. A. Gresham (W) to U.S. Nuclear Regulatory Commission, "Submittal of WCAP-17503-P, Revision 1 and WCAP-17503-NP, Revision 1, 'Westinghouse Generic Setpoint Control Program Recommendations,' and WCAP-17504-P, Revision 1 and WCAP-17504-NP, Revision 1, 'Westinghouse Generic Setpoint Methodology,' (Proprietary/Non-Proprietary)," LTR-NRC-16-9, March 23, 2016 (ADAMS Accession No. ML16085A152)

11. Letter, E. Lenning (NRC) to J. A. Gresham (Westinghouse), "Request For Additional Information Re: Westinghouse Electric Company Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, "Westinghouse Generic Setpoint Control Program Recommendations," and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology,' (TAC NO. ME8115)," April 15, 2015 (ADAMS Accession No. ML15033A187).

12. Letter from J. A. Gresham (W) to U.S. Nuclear Regulatory Commission, "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504 P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115), (Proprietary/Non-Proprietary)," LTR-NRC-15-37, June 25, 2015 (ADAMS Accession No. ML15183A246).

13. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," U.S. NRC, March 2007 (ADAMS Accession No. ML070660036)

14. NRC Generic Letter 91-04, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle," April 2, 1991.

15. NRC Regulatory Guide 1.105, Revision 3, "Instrument Setpoints for Safety Systems," December 1999

16. NRC Regulatory Issue Summary (RIS) 2006-17, "NRC Staff Position on the Requirements of 10 CFR 50.36, 'Technical Specifications,' Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels."

17. "Notice of Availability Supplement to NRC-2009-0487 NRC Staff Guidance for License Amendment Requests to Implement a TSTF-493 Option B Setpoint Control Program," Revision 4, Option B, December 14, 2012 (ADAMS Accession No. ML12342A157)

18. TSTF Owners Group Transmittal of TSTF-493 Rev 4 Letter from TSTF to Michael Lesar (NRC), "Technical Specification Task Force (TSTF) Response to November 10, 2009 Federal Register Notice, 'Notice of Opportunity for Public Comment on the Proposed Model Safety

19. Evaluation for Plant-Specific Adoption of Technical Specification Task Force Traveler-493, Revision 4, Clarify Application of Setpoint Methodology for LSSS Functions'," January 5, 2010 (ADAMS Accession No. ML100060064)

20. TSTF Owners Group Transmittal of TSTF-493, Revision 4, "Errata," April 23, 2010 (ADAMS Accession No. ML101160026)

Attachment: Resolution of Comments on Draft Safety Evaluation

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Date: October 14, 2016

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LTR-NRC-16-9

March 23, 2016

Subject: Submittal of WCAP-17503-P, Revision 1 and WCAP-17503-NP, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," and WCAP-17504-P, Revision 1 and WCAP-17504-NP, Revision 1, "Westinghouse Generic Setpoint Methodology," (Proprietary/Non-Proprietary)

Enclosed are the proprietary and non-proprietary versions of WCAP-17503-P, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," dated March 2016, and WCAP-17504-P, Revision 1, "Westinghouse Generic Setpoint Methodology," dated March 2016, submitted for review and approval under the NRC's licensing topical report program for referencing in licensing actions.

Also enclosed are:

1. An Application for Withholding Proprietary Information from Public Disclosure, AW-16-4385 (Non-Proprietary) with Proprietary Information Notice and Copyright Notice
2. An Affidavit (Non-Proprietary).

This submittal contains proprietary information of Westinghouse Electric Company LLC. In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Commission's regulations, we are enclosing with this submittal an Application for Withholding Proprietary Information from Public Disclosure and an Affidavit. The Affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference AW-16-4385 and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

J. Gresham

James A. Gresham, Manager
Regulatory Compliance

Enclosures

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AW-16-4385

March 23, 2016

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: WCAP-17503-P, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," and WCAP-17504-P, Revision 1, "Westinghouse Generic Setpoint Methodology," (Proprietary)

Reference: Letter from James A. Gresham to Document Control Desk, LTR-NRC-16-9, dated March 23, 2016.

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit AW-16-4385 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The Affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of this Application for Withholding or the accompanying Affidavit should reference AW-16-4385 and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

James A. Gresham, Manager
Regulatory Compliance

AW-16-4385
March 23, 2016

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

I, James A. Gresham, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

James A. Gresham, Manager
Regulatory Compliance

(1) I am Manager, Regulatory Compliance, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(iii) There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iv) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, is to be received in confidence by the Commission.

(v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in WCAP-17503-P, Revision 1, "Westinghouse Generic Setpoint Control Program Recommendations," dated March 2016, and WCAP-17504-P, Revision 1, "Westinghouse Generic Setpoint Methodology," dated March 2016, for submittal to the Commission, being transmitted by Westinghouse Letter, LTR-NRC-16-9, and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with Westinghouse's request for NRC approval of WCAP-17503-P and WCAP-17504-P, and may be used only for that purpose.

(a) This information is part of that which will enable Westinghouse to obtain NRC approval of WCAP-17503, Revision 1, "Westinghouse Generic Setpoint Control

Program Recommendations," and WCAP-17504, Revision 1, "Westinghouse Generic Setpoint Methodology."

Provide a base setpoint control program for customers to reference on an individual plant basis.

Provide a generic setpoint methodology document for customers to reference as part of a plant specific setpoint control program.

(b) Further, this information has substantial commercial value as follows:

(i) Westinghouse plans to sell the use of similar information to its customers for the purpose of providing reference documents for generating plant specific setpoint control program submittals.

(ii) Westinghouse can sell support and defense of the use of the setpoint control program and generic setpoint methodology reference documents.

(iii) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of a document, furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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1.0 INTRODUCTION

This document provides the basic instrument uncertainty algorithms for the Reactor Trip System (RTS) trip functions, Engineered Safety Features Actuation System (ESFAS) protection functions, Emergency Operating Procedure (EOP) operator action points, control system functions assumed as initial condition assumptions in the safety analyses, and control board and computer indication of plant parameters utilized by the plant operators to confirm proper operation of the control and protection instrumentation for a Westinghouse Nuclear Steam Supply System (NSSS). These algorithms, when supported by appropriate plant procedures and equipment qualification, provide total instrument loop uncertainties, termed Channel Statistical Allowance (CSA), at a 95 % probability and 95 % confidence level; as required by U. S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.105, Revision 3 (Reference 1). [

]^{a,c}

This document is divided into five sections. Section 2.0 identifies the current, Westinghouse generalized algorithm (Eq. 2.1) used as the basis to determine the overall instrument uncertainty for an RTS/ESFAS function. This specific algorithm evolved from a Westinghouse paper presented at an Instrument Society of America/Electric Power Research Institute (ISA/EPRI) conference in June 1992 (Reference 2). This approach is consistent with American National Standards Institute (ANSI), ANSI/ISA-67.04.01-2006 (R2011) (Reference 3). The basic uncertainty algorithm is the Square Root Sum of the Squares (SRSS) of the applicable uncertainty terms, which is endorsed by the International Society of Automation (ISA) standard. All appropriate and applicable uncertainties, as defined by a review of the plant baseline design input documentation, have been included in each RTS/ESFAS function uncertainty calculation. ISA-RP67.04.02-2010 (Reference 4) was utilized as a general guideline, but each uncertainty and its treatment is based on Westinghouse methods which are consistent or conservative with respect to this document. NRC RG 1.105 (Revision 3) endorses the 1994 version of ISA S67.04, Part I. Westinghouse has evaluated this NRC document and has determined that the RTS/ESFAS function uncertainty calculations contained in this report are consistent with the guidance contained in Revision 3. The total channel uncertainty, CSA, and its individual components are considered 95/95 level values, as requested in the proposed Draft Regulatory Guide DG-1141 (ML081630179) (Reference 33). Variations of the protection function uncertainty algorithm are presented to demonstrate the Westinghouse treatment of uncertainties for control functions and parameter indication. It should be noted that there are a limited number of plants that initiated Westinghouse performance of instrument uncertainty calculations under Revision 0 of this document. It should be understood that the use of the Revision 0 equations does not introduce non-conservatism with respect to the Revision 1 equations.

Section 3.0 of this report provides definitions of terms and associated acronyms used in the RTS/ESFAS function, control and indication uncertainty calculations. Appropriate references to industry standards have been provided where applicable. Included in this section are detailed descriptions of the uncertainty terms and values for typical RTS/ESFAS, control and indication function uncertainty calculations

performed by Westinghouse. Provided on each table is the function specific uncertainty algorithm which notes the appropriate combination of instrument uncertainties to determine the CSA. Included for the protection function is a listing of the Safety Analysis Limit (SAL), the Nominal Trip Setpoint (NTS), the Total Allowance (TA) (the difference between the SAL and NTS, in % span), Margin and Operability criteria, As Left Tolerance (ALT) and As Found Tolerance (AFT), for both the sensor/transmitter and process racks.

Section 4.0 provides an overview of the Westinghouse evaluation process for calibration and drift data. It describes the basic approach utilized [

]^{a,c} This process has been used since 1998 in the evaluation of surveillance data and was last described to the NRC in a Westinghouse presentation in March 2007 (Reference 27).

Section 5.0 provides a description of the Westinghouse recommendations for implementation of the Westinghouse Setpoint Methodology (WSM) in the plant Technical Specifications and the assessment of operability of sensor/transmitters and process racks.

The NRC has identified acceptance criteria and review procedures for a plant Setpoint Control Program (SCP) in BTP 7-12 Revision 5 (Reference 5). Appendix A identifies how this document addresses those acceptance criteria. Appendix B identifies how this document addresses information noted as necessary in the review procedures.

The purpose of WCAP-17504 Revision 0 was to provide a baseline document on the WSM, which has evolved significantly since its first use on D. C. Cook Unit 1 in 1978. WCAP-17504 Revision 1 was created as a result of a Westinghouse/NRC meeting on September 16, 2015. At that meeting, discussions were held to address areas of interest resulting from the Westinghouse responses to the NRC Request for Additional Information (RAI) on the review of WCAP-17504 Revision 0. Also discussed were areas of interest resulting from DG-1141, Pre-Decisional version of RG 1.105 Revision 4 (ML081630179) (Reference 33). WCAP-17504 Revision 0, which pre-dates DG-1141, states that the WSM supports a two-sided (±) 95/95 conclusion with respect to the CSA. WCAP-17504 Revision 1 provides additional information documenting how the WSM supports a two-sided (±) 95/95 conclusion with respect to the CSA, individual uncertainty terms and, intermediate and final calculations. Statements have been included in the term definitions clearly identifying that each term is supported at the required 95/95 level. Thus, WCAP-17504 Revision 1 provides a basis for meeting the DG-1141 requirements of C.6, "Uncertainty Data and the 95/95 Criterion." Finally, a point of clarification; it is Westinghouse's intent that WCAP-17504 be a stand-alone document, e.g., setpoint uncertainty calculations to support TSTF-493 Option A, as performed by Westinghouse, can be supported utilizing only WCAP-17504 as the methodology document. However, WCAP-17503 is not envisioned as a stand-alone document, e.g., TSTF-493 Option B requires the utilization of a prior approved setpoint methodology.

2.0 COMBINATION OF UNCERTAINTY COMPONENTS

This section describes the WSM for the combination of the uncertainty components utilized for protection, control and indication functions. The methodology used in the determination of the overall CSA is noted in Section 2.1 below. All appropriate and applicable uncertainties, as defined by a review of plant specific baseline design input documentation, are included in each protection, control or indication function CSA calculation.

2.1 Methodology

The methodology used to combine the uncertainty components for a channel is an appropriate combination of those groups which are statistically and functionally independent. Those uncertainties which are not independent are conservatively treated by arithmetic summation and then systematically combined with the independent terms.

The basic methodology used is a Square-Root-Sum-of-the-Squares (SRSS). This basic approach, or others of a similar nature, has been used for Westinghouse uncertainty calculations for many years: protection function instrument uncertainty calculations – June 1978 (Reference 6), statistical Departure from Nucleate Boiling (DNB) calculations – WCAP-8567 (Reference 7), **AP1000**®[(1)] Plant protection function uncertainties – WCAP-16361-P (Reference 8). WCAP-8567 was approved by the NRC, noting acceptability of statistical techniques for the application requested, in April 1978 (Reference 7). WCAP-16361-P was approved by the NRC in August 2007 (Reference 9). Also, various ANSI, American Nuclear Society (ANS), and ISA standards approve the use of probabilistic and statistical techniques in determining safety-related setpoints (References 3 & 10).

The generalized relationship between the uncertainty components and the calculated uncertainty for a protection channel is noted in Eq. 2.1:

$$CSA_{PROT} = \left\{ \sqrt{\begin{matrix} PMA^2 + PEA^2 + (SMTE + SD)^2 + (SMTE + SCA)^2 + \\ SPE^2 + STE^2 + (RMTE + RD)^2 + (RMTE + RCA)^2 + RTE^2 \end{matrix}} \right\} + EA + Bias$$

Eq. 2.1

[1] **AP1000** is a trademark or registered trademark of Westinghouse Electric Company LLC, its affiliates and/or subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

The generalized relationship between the uncertainty components and the calculated uncertainty for a control channel is noted in Eq. 2.2 (subscript IND denotes indication):

[ ]a,c

Eq. 2.2

The generalized relationship between the uncertainty components and the calculated uncertainty for an indication channel is noted in Eq. 2.3 (subscript IND denotes indication – control board meter or plant process computer):

[ ]a,c

Eq. 2.3

Where:

CSA	=	Channel Statistical Allowance
PMA	=	Process Measurement Accuracy
PEA	=	Primary Element Accuracy
SMTE	=	Sensor Measurement and Test Equipment Accuracy
SD	=	Sensor Drift
SCA	=	Sensor Calibration Accuracy
SPE	=	Sensor Pressure Effects
STE	=	Sensor Temperature Effects
RMTE	=	Rack Measurement and Test Equipment Accuracy
RD	=	Rack Drift
RCA	=	Rack Calibration Accuracy
RTE	=	Rack Temperature Effects
EA	=	Environmental Allowance

BIAS	=	One directional, known magnitude allowance
CA	=	Controller Accuracy
READOUT	=	Readout Device Accuracy
[		]a,c

Each of the previous terms is defined in Section 3.2, Setpoint Methodology Definitions.

The equations are based on the following:

1. Sensor and rack measurement and test equipment uncertainties are treated as dependent parameters with their respective drift and calibration accuracy allowances.
2. [ ]a,c The term is arithmetically summed with the SRSS in the direction of conservatism.
3. Bias terms are one directional with known magnitudes (which may result from several sources, e.g., drift or calibration data evaluations) and are also arithmetically summed with the SRSS.
4. [ ]a,c

Consistent with the request of DG-1141 Draft RG 1.105 Revision 4 (Reference 33), the individual uncertainty terms and the CSA value from Eq. 2.1 are considered to be 95 % probability at a 95 % confidence level (95/95) values. The control function CSA value from Eq. 2.2 is considered to be a 95 % probability at a 95 % confidence level (95/95) value, consistent with the requirements of the Westinghouse Improved Thermal Design Procedure (ITDP) (Reference 7) and the Westinghouse Revised Thermal Design Procedure (RTDP) (Reference 17). [ ]a,c

2.2 Sensor Allowances

Six parameters are considered to be sensor allowances: SCA, SMTE, SD, STE, SPE and EA. Two of these parameters are considered to be independent, two-sided (±), unverified (by plant calibration or drift determination processes), vendor supplied terms (STE and SPE). Based on Westinghouse evaluation of

[ ]a,c

STE and SPE are considered to be independent due to the manner in which the instrumentation is checked; i.e., the instrumentation is calibrated and drift is determined under conditions in which pressure and temperature are assumed constant. For example, assume a sensor is placed in some position in the containment during a refueling outage. After placement, an instrument technician calibrates the sensor at ambient pressure and temperature conditions. Sometime later with the plant shutdown, an instrument technician checks for sensor drift using the same technique as was previously used for calibrating the sensor. The conditions under which this drift determination is made are again ambient pressure and temperature. The temperature and pressure should be essentially the same at both measurements. Thus, they should have no significant effect on the drift determination and are, therefore, independent of the drift allowance. [

]a,c

SCA and SD are considered to be dependent with SMTE due to the manner in which the instrumentation is evaluated. A transmitter is calibrated by providing a known process input (measured with a high accuracy gauge) and evaluating the electrical output with a digital multimeter (DMM) or digital voltmeter (DVM). The gauge and DVM accuracies form the SMTE terms. The transmitter response is known, at best, to within the accuracy of the measured input and measured output. Thus, the calibration accuracy (SCA) is functionally dependent with the measurement and test equipment (SMTE). Since the gauge and DVM are independent of each other (they operate on two different physical principles), the two SMTE terms may be combined by SRSS prior to addition with the SCA term. Transmitter drift is determined using the same process used to perform a transmitter calibration. That is, a known process input (measured with a high accuracy gauge) is provided and the subsequent electrical output is measured with a DMM or DVM. In most cases the same measurement and test equipment is used for both calibration and drift determination. Thus, the drift value (SD) is functionally dependent with the measurement and test equipment (SMTE) and is treated in the same manner as SMTE and SCA.

While the data is gathered in the same manner, SD is independent of SCA in that they are two different parameters. On an every calibration cycle basis, SCA is confirmed through the evaluation of the maximum difference between the As Left value and the Desired value for the three pass calibration data. [ ]^a,c RA is confirmed through the evaluation of the characteristics of its three components, Hysteresis, Linearity and Repeatability utilizing the three pass calibration data. SD is the difference between the [ ]^a,c It is assumed that a [ ]^a,c Performance of this data evaluation consistent with the Westinghouse calibration and drift evaluation process described in Section 4, confirms that SCA and SD are random, two-sided (±) 95/95 parameters.

[ ]^a,c

Transmitters are designed and subsequently verified through qualification testing, to be able to withstand exposure to high doses of radiation due to mass loss from a break in the primary side piping. This is addressed in the uncertainty calculation by the inclusion of an EA radiation term. Vendor specifications

typically identify the device response as a "±" term, indicating that the transmitter may respond in either the indicated higher than actual direction or indicated lower than actual direction when exposed to significant radiation. Because of this identification, this term is interpreted by many to be a random variable. [

]a,c

a,c

However, there are several transmitter vendors that have identified the determination of post-seismic residual effects. The vendor specifications identify the transmitter response as a "±" term, indicating that the seismic event may result in a residual effect in either the indicated higher than actual direction or the indicated lower than actual direction. Because of this identification, this term is interpreted by some to be a random variable. [

]a,c

[

]a,c

a,c

2.3 Rack Allowances

Four parameters are considered to be rack allowances: RCA, RMTE, RTE and RD.

RTE is considered to be an independent, two-sided (±), unverified (by plant calibration or drift determination processes), vendor supplied parameter. The process racks are located in an area with ambient temperature control, making consistency with the rack evaluation temperature easy to achieve. Based on Westinghouse process rack data, this parameter is treated as a two-sided (±) 95/95 value.

RCA and RD are considered to be two-sided (±) terms dependent with RMTE. The functional dependence is due to the manner in which the process racks are evaluated. In order to calibrate or determine drift for the process rack portion of a channel, a known input (in the form of a voltage, current or resistance) is provided and the point at which the trip bistable changes state is measured. The input parameter is either measured by the use of a DMM or DVM (for a current or voltage signal) or is known to some degree of precision by use of precision equipment, e.g., a precision decade box for a resistance input. For simple channels, only a DMM or DVM is necessary to measure the input and the state change is noted by a light or similar device. For more complicated channels, multiple DVMs may be used or a DVM in conjunction with a decade box. The process rack response is known at best to within the accuracy of the measured input and indicated output. Thus the calibration accuracy (RCA) is functionally dependent with the measurement and test equipment (RMTE). In those instances where multiple pieces of measurement and test equipment are utilized, the uncertainties are combined via SRSS when appropriate.

The RCA term represents the total calibration uncertainty for the channels which are calibrated as a single string. Drift for the process racks is determined using the same process used to perform the rack calibration, and in most cases utilizes the same measurement and test equipment. Thus, the drift value (RD) is also functionally dependent with the measurement and test equipment (RMTE) and is treated in the same manner as RMTE and RCA.

While the data is gathered in the same manner, RD is independent of RCA in that they are different parameters. On an every calibration cycle basis, RCA is confirmed through the evaluation of the maximum difference between the As Left value and the Desired value for the three pass calibration data. [ ][a,c] RA is confirmed through the evaluation of the characteristics of its three components, Hysteresis, Linearity and Repeatability utilizing the three pass calibration data. RD is the difference between the [ ][a,c] The RD term represents the drift for all process rack modules in an instrument string, regardless of the channel complexity. For multiple instrument strings there may be multiple RD terms, e.g., Overtemperature ΔT for Westinghouse 7300 process racks has an RD term for each of the four different input parameters, ΔT, Tavg, Pressurizer Pressure and ΔI. It is assumed that a [ ][a,c] Performance of this data evaluation consistent with the Westinghouse calibration and drift evaluation process described in Section 4, confirms that RCA and RD are random, two-sided (±) 95/95 parameters.

a,c

a,c

2.4 Process Allowances

The PMA and PEA parameters are considered to be independent of both sensor and rack parameters. The PMA terms provide allowances for the non-instrument related effects; e.g., neutron flux distribution, calorimetric power uncertainty assumptions, temperature streaming in a pipe, process pressure effects or fluid density changes. There may be more than one independent PMA uncertainty allowance for a channel, if warranted. The PEA term typically accounts for uncertainties due to metering devices, such as elbows, venturis, and orifice plates. In this application, PEA is limited by Westinghouse to RCS Flow (Cold Leg Elbow Taps, Cold Leg Bends and Hot Leg Elbows), Steam Flow, Feedwater Flow and Steam Generator Blowdown Flow. PEA may also be used for the uncertainties associated with potential transformers for Undervoltage functions. In these applications, the PEA term has been determined to be independent of the sensors and process racks. It should be noted that treatment as an independent parameter does not preclude determination that a PMA or PEA term should be treated as a limit of error or bias. If that is determined to be appropriate, Eq. 2.1 would be modified such that the affected term would be treated by arithmetic summation with appropriate determination and application of the sign of the uncertainty. [

]a,c

[

]a,c

2.5 Digital Functions

The treatment of digital functions varies to some extent due to the type of function. For example, indication via the plant process computer is quite simplistic in nature; add an Analog to Digital (A/D) converter to the rack allowances. [

]a,c There are typically two types of digital protection functions, 1) form/fit/function replacement for an analog channel, e.g., Westinghouse **Eagle-21**™[2] protection racks, or 2) complex functions that utilize multiple intermediate calculations, e.g., **AP1000** Pressurizer Level or Overtemperature ΔT. In the first instance, the process rack uncertainties associated with an analog channel (RCA, RTE, RD) are replaced with card specific equivalents for a digital channel. The digital equivalents are card specific [

]a,c For simple digital protection functions, NTS is defined as a single value in voltage, current, resistance or an engineering unit (psia, psig, % span, % Rated Thermal Power, % level) [

]a,c

For complex functions, the uncertainties can be considerably different. [

]a,c

a,c

[2] **Eagle-21** is a trademark or registered trademark of Westinghouse Electric Company LLC, its affiliates and/or subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

a,c

3.0 PROTECTION SYSTEM SETPOINT METHODOLOGY

This section contains definitions of terms used in the instrument uncertainty calculations. Also included are detailed example tables providing representative uncertainties to demonstrate the utilization of the algorithms.

3.1 Instrument Channel Uncertainty Calculations

Tables 3-1 through 3-3 provide individual component uncertainties and CSA calculations for an example set of uncertainty calculations. Table 3-1 is for a protection function. Table 3-2 is for a control function. Table 3-3 is for an indication function. The tables list the applicable terms for the representative uncertainty calculation, e.g., Safety Analysis Limit, Nominal Trip Setpoint, (in engineering units), and Channel Statistical Allowance, Margin, Total Allowance, As Left Tolerance, As Found Tolerance, and uncertainty terms (in % span). Westinghouse reports uncertainty values, as demonstrated in Tables 3-1, 3-2 and 3-3, to one decimal place using the technique of :

- Rounding down values < 0.05 % span.
- Rounding up values ≥0.05 % span.
- Parameters reported as "0.0" have been identified as having a value of ≤ 0.04 % span.
- Parameters reported as "0" are not applicable (i.e., have no value) for that channel.

This has been the Westinghouse practice for rounding and reporting values since the first uncertainty report for D. C. Cook Unit 2 (Reference 6). Table 3-4 provides the derivation of the translation of differential pressure span to % nominal flow and % flow span for flow functions.

3.2 Setpoint Methodology Definitions

For the channel uncertainty values used in this report, the following definitions are provided, in alphabetical order:

- **Analog to Digital Convertor** (A/D)

  An electronic circuit module that converts a continuously variable analog signal to a discrete digital signal via a prescriptive algorithm.

- **As Found**

  The condition in which a transmitter, process rack module, or process instrument loop is found after a period of operation.

- **As Found Tolerance** (AFT)

  The As Found limit identified in the plant surveillance procedures. This defines a significant operability criterion for the instrument process rack and the transmitter. It is a sufficient condition to satisfy an operability assessment for an instrument process rack. The AFT for the instrument process rack is the same as (equals) the As Left Tolerance or instrument process rack calibration accuracy, i.e., AFT = ALT = RCA, see Figure 3-1. For process racks, the AFT is a two-sided parameter (±) about the Nominal Trip Setpoint. It is also defined as RD and is reflected in process rack surveillance procedures as the "as found limit," which is applied in both directions, initially in the field about the desired calibration point (which establishes RD as an absolute drift parameter), and [ ]^{a,c} about the calibration As Left point (which establishes RD as a relative drift parameter).

[ ]^{a,c}

- **As Left**

  The condition in which a transmitter, instrument process rack module, or process instrument loop is left after calibration or trip setpoint verification. This condition is typically better than the calibration accuracy for that piece of equipment.

- **As Left Tolerance** (ALT)

  The As Left limit identified in the plant calibration procedures. This defines the initial operability criterion for the instrument process rack (see Figure 3-1) or the transmitter. It is a necessary condition to satisfy an operability assessment for an instrument process rack or transmitter. The ALT is defined as the appropriate calibration accuracy in the uncertainty calculations for the sensor or associated instrument process rack string and is initially based on the vendor's RA. For process racks, the ALT is a two-sided parameter (±) equal to the RCA about the NTS, see Figure 3-1. It is also reflected in process rack calibration procedures as the "as left limit," which is applied in both directions about the desired calibration points, e.g., 0 %, 25 %, 50 %, 75 % and 100 % span.

[ ]^{a,c}

- **Bias**

    - A parameter with a known consistent arithmetic sign, e.g., heatup effect on a level channel Reference Leg.
    - A parameter that is treated as a limit of error, e.g., transmitter heatup in a Steambreak elevated temperature environment.

- **Channel**

    The sensing and process equipment, i.e., transmitter to bistable (analog process racks) or transmitter to trip output (digital process racks), for one input to the voting logic of a protection function. Westinghouse designs protection functions with voting logic made up of multiple channels, e.g., 2 out of 4 Steam Generator Level - Low-Low channels for one steam generator must have their bistables in the tripped condition for a Reactor Trip to be initiated. For control functions, a channel is the sensing and process equipment through the controller module. For indication functions, a channel is the sensing and process equipment through the indicator (control board or Plant Process Computer).

- **Channel Statistical Allowance** (CSA)

    The combination of the various channel uncertainties via SRSS, statistical, or algebraic techniques. It includes instrument (both sensor and process rack) uncertainties and non-instrument related effects, e.g., Process Measurement Accuracy, see Eq. (s) 2.1, 2.2 and 2.3. This parameter is compared with the Total Allowance for determination of instrument channel margin, see Figure 3-1. For a protection function the uncertainties included in, and the conservatism of, the CSA algorithm results in a CSA magnitude that is calculated on a two-sided (±) 95 % probability / 95 % confidence level (95/95) basis.

- **Controller Accuracy** (CA)

    Allowance for the accuracy of the controller rack module(s) that performs the comparison and calculates the difference between the controlled parameter and the reference signal. [

    ]a,c

- **Digital to Analog Convertor** (D/A)

    An electronic circuit module that converts a discrete digital signal to a continuously variable analog signal via a prescriptive algorithm.

- **Environmental Allowance** (EA)

  The change in a process signal (transmitter or process rack output) due to adverse environmental conditions from a limiting design basis accident condition or seismic event. Typically this value is determined from a conservative set of enveloping conditions and may represent the following:

  - Temperature effects on a transmitter,
  - Radiation effects on a transmitter,
  - Seismic effects on a transmitter,
  - Temperature effects on a level transmitter reference leg,
  - Temperature effects on signal cable, splice, terminal block or connector insulation or
  - Seismic effects on process racks.

[ ]a,c

- **Margin**

  The calculated difference (in % instrument span) between TA and CSA.

  Margin = TA – CSA

  Margin is defined to be a non-negative number i.e., Margin ≥ 0 % span, see Figure 3-1. [

  ]a,c

- **Nominal Trip Setpoint** (NTS)

  The trip setpoint defined in the uncertainty calculation and reflected in the plant procedures. This value is the nominal value programmed into the digital instrument process racks or the nominal value to which the bistable is set (as accurately as reasonably achievable) for analog instrument process racks. The NTS is based on engineering judgement (to arrive at a Margin ≥ 0 % span), or a historical value, that has been demonstrated over time to result in adequate operational margin, see Figure 3-1. Based on the requirements of 10 CFR 50.36(c)(1)(ii)(A), Westinghouse defines the NTS as the Limiting Safety System Setting (LSSS) for the RTS and ESFAS functions listed in the plant Technical Specifications, e.g., Tables 3.3.1-1 and 3.3.2-1 of NUREG-1431 (Reference 13) or the **AP1000** plant (Reference 14).

- **Normalization**

  The process of establishing a relationship, or link, between a process parameter and an instrument channel. This is in contrast with a calibration process. A calibration process is performed with independent known values, i.e., a bistable is calibrated to change state when a specific voltage is reached. This voltage corresponds to a process parameter magnitude with the relationship established through the scaling process. A normalization process typically involves an indirect measurement, [

  ]^{a,c}

- **Primary Element Accuracy** (PEA)

  Uncertainty due to the use of a metering device. In Westinghouse RTS/ESFAS calculations, this parameter is limited to use on a venturi, orifice, elbow or potential transformer. Typically, this is a calculated or measured accuracy for the device. [

  ]^{a,c} PEA may also be used for the uncertainties associated with potential transformers for Undervoltage functions. The potential transformer class defines the uncertainty.

- **Process Loop** or **Instrument Process Loop**

  The process equipment for a single channel of a protection, control or indication function.

- **Process Measurement Accuracy** (PMA)

  An allowance for non-instrument related effects which have a direct bearing on the accuracy of an instrument channel's reading, e.g., neutron flux distribution, calorimetric power uncertainty assumptions, temperature streaming/stratification in a large diameter pipe, process pressure effects or fluid density changes in a pipe or vessel. If calculated, PMA terms are determined in a conservative manner and are considered to be bounding. If defined as an allowance, conservatism is introduced to assure the bounding nature of the parameter magnitude.

- **Process Racks**

  The modules downstream of the transmitter or sensing device, which condition a signal and act upon it prior to input to a voting logic system. For analog process systems, this includes all the equipment contained in the process equipment cabinets, e.g., conversion (dropping) resistor, loop power supply, lead/lag, rate, lag functions, function generator, summator, control/protection isolator, and bistable (protection function), controller module (control function), meter (control board indication) or Analog to Digital (A/D) conversion module (process computer). For digital process systems, this again includes all the equipment contained in the process equipment cabinets, e.g., conversion (dropping) resistor, A/D signal conditioning module, processor module and trip module (protection function), D/A output module and controller module (analog control function), D/A output module and meter (analog control board indication) and D/A output module and A/D conversion module (process computer). The go/no go signal generated by the bistable (analog) or the trip module (digital) is the output of the last module in the protection function process rack instrument loop and is the input to the voting logic.

- **Rack Calibration Accuracy** (RCA)

  The two-sided (±) calibration tolerance of the process racks as reflected by the ALT in the plant calibration procedures. The RCA is defined at multiple points across the calibration range of the channel, e.g., 0 %, 25 %, 50 %, 75 % and 100 % span for input modules, and specifically at the NTS for the bistable or trip module, see Figure 3-1. [

]a,c

[

]a,c

It is assumed that the individual modules in a loop are calibrated to a particular tolerance and that the process loop (as a string) is verified to be calibrated to a specific tolerance (RCA). [

]a,c

- **Rack Drift** (RD)

The change in input-output relationship (As Found – As Left) over a period of time at reference conditions, e.g., at constant temperature. [

]a,c Recording and trending of the As Found condition of the process racks (RD = (As Found – As Left)) consistent with the process described in Section 4 is necessary to assure conformance with the uncertainty calculation basic assumptions and the DG-1141 Draft RG 1.105 (Revision 4) required 95/95 basis. (As Found – As Left) is defined as [ ]a,c

- **Rack Measurement & Test Equipment Accuracy** (RMTE)

The accuracy of the test equipment (typically a transmitter simulator, voltage or current power supply, and DVM) used to calibrate a process loop in the racks. Westinghouse recommends that RMTE should be as accurate as reasonably achievable. A ratio of RCA:RMTE or RD:RMTE of less than 10:1 must be explicitly included in the uncertainty calculation. Temperature effects on RMTE, as defined by the M&TE vendor, based on the location specific environment should be included when appropriate. This is consistent with NRC Information Notice 96-22 (Reference 31) and is included in the determination of the RCA:RMTE or RD:RMTE ratio. When the magnitude of RMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p. 61), i.e., RCA:RMTE or RD:RMTE $\geq$ 10:1, RMTE may be considered an integral part of RCA or RD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and need not be included in the uncertainty calculations.

a,c

- **Rack Temperature Effects** (RTE)

  Change in input-output relationship for the process rack module string due to a change in the ambient environmental conditions (temperature, humidity), and voltage and frequency from the reference calibration conditions. It has been determined that temperature is the most significant, with the other parameters being second order effects. For process instrumentation, a typical value of [ ]^{a,c} is used for the analog channel RTE which, based on design testing, allows for an ambient temperature deviation of ± 50 °F. [

  ]^{a,c}

- **Range**

  The upper and lower limits of the operating region for a device, e.g., 0 to 1400 psig for a Steamline Pressure transmitter. This is not necessarily the calibrated span of the device, although quite often the two are close. For further information see ANSI/ISA-51.1-1979 (R1993) (Reference 12).

- **Readout Device Accuracy** (READOUT)

  - The measurement accuracy of a special test, high accuracy, local gauge, DVM, or DMM on its most accurate, applicable range for the parameter measured.
  - ½ the smallest increment of an indicator, e.g., control board meter, i.e., readability.

- **Reference Accuracy** (RA)

  Reference Accuracy is the "accuracy rating" as defined in ISA-51.1-1979 (R1993) (Reference 12, page 12), specifically as applied to Note 2 and Note 3 for a sensor/transmitter or an instrument process loop string (channel). The magnitude is typically defined in a manufacturer's specification data sheet. Inherent in this definition is the verification of the following under a set of reference conditions; Conformity (Reference 12, page 16), i.e., Linearity (Reference 12, page 39), Hysteresis (Reference 12, page 36) and Repeatability (Reference 12, page 49). The determination of the components of RA require the performance of three passes up and three passes down across the instrument span to gather sufficient data (Reference 12, page 64, Table 3). This parameter is explicitly verified for each sensor/transmitter or channel at least [ ]^{a,c} as part of the TSTF-493 trending program.

- **Safety Analysis Limit** (SAL)

  The parameter value identified in the plant safety analysis or other plant operating limit at which a reactor trip or actuation function is assumed to be initiated. The SAL is typically defined in Chapter 15 of the UFSAR (current operating plants) or Tier 2, Chapter 15, Table 15.0-4a of Reference 14 (**AP1000** plant). Actual SAL values are determined, or confirmed, by review of the plant safety analyses. The SAL is the starting point for determination of the acceptability of the CSA, see Figure 3-1.

- **Sensor Calibration Accuracy** (SCA)

  The two-sided (±) calibration tolerance for a sensor or transmitter as defined by the ALT in the plant calibration procedures. The SCA is defined at multiple points across the calibration range of the channel, e.g., 0 %, 25 %, 50 %, 75 % and 100 % span. [

  ]^{a,c}

  Based on Westinghouse recommendations for Resistance Temperature Detector (RTD) cross-calibration, this accuracy is typically [ ]^{a,c} for the Hot and Cold Leg RTDs.

- **Sensor Drift** (SD)

  The change in input-output relationship (As Found – As Left) over a period of time at reference calibration conditions, e.g., at constant temperature. Recording and trending of the As Found condition of the sensor or transmitter (SD = (As Found – As Left)) consistent with the process described in Section 4 is necessary to assure conformance with the uncertainty calculation basic assumptions and the DG-1141 Draft RG 1.105 (Revision 4) required 95/95 basis. (As Found – As Left) is defined as [ ]^{a,c}

- **Sensor Measurement & Test Equipment Accuracy** (SMTE)

  The accuracy of the test equipment (typically a high accuracy local readout gauge and DMM) used to calibrate a sensor or transmitter in the field or in a calibration laboratory. Westinghouse recommends that SMTE should be as accurate as reasonably achievable. A ratio of SCA:SMTE

or SD:SMTE of less than 10:1 must be explicitly included in the uncertainty calculation. Temperature effects on SMTE, as defined by the M&TE vendor, based on the location specific environment should be included when appropriate. This is consistent with NRC Information Notice 96-22 (Reference 31) and is included in the determination of the SCA:SMTE or SD:SMTE ratio. When the magnitude of SMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p. 61), i.e., SCA:SMTE or SD:SMTE ≥ 10:1, SMTE may be considered an integral part of SCA or SD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and need not be included in the uncertainty calculations. [

]^{a,c}

- **Sensor Pressure Effects** (SPE)
    - The change in input-output relationship due to a change in the static head pressure from the calibration conditions.
    - The accuracy to which a correction factor is introduced for the difference between calibration and operating conditions for a Δp transmitter.

  [

  ]^{a,c}

- **Sensor Temperature Effects** (STE)

  The change in input-output relationship due to a change in the ambient environmental conditions (temperature, humidity), and voltage and frequency from the reference calibration conditions. It has been determined that temperature is the most significant, with the other parameters being second order effects. This term is typically limited to the effect due to temperature swings that occur at less than 130 °F. [

  ]^{a,c}

- **Span**

  The region for which a device is calibrated and verified to be operable, e.g., for a Steamline Pressure transmitter, 1400 psi.

- **Square-Root-Sum-of-the-Squares** (SRSS)

$$\varepsilon = \sqrt{(a)^2 + (b)^2 + (c)^2}$$

As approved for use in setpoint calculations by ANSI/ISA-67.04.01-2006 (R2011)(Reference 3).

- **Total Allowance** (TA)

The absolute value of the difference (in % instrument span) between the SAL and the NTS.

$$TA = |SAL - NTS|$$

An example of the calculation of TA is:

Pressurizer Pressure - Low (Safety Injection)

SAL	1740.0 psig
NTS	-1850.0 psig
TA	|-110.0 psi| = 110.0 psi

The instrument span = 1700 – 2500 psig = 800 psi, therefore,

$$TA = \frac{(110.0\ psi) * (100\%\ span)}{(800\ psi)} = 13.8\ \%\ span$$

- **Trend**

The evaluation of [ ]^{a,c} consistent with the process described in Section 4 on a periodic basis [ ]^{a,c} utilizing As Left (gathered utilizing three passes up and three passes down across the instrument span) and As Found [ ]^{a,c} plant data for SCA, SD, RCA and RD for each control, protection and indication function to verify that the statistically based assumptions of the uncertainty calculations and the DG-1141 Draft RG 1.105 (Revision 4) required 95/95 basis are satisfied.

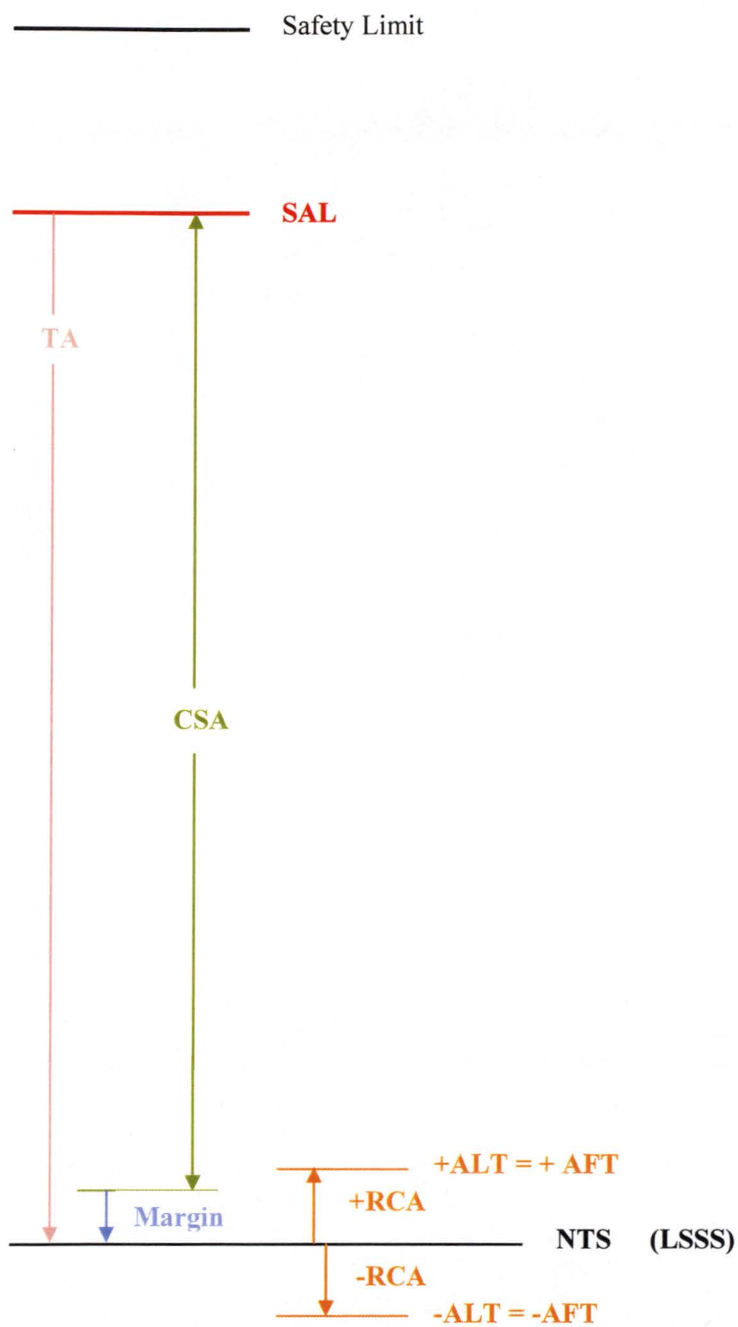

Figure 3-1 Westinghouse Setpoint Parameter Relationship Diagram (Increasing Function)

Table 3-1
Protection Function Example - Pressurizer Pressure – Low (Safety Injection)
Barton 763A Transmitter, Westinghouse 7300 Process Racks

Parameter	Allowance*
Process Measurement Accuracy (PMA)	[ ]a,c
Primary Element Accuracy (PEA)	
Sensor Calibration Accuracy (SCA)	
Sensor Measurement & Test Equipment Accuracy (SMTE) [ ]a,c	
Sensor Pressure Effects (SPE)	
Sensor Temperature Effects (STE)	
Sensor Drift (SD)	
Environmental Allowance (EA) [ ]a,c	
Bias [ ]a,c	
Rack Calibration Accuracy (RCA)	
Rack Measurement & Test Equipment Accuracy (RMTE) [ ]a,c	
Rack Temperature Effect (RTE)	
Rack Drift (RD)	

* In percent span (800 psi)

Table 3-1 (continued)
Protection Function Example

Channel Statistical Allowance =

$$\left\{\sqrt{\begin{matrix}PMA^2 + PEA^2 + (SMTE + SD)^2 + (SMTE + SCA)^2 + SPE^2 + STE^2 + \\ (RMTE + RD)^2 + (RMTE + RCA)^2 + RTE^2\end{matrix}}\right\} +$$
$$EA_T + EA_R + EA_{IR} + Bias$$

[ ] a,c

SAL = 1740 psig
NTS = 1850 psig
Instrument span = 1700 – 2500 psig = 800 psi / 4-20 mA = 16 mA / 0 – 10 VDC = 10 VDC
TA = |(1740 – 1850)*(100/800)| = 13.8 % span
[ ] a,c

Transmitter +ALT = [ ] a,c
Transmitter –ALT =
Transmitter +AFT =
Transmitter –AFT =

Process Racks +ALT = [ ] a,c
Process Racks –ALT =
Process Racks +AFT =
Process Racks –AFT =

Table 3-1 (continued)
Protection Function Example

Example Scaling Information at Calibration Points

Calibration Point	Span	psig	Xmtr mA	Rack VDC

a,c

Table 3-2
Control Function Example - Pressurizer Pressure – Control
Barton 763A Transmitter, Westinghouse 7300 Process Racks

Parameter	Allowance*
Process Measurement Accuracy (PMA)	[ ] a,c
Thermal Inertia Allowance (treated as a bias)	
Primary Element Accuracy (PEA)	
Sensor Calibration Accuracy (SCA)	
Sensor Measurement & Test Equipment Accuracy (SMTE) [ ] a,c	
Sensor Pressure Effects (SPE)	
Sensor Temperature Effects (STE)	
Sensor Drift (SD)	
Environmental Allowance (EA)	
Bias [ ] a,c	
Rack Calibration Accuracy (RCA_{IND}) Control Board meter	
Rack Measurement & Test Equipment Accuracy ($RMTE_{IND}$) [ ] a,c	
Rack Temperature Effect (RTE)	
Rack Drift (RD_{IND}) Control Board meter	
Controller Accuracy (CA)	
Indication (READOUT) Control Board meter readability	

* In percent span (800 psi)

Table 3-2 (continued)
Control Function Example

Channel Statistical Allowance [ ][a,c] (indicated higher than actual) =

[ ]a,c

[ ]a,c

Channel Statistical Allowance [ ][a,c] (indicated lower than actual) =

[ ]a,c

Table 3-2 (continued)
Control Function Example

Nominal Control Setpoint (NCS) = 2235 psig
Instrument span = 1700 – 2500 psig = 800 psi / 4 – 20 mA = 16 mA / 0 – 10 VDC = 10 VDC

Safety Analysis Initial Condition (indicated lower than actual) = 2275 psig
TA (indicated lower than actual) = |(2275 – 2235)*100/800| = 5.0 % span
[ ] a,c

Safety Analysis Initial Condition (indicated higher than actual) = 2195 psig
TA (indicated higher than actual) = |(2195 – 2235)*100/800| = 5.0 % span
[ ] a,c

Transmitter +ALT = [
Transmitter –ALT =
Transmitter +AFT =
Transmitter –AFT =] a,c

Process Racks (controller) +ALT = [
Process Racks (controller) –ALT =
Process Racks (controller) +AFT =
Process Racks (controller) –AFT =] a,c

Process Racks (control board meter) +ALT = [
Process Racks (control board meter) –ALT =
Process Racks (control board meter) +AFT =
Process Racks (control board meter) –AFT =] a,c

Table 3-2 (continued)
Control Function Example

Example Scaling Information at Calibration Points

Calibration Point	Span	Meter psig	Xmtr mA	Controller VDC

a,c

Table 3-2 (continued)
Control Function Example

Calibration Point	Span	Meter psig	Xmtr mA	Controller VDC

a,c

Table 3-3
Indication Function Example - Pressurizer Pressure
Barton 763A Transmitter, Westinghouse 7300 Process Racks, VX-252 Meter

Parameter	Allowance*
Process Measurement Accuracy (PMA)	[ ] a,c
Primary Element Accuracy (PEA)	
Sensor Calibration Accuracy (SCA)	
Sensor Measurement & Test Equipment Accuracy (SMTE) [ ] a,c	
Sensor Pressure Effects (SPE)	
Sensor Temperature Effects (STE)	
Sensor Drift (SD)	
Environmental Allowance (EA)	
Bias [ ] a,c	
Rack Calibration Accuracy (RCA_{IND}) Control Board meter	
Rack Measurement & Test Equipment Accuracy ($RMTE_{IND}$) [ ] a,c	
Rack Temperature Effect (RTE)	
Rack Drift (RD_{IND}) Control Board meter Drift	
Indication (READOUT) Control Board meter readability	

* In percent span (800 psi)

Table 3-3 (continued)
Indication Function Example

Channel Statistical Allowance [ ]^{a,c} (indicated higher than actual) =

[ ]^{a,c}

[ ]^{a,c}

Channel Statistical Allowance [ ]^{a,c} (indicated lower than actual) =

[ ]^{a,c}

Table 3-3 (continued)
Indication Function Example

Instrument span = 1700 – 2500 psig = 800 psi / 4 – 20 mA = 16 mA / 0 – 10 VDC = 10 VDC

[ ] a,c

Transmitter +ALT = [
Transmitter –ALT =
Transmitter +AFT =
Transmitter –AFT =] a,c

Process Racks (control board meter) +ALT = [
Process Racks (control board meter) –ALT =
Process Racks (control board meter) +AFT =
Process Racks (control board meter) –AFT =] a,c

Example Scaling Information at Calibration Points

Calibration Point	Span	Digital* Meter psig	Xmtr mA

[ ] a,c

[ ] a,c

Table 3-3 (continued)
Indication Function Example

Calibration Point	Span	Digital* Meter psig	Xmtr mA

a,c

a,c

Table 3-4
ΔP Measurements Expressed in Flow Units

The ΔP accuracy expressed as percent of span of the transmitter applies throughout the measured span, i.e., ± 1.5 % of 100 inches ΔP = ± 1.5 inches anywhere in the span. Because $F^2 = f(\Delta P)$ the same cannot be said for flow accuracies. When it is more convenient to express the accuracy of a transmitter in flow terms, the following method is used:

$$(F_N)^2 = \Delta P_N$$

Where: N = Nominal Flow

$$2 F_N \partial F_N = \partial \Delta P_N$$

Thus,

$$\partial F_N = \frac{\partial \Delta P_N}{2 F_N} \qquad \text{Eq. 3-4.1}$$

Error at a point (not in percent) is:

$$\frac{\partial F_N}{F_N} = \frac{\partial \Delta P_N}{2(F_N)^2} = \frac{\partial \Delta P_N}{2 \Delta P_N} \qquad \text{Eq. 3-4.2}$$

and

$$\frac{\Delta P_N}{\Delta P_{max}} = \frac{(F_N)^2}{(F_{max})^2} \qquad \text{Eq. 3-4.3}$$

Where: max = maximum flow and the transmitter ΔP error is:

$$\frac{\partial \Delta P_N}{\Delta P_{max}}(100) = \text{ percent error in Full Scale } \Delta P \text{ (\% } \varepsilon \text{ FS } \Delta P) \qquad \text{Eq. 3-4.4}$$

Table 3-4 (continued)
ΔP Measurements Expressed in Flow Units

Therefore,

$$\frac{\partial F_N}{F_N} = \frac{\Delta P_{max}\left[\frac{\%\,\varepsilon\, FS\, \Delta P}{100}\right]}{2\Delta P_{max}\left[\frac{F_N}{F_{max}}\right]^2} = \left[\frac{\%\,\varepsilon\, FS\, \Delta P}{(2)(100)}\right]\left[\frac{F_{max}}{F_N}\right]^2 \qquad \text{Eq. 3-4.5}$$

Error in flow units is:

$$\partial F_N = F_N\left[\frac{\%\,\varepsilon\, FS\, \Delta P}{(2)(100)}\right]\left[\frac{F_{max}}{F_N}\right]^2 \qquad \text{Eq. 3-4.6}$$

Error in percent nominal flow is:

$$\frac{\partial F_N}{F_N}(100) = \left[\frac{\%\,\varepsilon\, FS\, \Delta P}{2}\right]\left[\frac{F_{max}}{F_N}\right]^2 \qquad \text{Eq. 3-4.7}$$

Error in percent full span is:

$$\frac{\partial F_N}{F_{max}}(100) = \left[\frac{F_N}{F_{max}}\right]\left[\frac{\%\,\varepsilon\, FS\, \Delta P}{(2)(100)}\right]\left[\frac{F_{max}}{F_N}\right]^2(100)$$

$$= \left[\frac{\%\,\varepsilon\, FS\, \Delta P}{2}\right]\left[\frac{F_{max}}{F_N}\right] \qquad \text{Eq. 3-4.8}$$

Equation 3-4.8 is typically used to express errors in percent full span in Westinghouse uncertainty calculations.

4.0 WESTINGHOUSE CALIBRATION AND DRIFT EVALUATION PROCESS

a,c

a,c

a,c

a,c

a,c

a,c

a,c

a,c

Figure 4-1 Westinghouse Calibration and Drift Data Evaluation Process Diagram

5.0 APPLICATION OF THE WESTINGHOUSE SETPOINT METHODOLOGY

5.1 Uncertainty Calculation Basic Assumptions / Premises

The equations noted in Sections 2 and 3 are based on the following premises:

1. The instrument technicians make reasonable attempts to achieve the NTS as an As Left condition at the start of each process rack's surveillance interval, i.e., the calibration error is driven towards 0.0 % span.
2. The process rack RCA will be confirmed each calibration cycle [ ]^{a,c} and Reference Accuracy evaluated [ ]^{a,c} When combined with previous As Left values, the trend characteristics of that instrument channel can be determined. [ ]^{a,c} of the calibration process and, thus, confirm the WSM uncertainty calculation assumption. The ability to calibrate is the first step in establishing the operability condition of the instrument channel. When a "leave alone zone" concept is incorporated into the calibration process, it is incumbent upon the plant staff to verify through the calibration trend evaluation process that a calibration bias is not introduced.
3. The process rack RD will be evaluated [ ]^{a,c} Process rack drift is defined as the arithmetic difference between [ ]^{a,c} The recording of the [ ]^{a,c} at the same points, determines the instrument drift. When combined with previous drift data for that instrument channel, the trend characteristics of drift for that channel can be determined. The instrument channel characteristics establish the performance of that channel. [ ]^{a,c} The magnitude of drift for an instrument channel is the second indication of the operability condition of the channel.
4. The process racks, including the bistables for analog racks, are verified/functionally tested in a string or loop process.
5. The instrument technicians make reasonable attempts to achieve a small calibration error as an As Left condition at the start of each transmitter's surveillance interval, i.e., the calibration error is driven towards 0.0 % span.
6. The transmitter SCA will be confirmed each calibration cycle [ ]^{a,c} and Reference Accuracy evaluated [ ]^{a,c}

[

]a,c When combined with previous As Left values, the trend characteristics of that device can be determined. [

]a,c of the calibration process and, thus, confirm the WSM uncertainty calculation assumption. The ability to calibrate is the first step in establishing the operability condition of the device. When a "leave alone zone" concept is incorporated into the calibration process, it is incumbent upon the plant staff to verify through the calibration trend evaluation process that a calibration bias is not introduced.

7. The transmitter SD will be evaluated [

]a,c Transmitter drift is defined as the arithmetic difference between [ ]a,c The recording of the [

]a,c at the same points, determines the transmitter drift. When combined with previous drift data for that device, the trend characteristics of drift for that device can be determined. The transmitter characteristics establish the performance of that transmitter. [

]a,c The magnitude of drift for a transmitter is the second indication of the operability condition of the device.

It should be noted for (1) and (5) above that it is not necessary for the instrument technician to recalibrate a device or channel if the As Found condition is not exactly at the nominal condition, but is within the two-sided (±) ALT. As noted above, the uncertainty calculations assume that the ALT (conservative and non-conservative direction) is satisfied on a reasonable, statistical basis, not that the nominal condition is satisfied exactly. The evaluations above assume that the SCA, SD, RCA and RD parameter values noted in Tables 3-1 and 3-2 are satisfied on at least a two-sided (±) 95 % probability / 95 % confidence level basis. Therefore, it is necessary for the plant to periodically re-verify the continued validity of these assumptions. Westinghouse recommends that this verification be performed [

]a,c This prevents the institution of non-conservative biases due to a procedural (or unwritten cultural) basis without the plant staff's knowledge and appropriate treatment.

In summary, a sensor/transmitter or process rack channel is considered to be "calibrated" when the two-sided (±) ALT for all points over three passes is satisfied. An instrument technician may determine to recalibrate if near the extremes of the ALT, but it is not required. Recalibration is explicitly required any time the As Found condition of the device or channel is outside of the ALT. A device or channel may not be left outside the ALT without declaring the device or channel "inoperable" and appropriate action taken. Thus, an ALT may be considered as an outer limit for the purposes of calibration and instrument uncertainty calculations.

Process rack [

]^{a,c}

Thus, Westinghouse has concluded, that for operable process racks, AFT = ALT = RCA. With respect to sensor/transmitters, the AFT = SD, based initially on the vendor specification data and subsequently on the periodic evaluation of SD data [ ]^{a,c}

The above results in the WSM's reliance on the NTS, and not the Limiting Trip Setpoint (LTSP) as defined in ISA-67.04.01-2006 (R2011) (Reference 3) or the Limiting Setpoint (LSP) as defined in RIS 2006-17 (Reference 15). Specific to Reference 15, the LSP is noted as: "*... the limiting setting for the channel trip setpoint (TSP) considering all credible instrument errors associated with the instrument channel. The LSP is the limiting value to which the channel must be reset at the conclusion of periodic testing to ensure the safety limit (SL) will not be exceeded if a design basis event occurs before the next periodic surveillance or calibration.*" As noted on the previous page, with respect to the WSM, operability of the process racks is defined as the ability to be calibrated about the calibration points across the instrument span, including the NTS (ALT about the calibration points, including the NTS), and subsequent surveillance should find the channel within the AFT = ALT about the calibration points, including the NTS. On those rare occasions that the channel is found outside of the AFT = ALT, operability requirements would be initially satisfied via recalibration about the calibration points across the instrument span, including reset about the NTS. Operability defined as conservative with respect to a zero margin LSP is a concept that is insufficient for the WSM, and is inconsistent with its basic assumption of the AFT = ALT = RCA definition. In order to have confidence (statistical or otherwise) of appropriate operation of the process racks, it is necessary that the process racks operate within the two-sided (±) limits defined about the calibration points across the instrument span, including the NTS. This is particularly true for protection functions that have historical NTS values that generate large CSA margins. From a WSM perspective, systematic allowance of large drift magnitudes in excess of equipment design – either by large magnitude RD or RMTE terms or utilization of an LSP, generates a false sense of security which is inappropriate for future operation consideration, and which erodes the concept of performance based specifications and limits.

5.2 Process Rack Operability Assessment Program and Criteria

The parameter of most interest as an indication of process rack operability is verification of the Reference Accuracy [ ]^{a,c}. The next parameter of interest is the process rack relative drift [ ]^{a,c} found to be within RD, where RD is the two-sided (±) 95/95 drift value assumed for that channel. However, this would require the instrument technician to record and have available in the field both the current As Found and the previous As Left condition data to perform a calculation in the field. Generally, plants are reluctant to perform this field calculation due to the requirements of having the [ ]^{a,c} for that channel at the time of the drift

determination and the need for independent calculation verification. Few plants require that the [ ]a,c condition be ascertained prior to performance of a surveillance test or are set up for independent verification of calculations in the field.

An alternative for the process racks is the Westinghouse method for use of a fixed magnitude, two-sided (±) AFT about the calibration points across the instrument span, including the NTS. It would be reasonable for this AFT to be RMTE + RD, where RD is the actual statistically determined 95/95 drift value and RMTE is defined in the plant procedures. However, comparison of this value with the RCA tolerance utilized in the Westinghouse uncertainty calculations would yield a value where the AFT is less than the RCA tolerance (ALT). [

]a,c Therefore, a more reasonable approach for the plant staff to follow was determined. An AFT criterion based on an absolute magnitude that is the same as the RCA criterion, i.e., the allowed deviation from the calibration points across the instrument span, including the NTS, on an absolute indication basis is plus or minus (±) the RCA tolerance (ALT). A channel found inside the RCA tolerance (ALT) on an indicated basis at all calibration points is considered to be operable. A channel found outside the RCA tolerance (ALT) at a single calibration point is evaluated and recalibrated utilizing three passes across the instrument span. The channel must be returned to within the ALT at all three pass calibration points for the channel to be considered operable. This criterion is incorporated into plant, function specific calibration and drift procedures as the defined ALT about the calibration points, including the NTS. [

]a,c A channel found to exceed this criterion multiple times should trigger a more comprehensive evaluation of the operability of the channel. Thus, more elaborate evaluation and monitoring may be included, as necessary, if the drift is found to be excessive or the channel is difficult to calibrate.

5.3 Application of Process Rack Operability Assessment to the Plant Technical Specifications

The drift operability criteria described for the process racks in Section 5.2 are based on a statistical evaluation of the performance of the installed hardware. These criteria [

]a,c

[

]a,c

Sections 5.1 and 5.2 are consistent with the recommendations of the Westinghouse paper presented at the June 1994, ISA/EPRI conference in Orlando, Florida (Reference 16). In addition, the plant operability assessment processes described in Sections 5.2 and 5.3 are consistent with the basic intent of ISA-67.04.01-2006 (R2011) (Reference 3). Therefore, the ALT and AFT magnitudes are "performance based" and are determined by adding (subtracting) the calibration accuracy (RCA=ALT=AFT) of the device tested during the Channel Operational Test to the NTS.

An example of the ALT and AFT calculations for the process racks is:

Pressurizer Pressure – Low (Safety Injection)

ALT/AFT Determination
NTS = 1850 psig
SPAN = 800 psi
RCA = [ ] a,c

ALT = NTS ± RCA
(+) ALT = [
(-) ALT =] a,c

AFT = NTS ± RCA
(+) AFT = [
(-) AFT =] a,c

See Table 3-1, the section labeled "Example Scaling Information at Calibration Points" for the process rack ALT and AFT limits about each of the calibration points across the instrument span.

Those plants that opt for Option A of TSTF-493 Revision 4 (Reference 18) will have one of several parameters listed in the Technical Specifications for RTS/ESFAS functions. These options and the Westinghouse recommendations that address them are noted below.

1. Allowable Value only,
2. Nominal Trip Setpoint only and
3. Nominal Trip Setpoint and Allowable Value.

Of the three approaches, Westinghouse recommends the Technical Specifications include the NTS only (2) as that places control on the parameter of primary interest, the NTS. As the WSM does not support the Allowable Value concept, for (1) and (3); Westinghouse will provide only the ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS.

Those plants that opt for Option B of TSTF-493 Revision 4 (Reference 18) will relocate the RTS/ESFAS trip setpoints values from the Technical Specifications and utilize a Setpoint Control Program (SCP). The Westinghouse recommendations for an SCP based on the WSM are identified in WCAP-17503-P, Revision 1 (Reference 19). In this instance, the process rack ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS, for each protection function are defined in an administratively controlled document. If the protection function uncertainty calculations are performed by Westinghouse, this document would be a plant specific WCAP providing a summary of the uncertainty calculations with tables identifying the process rack ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS.

5.4 Sensor/Transmitter Operability Assessment Program and Criteria

The parameter of most interest for indication of transmitter operability is verification of the Reference Accuracy [ ]a,c. The next parameter of interest is the transmitter relative drift [ ]a,c for the calibration points across the instrument span found to be within SD, where SD is the two-sided (±) 95/95 drift value assumed for that device. However, this would require the instrument technician to record and have available in the field both the [ ]a,c condition data to perform calculations in the field. Generally, plants are reluctant to perform these field calculations due to the requirements of having the [ ]a,c values for that device at the time of the drift determination and the need for independent calculation verification. Few plants require that the [ ]a,c be ascertained prior to performance of a surveillance test or are set up for independent verification of calculations in the field.

An alternative for the transmitters is the very common method of use of a fixed magnitude, two-sided (±) AFT about each of the nominal calibration points, e.g., 0 %, 25 %, 50 %, 75 % and 100 % span. Based on the [ ]a,c operability of the device is determined as follows.

1. A transmitter found inside the SCA tolerance (ALT) about all calibration points, on an indicated basis [ ]a,c is considered to be operable. Two more sequential passes of data inside the ALT must be gathered for confirmation of the Reference Accuracy.
2. A transmitter found outside the SCA tolerance (ALT) about one or more calibration point(s) but within the SD (AFT) at all of the calibration points [ ]a,c is considered operable and must be recalibrated (three complete passes).
3. A transmitter found outside the SD (AFT) at three or more calibration point(s) [ ]a,c is considered inoperable. A condition report should be initiated and the device must be recalibrated (three complete passes) to demonstrate a return to an operable condition.

In all cases, for the device to be considered operable, the transmitter must be returned to within the ALT about all desired calibration points (three complete passes). This criterion is incorporated into plant, function specific calibration and drift procedures as the defined ALT about the desired calibration points. [ ]a,c. This comparison can then be utilized to ensure consistency with the assumptions of the uncertainty calculations documented in Tables 3-1 through 3-3, see Assumption 7. A transmitter found to exceed this criterion multiple times should trigger a more comprehensive evaluation of the operability of the device. Thus, more elaborate evaluation and monitoring may be included, as necessary, if the drift is found to be excessive or the transmitter is difficult to calibrate.

5.5 Application of the Sensor/Transmitter Operability Assessment

The drift operability criteria described for transmitters in Section 5.4 are based on a statistical evaluation of the performance of the installed hardware. These criteria [

]a,c

Utilizing the approach of Section 5.4, ALT and AFT values for the transmitter would be defined at the multiple calibration points, as noted in Table 3-1. An example is provided below.

Pressurizer Pressure - Low (Safety Injection)

ALT/AFT Determination

SPAN = 800 psi / 16 mA

[ ]a,c

Calibration Points = 0 %, 25 %, 50 %, 75 %, 100 % span

Calibration zero = 1700 psig

Calibration Points = 1700, 1900, 2100, 2300, 2500 psig

ALT = Calibration Point ± SCA

0 % span:	(+) ALT = [ ]^{a,c}	(-) ALT = [ ]^{a,c}
25 % span:	(+) ALT =	(-) ALT =
50 % span:	(+) ALT =	(-) ALT =
75 % span:	(+) ALT =	(-) ALT =
100 % span:	(+) ALT =	(-) ALT =

The above ALT values would be found in the calibration procedure.

AFT = Calibration Point ± SD

0 % span:	(+) AFT = [ ]^{a,c}	(-) AFT = [ ]^{a,c}
25 % span:	(+) AFT =	(-) AFT =
50 % span:	(+) AFT =	(-) AFT =
75 % span:	(+) AFT =	(-) AFT =
100 % span:	(+) AFT =	(-) AFT =

The above AFT values would be found in the surveillance procedure.

6.0 SUMMARY OF IMPORTANT POINTS

Noted below is a summary of important points or assumptions with regards to the WSM.

1. The basic algorithm is an SRSS, accounting for M&TE dependency with the calibration or drift parameter.
2. Protection function uncertainty calculations are based on a single channel.
3. [ ]^{a,c}
4. Westinghouse instrument uncertainties are two-sided.
5. EA terms are not considered statistically dependent with all other parameters, however, the EA terms are generally large magnitude, non-random terms that are conservatively treated as limits of error.
6. [ ]^{a,c}
7. PMA terms provide allowances for the non-instrument related effects.
8. PEA term accounts for uncertainties due to metering devices, such as elbows, venturis, and orifice plates. In RTS/ESFAS uncertainty calculations, these are limited in application to flow measurements, e.g., RCS Flow (Cold Leg Elbow Taps, Cold Leg Bends, Hot Leg Elbows), Steam Flow, Feedwater Flow and Steam Generator Blowdown Flow.
9. The PEA term may be used for potential transformer characteristics for Undervoltage applications.
10. The protection function CSA value is a two-sided (±) 95 % probability at a 95 % confidence level (95/95) result.
11. The control function CSA value is a two-sided (±) 95 % probability at a 95 % confidence level (95/95) result.
12. [ ]^{a,c}
13. There are typically two types of digital protection functions, 1) form/fit/function replacement for an analog channel and, 2) complex functions that utilize multiple intermediate calculations.
14. [ ]^{a,c}

15. [

]a,c

16. Westinghouse reports CSA values to one decimal place using the technique of rounding down values less than 0.05 % span and rounding up values greater than or equal to 0.05 % span.

17. For process racks, AFT = ALT = RCA, i.e., the AFT is a two-sided parameter (±) about the calibration points across the instrument span, including the NTS.

18. For transmitters, the AFT is a two-sided parameter (±) about the calibration points (absolute drift), or the AFT is a two-sided parameter (±) about the calibration recorded [ ]a,c (relative drift).

19. For process racks, the ALT is a two-sided (±) parameter equal to the RCA about the the calibration points across the instrument span, including the NTS.

20. For transmitters, the ALT is defined as the two-sided (±) SCA magnitude about the desired calibration points.

21. Margin is defined to be a non-negative number.

22. Westinghouse defines the NTS as the LSSS for the RTS and ESFAS functions listed in the plant Technical Specifications.

23. RCA is the two-sided (±) calibration tolerance of the process racks as reflected in the plant calibration procedures.

24. RCA is defined at multiple points across the calibration range of the channel, and specifically at the NTS for the bistable or trip module.

25. The RCA magnitude should be, and calibration procedure should confirm, the Reference Accuracy of the instrument process racks, i.e., requires gathering data from three passes up/three passes down.

26. Recording and trending of the three pass As Left condition data of the process racks (ALT = RCA) is necessary to assure conformance with the uncertainty calculation basic assumptions.

27. It is assumed that individual modules in a loop are calibrated to a particular tolerance and that the process loop (as a string) is verified to be calibrated to the RCA. [ ]a,c

28. Recording and trending of the [ ]a,c data of the process racks (RD) is necessary to assure conformance with the uncertainty calculation basic assumptions.

29. Actual SAL values are determined, or confirmed, by review of the plant safety analyses.

30. The SAL is the starting point for determination of the acceptability of the CSA.

31. The two-sided (±) calibration tolerance for a sensor or transmitter (ALT) is defined in the plant calibration procedures.

32. The SCA is defined at multiple points across the calibration range of the channel.

33. The SCA magnitude should be, and the calibration procedure should confirm, the Reference Accuracy of the device, i.e., requires gathering data from three passes up/three passes down.

34. Recording and trending of the three pass As Left condition data of the sensor or transmitter (SCA) is necessary to assure conformance with the uncertainty calculation basic assumptions.

35. Recording and trending of the [ ]^{a,c} data of the sensor or transmitter (SD) is necessary to assure conformance with the uncertainty calculation basic assumptions.

36. [ ]^{a,c}

37. [ ]^{a,c}

38. [ ]^{a,c}

39. [ ]^{a,c}

40. [ ]^{a,c}

41. [ ]^{a,c}

42. Westinghouse will not pool data from multiple sites or different vendor hardware.

43. [ ]^{a,c}

44. [ ]^{a,c}

45. [ ]^{a,c}

46. [ ]^{a,c}

47. [ ]^{a,c}

48. [ ]^{a,c}

49. The instrument technicians make reasonable attempts to achieve the NTS as an As Left condition at the start of each process rack's surveillance interval, i.e., the calibration error is driven towards 0.0 % span.

50. The process rack calibration accuracy (As Left values) will be evaluated [ ]^{a,c}

51. The ability to calibrate is the first step in establishing the operability condition of the instrument channel.

52. When a "leave alone zone" concept is incorporated into the calibration process, it is incumbent upon the plant staff to verify through the calibration trend evaluation process that a calibration bias is not introduced.

53. [ ]^{a,c}

54. The recording of the [ ]^{a,c} determines the instrument drift. The magnitude of drift for an instrument channel/rack is the second indication of the operability condition of the instrument channel/rack.

55. The process racks, including the bistables, are verified/functionally tested in a string or loop process.

56. The instrument technicians make reasonable attempts to achieve a small calibration error as an As Left condition at the start of each transmitter's surveillance interval, i.e., the calibration error is driven towards 0.0 % span.

57. The transmitter calibration accuracy (As Left values) will be evaluated [ ]^{a,c}

58. The ability to calibrate is the first step in establishing the operability condition of the device.

59. The transmitter drift will be evaluated [ ]^{a,c}

60. The transmitter characteristics establish the performance of that transmitter. The magnitude of drift for a transmitter is the second indication of the operability condition of the device.

61. The operability evaluations confirm that the SCA, SD, RCA and RD parameter values are satisfied on at least a two-sided (±) 95 % probability / 95 % confidence level basis. Therefore, it

is necessary to periodically re-verify the continued validity of these assumptions. Westinghouse recommends verification [ ]^{a,c}

62. The WSM relies on the NTS as the initial condition for process rack operability evaluations.

63. [ ]^{a,c}

64. Process rack ALT and AFT magnitudes are "performance based" and are determined by adding (subtracting) the calibration accuracy (RCA=ALT=AFT) of the device tested during the Channel Operational Test to the NTS.

65. With regards to TSTF-493 Revision 4, Option A: as the WSM does not support the Allowable Value concept; Westinghouse will provide only the ±ALT and ±AFT values for the calibration points across the instrument span, including the NTS.

66. With regards to TSTF-493 Revision 4, Option B, Westinghouse recommendations are identified in WCAP-17503-P, Revision 1.

67. Westinghouse has defined a three step transmitter operability evaluation process based on drift.

    a. If found inside the SCA tolerance (ALT) about all calibration points on an indicated basis [ ]^{a,c} – the transmitter is considered to be operable and may be recalibrated. Two more sequential passes of data inside the ALT must be gathered for confirmation of the Reference Accuracy.
    b. If found outside the SCA tolerance (ALT) about one or more calibration point(s) but within the SD (AFT) at all of the calibration points [ ]^{a,c} – the transmitter is considered operable and must be recalibrated (three complete passes).
    c. If found outside the SD (AFT) at three or more calibration point(s) [ ]^{a,c} – the transmitter is considered inoperable. A condition report should be initiated and the device must be recalibrated (three complete passes) to demonstrate a return to an operable condition.

In all cases, for the device to be considered operable, the transmitter must be returned to within the ALT about all desired calibration points (for the three complete passes).

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32. IEEE Std 498-1990, "Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities," Institute of Electrical and Electronics Engineers, December 1990.

[3] Microsoft and Excel are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries

33. Draft Regulatory Guide DG-1141, (Proposed Revision 4 of Regulatory Guide 1.105, dated December 1999), "Setpoints for Safety-Related Instrumentation," (ML081630179), Nuclear Regulatory Commission, June 2014.

APPENDIX A: NRC BTP 7-12 ACCEPTANCE CRITERIA

1. Facility setpoint list identifying safety setpoints and non-safety setpoints for functions providing protective functions important to safety or that are relevant to compliance with technical specification limiting conditions for operation.

a,c

2. Identification of safety setpoints that are not safety-limit-related LSSS and the basis for this determination.

[ ]a,c

3. Identification of setpoints that trigger procedural actions that are important to safety.

[ ]a,c

4. Description of the setpoint methodology and procedures used in determining setpoints, including information sources, scope, assumptions, interface reviews, and statistical methods.

[ ]a,c

5. Terminology used to describe limits, allowances, and tolerances, and environmental or other effects used to support setpoint calculations.

[ ]a,c

6. Technical specifications and basis for LSSSs.

[ ]a,c

7. Basis for acceptable as-found band and acceptable as-left band and determination of the instrument operability based on acceptable as-found band and acceptable as-left band.

[ ]a,c

8. Basis for calibration intervals.

[

]a,c

9. Basis for assumptions regarding instrument uncertainties and discussion of the method used to determine uncertainty values.

[

]a,c

10. Description of the provisions for control of measuring and test equipment used for calibration of the instrument.

[

]a,c

11. Description of the program and methodology used to monitor and manage instrument uncertainties, including drift.

[

]a,c

12. Description of the functional and performance criteria for the initiation and execution of the safety functions at the setpoints.

[

]a,c

13. Instrument specifications, including range, accuracy, repeatability, hysteresis, dynamic response, environmental qualification, calibration reference, and calibration intervals for each instrument type.

[

]a,c

14. Instrument loop diagrams showing all hardware elements of the instrument loop(s).

[

]a,c

15. *Instrument and tubing layout drawings and installation details showing locations and elevations of instruments and tubing relative to a reference datum, as well as the points where the instrument interfaces with the monitored process.*

[ ][a,c]

16. *For digital instrumentation, the configuration database for the instrumentation functions, and identification of digital elements (hardware and software) where error could be introduced into the measurement – for example, errors that could result from analog-to-digital or digital-to analog conversion or from numerical methods used in the software (e.g., curve fitting).*

[ ][a,c]

17. *The description of assumptions in accordance with ISA-S67.04, should include the environmental allowances (temperature, pressure, humidity, radiation, vibration, seismic, and electrical) for the instruments.*

[ ][a,c]

APPENDIX B: NRC BTP 7-12 REVIEW PROCEDURES

1. Relationships between the safety limit, analytical limit, limiting trip setpoint, the allowable value, the setpoint, the acceptable as-found band, the acceptable as-left band, and the setting tolerance.

[ ] a,c

2. The reviewer should assure that the setpoint technical specifications meet the requirements of 10 CFR 50.36. Additional information related to setpoint technical specifications is provided in RIS 2006-17.

[ ]a,c

3. Basis for selection of the trip setpoint.

[ ]a,c

4. Uncertainty terms that are addressed.

[ ]a,c

5. Method used to combine uncertainty terms.

[ ]a,c

6. Justification of statistical combination.

[ ]a,c

7. Relationship between instrument and process measurements units.

[ ]a,c

8. Data used to select the trip setpoint, including the source of the data.

[

]a,c

9. Assumptions used to select the trip setpoint (e.g., ambient temperature limits for equipment calibration and operation, potential for harsh accident environment).

[

]a,c

10. Instrument installation details and bias values that could affect the setpoint.

[

]a,c

11. Correction factors used to determine the setpoint (e.g., pressure compensation to account for elevation difference between the trip measurement point and the sensor physical location).

[

]a,c

12. Instrument test, calibration or vendor data, as-found and as-left; each instrument should be demonstrated to have random drift by empirical and field data. Evaluation results should be reflected appropriately in the uncertainty terms, including the setpoint methodology.

[ ]a,c

APPENDIX C: Westinghouse Letter LTR-NRC-15-37

Submittal of "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115)" (Proprietary/Non-Proprietary).

(Limited to NP-Attachment B)

Westinghouse

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Direct tel: (412) 374-4643
Direct fax: (724) 940-8560
e-mail: greshaja@westinghouse.com

LTR-NRC-15-37

June 25, 2015

Subject: Submittal of "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115)" (Proprietary/Non-Proprietary).

Enclosed are the proprietary and non-proprietary versions of "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115)"

Also enclosed are:

1. An Application for Withholding Proprietary Information from Public Disclosure, AW-15-4172 (Non-Proprietary), with Proprietary Information Notice and Copyright Notice
2. An Affidavit (Non-Proprietary).

This submittal contains proprietary information of Westinghouse Electric Company LLC. In conformance with the requirements of 10 CFR Section 2.390, as amended, of the Commission's regulations, we are enclosing with this submittal an Application for Withholding Proprietary Information from Public Disclosure and an Affidavit. The Affidavit sets forth the basis on which the information identified as proprietary may be withheld from public disclosure by the Commission.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference AW-15-4172 and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

James A. Gresham, Manager
Regulatory Compliance

Enclosures

bcc: James A. Gresham
Cheryl Robinson
Anne M. Stegman

Westinghouse

Westinghouse Electric Company
1000 Westinghouse Drive
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AW-15-4172

June 25, 2015

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-NRC-15-37 P-Attachment, "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115)" (Proprietary)

Reference: Letter from James A. Gresham to Document Control Desk, LTR-NRC-15-37, dated June 25, 2015

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10 CFR Section 2.390, Affidavit AW-15-4172 accompanies this Application for Withholding Proprietary Information from Public Disclosure, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the accompanying Affidavit should reference AW-15-4172 and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

James A. Gresham, Manager
Regulatory Compliance

AW-15-4172
June 25, 2015

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

I, Henry A. Sepp, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

Henry A. Sepp, Director
CRE-Systems and Components Engineering

(1) I am Director, CRE-Systems and Components Engineering, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(iii) There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

4 AW-15-4172

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(vi) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, it is to be received in confidence by the Commission.

(v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in LTR-NRC-15-37 P-Attachment, "Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115)" (Proprietary), for submittal to the Commission, being transmitted by Westinghouse letter, LTR-NRC-15-37, and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the NRC review and approval of WCAP-17503-P/WCAP-17503-NP, Revision 0 and WCAP-17504-P/WCAP-17504-NP, Revision 0 and may be used only for that purpose.

(a) This information is part of that which will enable Westinghouse to:

(i) Secure NRC approval of WCAP-17503-P/WCAP-17503-NP, Revision 0 and WCAP-17504-P/WCAP-17504-NP, Revision 0.

(b) Further this information has substantial commercial value as follows:

(i) Westinghouse plans to sell the use of similar information to its customers for the purpose of performance of control and protection function instrument uncertainty calculations using a methodology that has received NRC prior approval.

(ii) Westinghouse plans to sell the use of similar information to its customers for the purpose of assisting in the organization and securing NRC approval of a plant-specific Setpoint Control Program.

(iii) Westinghouse can sell support and defense of industry guidelines and acceptance criteria for plant-specific applications.

(iv) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar uncertainty calculations and consultation services, including licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of documents furnished to the NRC in connection with requests for generic review and approval of WCAP-17503-P/WCAP-17503-NP, Revision 0 and WCAP-17504-P/WCAP-17504-NP, Revision 0.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

COPYRIGHT NOTICE

LTR-NRC-15-37 NP-Attachment

Westinghouse Responses to U.S. Nuclear Regulatory Commission Request for Additional Information for the Topical Reports (TRs) WCAP-17503-P/WCAP-17503-NP, Revision 0, 'Westinghouse Generic Setpoint Control Program Recommendations' and WCAP-17504-P/WCAP-17504-NP, Revision 0, 'Westinghouse Generic Setpoint Methodology' (TAC No. ME8115) (Non-Proprietary)

June 2015

Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

LTR-NRC-15-37 NP-Attachment B

Westinghouse Responses to NRC RAIs on WCAP-17504-P

1. **Applicability of WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, Westinghouse Generic Setpoint Methodology**

   Please elaborate upon the statement of intended applicability for the Westinghouse generic setpoint methodology that is contained in Section 1.0 "Introduction." Specifically, state whether this methodology document is applicable only to the Nuclear Steam Supply Systems (NSSS) of current operating 2-loop, 3-loop, and 4-loop Westinghouse plants, or whether it is intended for use in safety applications for other types of reactors.

Westinghouse Response:

WCAP-17504-P provides the basic instrument uncertainty algorithms for the Reactor Trip System (RTS) trip functions, Engineered Safety Features Actuation System (ESFAS) protection functions, Emergency Operating Procedure (EOP) operator action points, control system functions assumed as initial condition assumptions in the safety analyses, and control board and computer indication of plant parameters utilized by the plant operators to confirm proper operation of the control and protection instrumentation. This includes the following:

- RTS functions identified in Table 3.3.1-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
- ESFAS functions identified in Table 3.3.2-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
- Operator action points associated with instrumentation identified in Table 3.3.3-1 of NUREG-1431 (or equivalent for other NSSS vendor designs),
- Setpoints associated with LCO 3.3.5," Loss of Power Diesel Generator Start Instrumentation" of NUREG-1431 (or equivalent for other NSSS vendor designs),
- Instrumentation associated with the control and indication functions identified in WCAP-8567-P-A, "Improved Thermal Design Procedure" and
- Instrumentation associated with the control and indication functions identified in WCAP-11397-P-A, "Revised Thermal Design Procedure."

The plants for which this methodology is considered applicable (when explicitly noted in the plant Updated Final Safety Analysis Report (UFSAR) in the equivalent of NUREG-1431, Vol. 2, Rev. 3.0, Sections B 3.3.1, B 3.3.2, B 3.3.3 and B 3.3.5, References) are:

- Westinghouse designed 2, 3 and 4 loop NSSS,
- Westinghouse designed AP1000®[1],
- Toshiba designed Advanced Boiling Water Reactor and
- Combustion Engineering (C-E) designed NSSS.

[1] AP1000 is a trademark or registered trademark of Westinghouse Electric Company LLC, its affiliates and/or subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.

The methodology is not considered applicable to the uncertainty calculations identified in the C-E document CEN-356(V)-P, "Modified Statistical Combination of Uncertainties," which are associated with the operation of the C-E designed digital monitoring and protection systems, i.e., Core Operating Limit Supervisory System (COLSS) and Core Protection Calculator System (CPCS). This document was approved by the NRC in October, 1987.

2. Uncertainties Defined by Plant Specific Baseline Documentation

   Please clarify the intent of the statement in the introductory paragraph to Section 2.0, where it states: "All appropriate and applicable uncertainties, ***as defined by a review of plant specific baseline design input documentation***, are included in each protection, control or indication function CSA calculation." (Emphasis added) For example, which uncertainty terms are defined by Westinghouse and which terms are defined by plant specific baseline design documents? Are there any uncertainty terms that would not have been included in the expressions presented, if there had not been a review of plant specific baseline design input documentation? Or, is it intended to state that the *values* for each of the uncertainties in the expressions that follow are to be obtained through a review of the plant specific baseline design input documentation? Also, please explain what is meant by the term "baseline" documentation. How are baseline documents differentiated from other plant documents?

Westinghouse Response:

There are many potential differentiators with respect to documentation of instrument uncertainties, e.g., the vendor, supplier, licensee, purchaser, environmental conditions, all of which can influence an uncertainty value. In addition, there is no single answer as to who is responsible for a specific uncertainty term as it is dependent on several variables, e.g., did Westinghouse specify and qualify the device, or did the licensee purchase a vendor specified device? Westinghouse works with the licensee to determine each uncertainty component based on the device specifications and plant control of the device. Starting at the top, Westinghouse would consider the following as baseline design input documentation for an uncertainty calculation:

- UFSAR Chapters 7 and 15,
- Technical Specifications,
- Supporting safety analyses,
- Supporting control system analyses,
- Functional requirements documents,
- Process block diagrams,
- P&IDs, As-Built drawings,
- Equipment vendor manuals,
- Equipment supplier information – purchasing specifications,
- Qualification test reports,
- Licensee environmental calculations,
- Scaling calculations,
- Sensor/transmitter calibration procedures and As Left data,
- Sensor/transmitter surveillance procedures and As Found data,
- Process rack calibration procedures and As Left data,

Page 2 of 33

- Process rack surveillance procedures and As Found data and
- Plant measurement and test equipment specifications.

With respect to who defines the uncertainty terms – for a Westinghouse performed uncertainty calculation following the methodology outlined in WCAP-17504, Westinghouse is ultimately responsible for defining the terms utilized and the corresponding values with licensee oversight and concurrence. Westinghouse will use appropriate information from the list above to make the determination of what to include and the value. Even a simple protection function uncertainty calculation will use information from multiple sources; equipment suppliers, contractors, licensee and Westinghouse, i.e., there is no single source that can be defined for a given term. An example is a pressure transmitter purchased by the licensee:

[ ]^{a,c}

With respect to uncertainty term inclusion or exclusion, evaluations of plant component design, scaling, safety analyses and calibration procedures are appropriate to determine PMA term applicability and even the basic uncertainty terms to be considered or modeled, e.g., Steam Generator Level [ ]^{a,c}, Overtemperature ΔT [ ]^{a,c} and Overpower ΔT [ ]^{a,c}. Thus, there is significant sensitivity to more than a basic understanding of the plant design and operation that is not evident from a cursory evaluation of the basic uncertainty equations. A review of the uncertainty

equations will also note the absence of a dynamic effects uncertainty term. Westinghouse uncertainty calculations reflect a steady state condition. Westinghouse assumes that transient dynamic effects, e.g., transient and electronic filtering effects (lead, lag, rate lag), are modeled explicitly in the safety analyses, as they are in a Westinghouse performed safety analysis. Westinghouse considers it appropriate to confirm this aspect if the safety analyses are performed by others, e.g., fuel reloads, containment integrity analyses. Finally, there is the absence of EMI/RFI uncertainties in the uncertainty equations. It is impossible to model the unknown magnitudes due to these effects. Westinghouse requires the shielding for EMI or administrative controls preventing the presence of RFI around control and protection system components.

3. **M&TE Uncertainty and Calibration Standard Uncertainty Contribution to Total Instrument Channel Uncertainty**

   The NRC staff notes the expressions presented in Section 2.1 do not include a term representing the uncertainty of the calibration transfer standard (Calibration Standard) used at the plant to calibrate the measurement and test equipment (M&TE) used for calibrating the installed plant instrumentation. Similarly, there does not appear to be an expression for calculating or evaluating an upper bound limit of the magnitude of either Rack or Sensor M&TE uncertainty to be included in total channel statistical allowance. The explanation on page 19 for the term "RMTE" (Rack Measurement & Test Equipment Accuracy) states:

   > "When the magnitude of RMTE meets the requirements of ANSI/ISA-51.1-1979 (R 1993) (Reference 12, p. 61) it may be considered an integral part of RCA or RD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and may not be included in the uncertainty calculations."

   Similarly, on page 21 the explanation for the term "SMTE" (Sensor Measurement and Test Equipment Accuracy) states:

   > "When the magnitude of SMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p. 61) it may be considered an integral part of SCA. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and may not be included in the uncertainty calculations."

   However, ANSI/ISA-51.1-1979 (R 1993) actually states:

   > "When the accuracy rating of the reference measuring means is one tenth or less than that of the device under test, the accuracy rating of the reference measuring means may be ignored. *When the accuracy rating of the reference measuring means is one third or less, but greater than one tenth that of the device under test, the accuracy rating of the reference measuring means shall be taken into account.*" (Emphasis added)

In Section 4.0 "Westinghouse Calibration and Drift Evaluation Process" of WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, Section 4.1 "Input Data" states:

[

] (Emphasis added)

The NRC staff also notes that Clause 5 of IEEE Standard 498-1985, "IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities," (which is not endorsed within NRC Regulatory Guide 1.105) states:

> "In general, the inaccuracy of the reference standards shall contribute no more than one fourth of the allowable measuring and test equipment tolerance. However, when the actual inaccuracy of the measuring and test equipment is less than one fourth of the plant equipment tolerance, or if reference standards less than one fourth of the tolerance of the measuring and test equipment are not available, the requirement for one fourth may not be necessary. *The rationale for deviating from these requirements shall be justified and documented.*" (Emphasis added.)

The NRC staff notes that M&TE maintained and calibrated in tightly controlled ambient environments (e.g., a plant I&C maintenance calibration laboratory controlled to 77 °F ± 2 °F) and then brought into plant areas where a broad range of ambient temperature and humidity conditions exist, it is possible to exceed the M&TE manufacturer's reference conditions for its accuracy specifications, and it would be prudent to apply the manufacturer's degraded accuracy specification effect terms. When employing such equipment for calibration of safety channel process measurement devices located in areas where the plant ambient temperature conditions can vary significantly depending on seasonal variations or plant operating status, the magnitude of M&TE uncertainty contributing to the measured device uncertainty can vary. As an example, a Fluke Model 45 Digital Voltmeter set on fast reading rate and used for measuring a 20 mA output of a transmitter would have a reference accuracy of ± (0.05% of Reading + 2 digits) and a resolution of 0.1 mA over a 18°C to 28°C ambient temperature range, but has an accuracy de-rating temperature effect of ±(0.1 X (Accuracy Spec/°C)(ΔT) when operated outside the 18°C to 28°C (64.4 to 82.4°F) ambient temperature range. Thus, a measurement reading of the 20 mA transmitter output taken within the (64.4 to 82.4°F) reference condition band would have a 1-sigma uncertainty of ± 0.145 mA, but would have a 1-sigma uncertainty of ± 0.252 mA when operated at 85°F - 90°F ambient conditions.

The NRC staff also notes that the magnitude of M&TE uncertainty contribution to total channel uncertainty is based on several factors, including the M&TE manufacturer's published reference accuracy when operated within the reference conditions applicable to that accuracy specification; the use of factors or alternate uncertainty terms for de-rating M&TE accuracy if the M&TE is used under reference conditions outside the

published reference conditions (e.g., at elevated or cold ambient temperature conditions.) The M&TE uncertainty contribution is also dependent on the calibration standard accuracy used to calibrate the M&TE equipment, and the readability of the M&TE. It is also often based on the use of a combination of M&TE devices during a calibration process, such as the application of an accurate test pressure gauge to measure the applied test pressure to the input of a pressure or differential pressure sensor, in conjunction with a digital voltmeter to measure the current output of the transmitter dropped across a precision test resistor. The input M&TE device uncertainty must be propagated and combined appropriately with that of the output M&TE device to arrive at total uncertainty due to M&TE.

There are no terms in the Westinghouse uncertainty expressions of Section 2.0 representing calibration standard uncertainty, and there are no formulas or expressions provided for evaluating the magnitude of SMTE and RMTE. Therefore, it appears to the NRC staff that the Westinghouse uncertainty expressions presume the accuracy rating of the reference measuring means for calibrating (M&TE) is *always* one-tenth or less than that of the M&TE device being calibrated, and also presume the resulting M&TE uncertainty is always one-tenth or less than that of the sensor or group of rack devices under test.

a) Please explain the basis for this apparent presumption or provide clarification. Include a description of any specific expectations Westinghouse has licensees to ensure: (1) proper application of Westinghouse uncertainty expressions when verifying that the accuracy rating of calibration standard equipment used for calibrating measurement and test equipment (M&TE) is ten times better than that of the device under test, and (2) that M&TE equipment accuracy is always better than or equal to the rack or sensor device being calibrated. If appropriate, please include a statement as to the relative significance of the calibration standard uncertainty on the determination of M&TE uncertainty. Also include a statement regarding the significance of M&TE uncertainty on total loop uncertainty in the event that the accuracy of such calibration standards is not at least ten times better than the M&TE devices being calibrated, or the uncertainty of the M&TE devices is not one-tenth or better than the uncertainty of instrument channel devices being calibrated.

   For example, in the event the accuracy of selected plant calibration standards used for calibrating M&TE equipment is no better than three or four times better than the accuracy of the M&TE devices being calibrated (rather than the expected accuracy of ten times or better, indicate the impact this result would have on the estimate of total loop uncertainty and on rack calibration allowances, along with any safety margin that may exist within the methodology expressions that may bound the additional uncertainty due to M&TE equipment. Similarly, in the event that the M&TE uncertainty is not consistently one-tenth or less than that of the loop devices being calibrated, indicate the impact this condition would have on the estimate of total loop uncertainty and on rack calibration allowances, as well as the impact on any safety margin that may exist within the methodology expressions that may bound the additional uncertainty due to M&TE equipment.

Westinghouse Response:

It should not be construed that the generic magnitudes of SMTE and RMTE in Westinghouse uncertainty calculations are always one tenth of the SCA or RCA. This statement in the definition identifies that when plant specific M&TE for a function meets the 10:1 requirement, as demonstrated by calculation for the conditions under which the M&TE will be used, i.e., after accounting for temperature variation from the M&TE calibration environment, the effect of the M&TE magnitude on the CSA magnitude is minimal. Westinghouse always evaluates the magnitudes of SMTE and RMTE for a Westinghouse performed uncertainty calculation. Examples of explicitly accounting for SMTE and RMTE magnitudes are WCAP-16361-P Rev. 1, "Westinghouse Setpoint Methodology for Protection Systems – AP1000," (see as an example Table 3-8, "Pressurizer Pressure – Low & High") and WCAP-17119-P Rev. 2, "Methodology for South Texas Project Units 3 and 4, ABWR Technical Specification Setpoints, Advanced Boiling Water Reactor South Texas Project – Units 3 & 4," (see as an example Table 3-8, "Reactor Vessel Steam Dome Pressure High – RPS Trip Initiation"), both of which were generated under Westinghouse control and are attached for convenience. There are many other examples of Westinghouse performed plant specific uncertainty calculations that demonstrate this aspect of the Westinghouse Setpoint Methodology. There are instances where [ ]^{a,c}. There are more instances where [ ]^{a,c}. There are other plant specific examples where [ ]^{a,c}.

However, to explicitly address the NRC points, the following is noted.

- Westinghouse recommends to plants that M&TE should be as accurate as reasonably achievable. In some instances this results in a ratio of 10:1 or better. It should be understood that Westinghouse makes recommendations, but in the actual analysis, reflects the M&TE hardware the plant has procured and specified in its procedures. It is incumbent upon the plant to then maintain consistency with the plant procedures and the applicable uncertainty calculation.
- An M&TE ratio of less than 10:1 must be explicitly included in the uncertainty calculation.
- Westinghouse determines temperature effects on M&TE, as defined by the M&TE vendor, based on the plant specific environment and includes this effect when appropriate. This is consistent with NRC Information Notice 96-22 and is included in the determination of meeting the 10:1 ratio.
- While not explicitly applicable (because the standard has been withdrawn), Westinghouse recommends that the IEEE-498 requirement (identified for calibration reference standards, i.e., working standards) of 4:1 be applied when possible to M&TE as a lower limit, i.e., the ratio no less than.
- However, Westinghouse also recognizes that due to elevated zeroes or instrument turndown ratios, even a 1:1 ratio may not be reasonably achievable, e.g., [ ]^{a,c}. It is then clearly a requirement of the Westinghouse Setpoint Methodology that SMTE and/or RMTE must be explicitly addressed in the uncertainty calculation. Westinghouse has no

recollection of a Westinghouse performed uncertainty calculation where ratios of 1:1 or less were not explicitly included in the calculation.

- As a general rule, Westinghouse [

]^{a,c}

- With the use of digital electronics in both transmitters and process racks, it is becoming more difficult to achieve a 10:1 ratio for M&TE. Westinghouse has performed example calculations for two different functions to demonstrate the overall effect of calibration reference standard magnitudes on the Channel Statistical Allowance (CSA). The first calculation uses currently installed hardware – Pressurizer Pressure with a Rosemount 1154SH9 transmitter and Westinghouse 7300 analog process racks. The second uses the latest hardware, transmitter, racks and M&TE – Feedwater Pressure with a Rosemount 3051CG5 transmitter and Ovation digital process racks. Tables are presented with a range of M&TE to calibration reference standard ratios for both sets of calculations.

WCAP-16361-P Revision 1, "Westinghouse Setpoint Methodology for Protection Systems – AP1000"

TABLE 3-8
PRESSURIZER PRESSURE - LOW & HIGH

Parameter	Allowance*
	a,c
Process Measurement Accuracy	[
Primary Element Accuracy	
Sensor Reference Accuracy	
Sensor Calibration Accuracy	
Sensor Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Bias	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	]

* In percent span (800 psi)

Channel Statistical Allowance =

[ ]a,c

WCAP-17119-P Revision 2, "Methodology for South Texas Project Units 3 and 4, ABWR Technical Specification Setpoints, Advanced Boiling Water Reactor South Texas Project Units 3 and 4"

Table 3-8 Reactor Vessel Steam Dome Pressure High – RPS Trip Initiation	
Parameter	Allowance[1]
Process Measurement Accuracy	
Primary Element Accuracy	
Sensor Reference Accuracy	
Sensor Calibration Accuracy	
Sensor Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

a,c

1. In percent span (10 MPaG (1450.38 psig))

Channel Statistical Allowance =

$$\left[\begin{array}{l}(PMA)^2+(PEA)^2+(SCA+SMTE)^2+(SPE)^2+(STE)^2+(SRA)^2+\\(SD+SMTE)^2+(RRA)^2+(RCA+RMTE)^2+(RTE)^2+(RD+RMTE)^2\end{array}\right]^{\frac{1}{2}}+EA+BIAS$$

a,c

[ ]

a,c

a,c

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a,c

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a,c

b) If it is the intent to follow the guidance of ANSI/ISA 51.1-1979 (R 1993), please provide specific directions for licensees to follow when implementing the ANSI/ISA 51.1-1979 guidance stating "When the accuracy rating of the reference measuring means is one third or less, but greater than one tenth that of the device under test, the accuracy rating of the reference measuring means shall be taken into account." Provide precautions, limitations, and minimum required steps to be taken when identifying and accounting for M&TE uncertainty. If appropriate, discuss the means to account for calibration standard accuracy and readability.

Westinghouse Response:

Westinghouse would recommend that the magnitude of SMTE and RMTE be determined for all uncertainty calculations. If the ratio of SCA:SMTE (or RCA:RMTE) is less than 10:1; Westinghouse would recommend that the magnitude of SMTE (or RMTE) be explicitly addressed, i.e., included, in the uncertainty calculation. As demonstrated in the above examples, [

]^{a,c}

c) Please explain and clarify the intent of the statement: [

] This statement seems to imply that if the licensee procedures do not have any information describing required M&TE accuracy or do not delineate which calibration devices are required or acceptable for use in performing specific safety related instrument calibrations, then the licensee is free to ignore any effects of M&TE uncertainty. At a minimum, each licensee should have a list of all available M&TE equipment at its disposal, and have a good idea of which subset of that equipment should be allowed for use in performing each type of instrument channel calibration. However, the Westinghouse Setpoint Methodology is silent on how to perform an estimate of the worst-case potential M&TE uncertainty to account for the M&TE contribution to total instrument channel uncertainty when the M&TE uncertainty is greater than one tenth that of the device(s) under test.

Westinghouse Response:

Westinghouse suggests the statement above is being taken out of context with regards to the treatment of M&TE magnitudes in uncertainty calculations. As noted in the response to (b) above, Westinghouse recommends that the magnitude of SMTE and RMTE be determined for all uncertainty calculations and to be explicitly addressed, i.e., included, in the uncertainty calculation any time the SCA:SMTE or RCA:RMTE ratio is less than 10:1. With regards to the statement excerpted above; [

]^{a,c}

[ ]a,c

d) If appropriate, provide clarification or guidance for use of the uncertainty expressions to address the possibility that the available M&TE equipment may not always be one-tenth the accuracy of the devices being calibrated, including the need to verify the relative uncertainties between the M&TE available for use and the equipment being tested.

Westinghouse Response:

Westinghouse recommends (and generally finds in plant specific calibration and surveillance procedures) the determination of a maximum M&TE uncertainty allowed for the calibration or surveillance of a transmitter or instrument channel, e.g., ±0.2 mV on the 20 V range for a DMM. If a specific device is noted, there is also a general statement to allow the utilization of a device with an equivalent or better accuracy. Since Westinghouse would explicitly utilize this DMM uncertainty magnitude in the function uncertainty calculation, this specification and the equivalency requirement should be adequate instruction for the plant. However, to provide additional clarity as to the Westinghouse intent of treatment of M&TE, the definitions of RMTE and SMTE will be revised to as follows in the approved version of WCAP-17504, Revision 0.

- Rack Measurement & Test Equipment Accuracy (RMTE)

The accuracy of the test equipment (typically a transmitter simulator, voltage or current power supply, and DVM) used to calibrate a process loop in the racks. Westinghouse recommends that RMTE should be as accurate as reasonably achievable. A ratio of RCA:RMTE or RD:RMTE of less than 10:1 must be explicitly included in the uncertainty calculation. Temperature effects on RMTE, as defined by the M&TE vendor, based on the location specific environment should be included when appropriate. This is consistent with NRC Information Notice 96-22 (Reference 31) and is included in the determination of the RCA:RMTE or RD:RMTE ratio. When the magnitude of RMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p. 61) it may be considered an integral part of RCA or RD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and need not be included in the uncertainty calculations. [ ]a,c

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a,c

- **Sensor Measurement & Test Equipment Accuracy (SMTE)**

The accuracy of the test equipment (typically a high accuracy local readout gauge and DMM) used to calibrate a sensor or transmitter in the field or in a calibration laboratory. Westinghouse recommends that SMTE should be as accurate as reasonably achievable. A ratio of SCA:SMTE or SD:SMTE of less than 10:1 must be explicitly included in the uncertainty calculation. Temperature effects on SMTE, as defined by the M&TE vendor, based on the location specific environment should be included when appropriate. This is consistent with NRC Information Notice 96-22 (Reference 31) and is included in the determination of the SCA:SMTE or SD:SMTE ratio. When the magnitude of SMTE meets the requirements of ANSI/ISA-51.1-1979 (R1993) (Reference 12, p. 61) it may be considered an integral part of SCA or SD. Uncertainties due to M&TE that are 10 times more accurate than the device being calibrated are considered insignificant and need not be included in the uncertainty calculations.

a,c

4. Westinghouse Process Measurement Accuracy (PMA) Normalization Process

In Sections 2.5 and 3.2 of WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, dealing with complex digital functions and definitions, respectively, there is a discussion pertaining to the need for "normalizing" certain process measurement effects. For instance, in the [

]

a) Please describe the normalization process in greater detail. Specifically, which instrument channel functions or portions of instrument channel functions require a normalization process to benchmark safety channel readings or to estimate process measurement uncertainties?

Westinghouse Response:

Noted below are two tables of Westinghouse Control and Protection functions that are normalized and the associated reference parameter. How each is normalized and treated in the function's uncertainty calculation is provided below the tables.

Protection Function - Parameter	Reference
NIS Intermediate Range – [ ]^{a,c}	
NIS Power Range – [ ]^{a,c}	
Overtemperature ΔT – [ ]^{a,c}	
Overtemperature ΔT – [ ]^{a,c}	
Overtemperature ΔT – [ ]^{a,c}	
Overpower ΔT – [ ]^{a,c}	
Overpower ΔT – [ ]^{a,c}	
RCS Low Flow – [ ]^{a,c}	
RCS Loop ΔT Equivalent to Power – [ ]^{a,c}	
Steam flow/Feedwater flow mismatch – [ ]^{a,c}	

a,c

- NIS Intermediate Range – [ ]^{a,c}: The Nominal Trip Setpoint (NTS) for this function is in the range of 25 % Rated Thermal Power (RTP). However, [ ]^{a,c} in the function's Channel Statistical Allowance (CSA) calculation.
- NIS Power Range – [ ]^{a,c}: [ ]^{a,c}
- Overtemperature ΔT – [ ]^{a,c}: The Overtemperature ΔT reactor trip function provides DNB protection by restricting reactor power. It performs this function through monitoring the temperature equivalent of reactor power, RCS loop specific ΔT. However, [ ]^{a,c}

[

]^{a,c}

- Overtemperature ΔT – [ ]^{a,c}: A second aspect of the Overtemperature ΔT's DNB protection is [

]^{a,c}

- Overtemperature ΔT – [ ]^{a,c}: Another aspect of the Overtemperature ΔT's DNB protection is the effect of axial power distribution. This is evaluated through the use of [

]^{a,c}

- Overpower ΔT – [ ]^{a,c}: The Overpower ΔT reactor trip function is a diverse protection function to the NIS Power Range over power reactor trip. It performs this function through monitoring the temperature equivalent of reactor power, RCS loop specific ΔT. However, [

]^{a,c}

[ ]^{a,c}

- Overpower ΔT – [ ]^{a,c}: A second aspect of the Overpower ΔT protection is the [

]^{a,c}

- RCS – Low Flow – [ ]^{a,c}: Originally, RCS Flow was verified using a Precision RCS Flow Calorimetric measurement. [

]^{a,c}

- RCS Loop ΔT Equivalent to Power – [ ]a,c: Several Westinghouse plants have a modification to the Steam Generator Water Level – Low-Low reactor trip/startup of auxiliary feedwater. An SG Level trip time delay varies discretely as a function of indicated power. As the uncertainty with the NIS Power Range channels increases significantly with decreasing power, it was determined to use the temperature equivalent to reactor power (ΔT), which is linear as a function of power, as the input. However, [

]a,c

- Steam flow/Feedwater flow mismatch – [ ]a,c: [

]a,c

Control Function - Parameter	Reference
Cold Leg Elbow Tap indication – [ ]a,c	

a,c

Cold Leg Elbow Tap indication – [ ]a,c: [

]a,c

b) When plant process measurement data is recorded during the normalization process, that data contains uncertainty, such as reference accuracy, M&TE uncertainty, reading error, and other terms. How is this uncertainty information accounted for in the calibration of the instrument channels being normalized against plant readings? For example, are there acceptance limits of process measurement uncertainty that are treated as upper and lower bounds, or is the exact result of a recorded value used during the normalization adjustment? Please describe this process.

Westinghouse Response:

a,c

c) For each plant surveillance in which normalization is required to be performed, please describe in detail which specific measurements or computations are made to support or compare against specific instrument channel uncertainty terms and identify the applicable specific safety related instrument functions affected. Please provide a summary table that describes these required normalization processes.

Westinghouse Response:

Please see the response to (a) above.

d) When plant data is taken to perform process measurement accuracy normalization using alternative plant measurements (e.g., measurement of core thermal power calorimetric parameters to normalize feedwater flow measurement), what processes/procedures are employed to ensure the accuracy of the data recorded meets required acceptance criteria limits? For example, how is the licensee expected to ensure that such normalization data meets the required accuracy for the instrument channel functions that use the normalization data? How does the licensee ensure the normalization measurements taken are traceable to appropriate standards? For instance, how would a licensee know the worst-case uncertainty limits to which the associated normalization data must be taken for a particular function? Describe/provide any Westinghouse guidelines to licensees that ensure such normalization readings are controlled so the data meets certain acceptance criteria?

Westinghouse Response:

a,c

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a,c

5. **Effects of Propagation of Error through Non-Linear Instrumentation Components**

The NRC staff notes that Section 6.3.1 of the ISA Recommended Practice 67.04, Part II, and several licensee setpoint methodologies it has reviewed over the years describe the effects of propagation of random error from the input side of an instrument module to the output side of the module. When random error is propagated through nonlinear modules in which the signal is amplified or combined with random input errors coming from the outputs of several modules that feed it, the random portion of the error can become amplified. When multiple modules are strung together, the effects of propagation of input error to output can become magnified significantly. The staff notes that while sensor and rack uncertainties are described in WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, the topical report is silent on the effects of such propagation of error from input to output of an instrument channel.

a) Please describe why WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, does not discuss the effects of such random error propagation, or revise the WCAP to address this aspect. How has this effect been accounted for in the determination of Channel Statistical Allowance within the Westinghouse Setpoint Methodology (i.e., which error terms are estimated with sufficient margin to account for these effects)?

Westinghouse Response:

a,c

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a,c

b) If there is a Westinghouse study or report that has evaluated the effects of such error propagation and found these effects to be negligible for the scope of instrument safety functions typical for a 2, 3, or 4-loop Westinghouse design plant, please make such a report available for staff evaluation.

Westinghouse Response:

[ ]a,c

6. **Estimating the Magnitude of Uncertainty Terms for New Instrument Channel Devices**

Section 4 of WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, describes considerations and methods for estimating the magnitudes of several of the uncertainty terms described in Section 3.2, including the need for estimating uncertainty performance information at the 95/95 probability and confidence level for reactor trip and engineered safety features actuation systems. [

]

Please describe the Westinghouse Generic Setpoint Methodology steps one would need to take in estimating the magnitude of drift and other applicable uncertainty terms in the event that a safety channel instrument or groups of instruments were to be replaced due to obsolescence by an instrument or set of instruments comprised of equipment models not supplied by Westinghouse or that had never before been used at that site or for that particular safety function. For example, Section 5.1 states the initial sensor drift will be "based initially on the vendor specification data and subsequently on the periodic evaluation of SD data (As Found - As Left)." Is there a similar plan for evaluating and

accounting for the drift of rack components that are replaced with components that have not been used before?

Westinghouse Response:

[ ]a,c

7. **Basis of Assumptions for Estimating and/or Maintaining the Limits of Magnitude of Uncertainty Terms as Channel Operability Evaluation Limits**

Section 5.1 of WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, describes some of the underlying assumptions and considerations that form the basis of the Westinghouse Generic Setpoint Methodology. Please provide clarification of the following assumptions and considerations.

a) The Westinghouse Generic Setpoint Methodology, states that "for operable process racks, AFT = ALT = RCA," and that "an ALT may be considered as an outer limit for the purposes of calibration and instrument uncertainty calculations." It is also stated that "Recalibration is explicitly required any time the As Found condition of the device or channel is outside of the ALT. A device or channel may not be left outside the ALT without declaring the device or channel "inoperable" and appropriate action taken."

Section 5.2 also states: "A channel found inside the RCA tolerance (ALT) on an indicated basis is considered to be operable. A channel found outside the RCA tolerance (ALT) is evaluated and recalibrated. The channel must be returned to within the ALT for the channel to be considered operable."

Many, if not most operating plants have technical specifications containing values for Reactor Trip and Engineered Safety Features Actuation functions as "Allowable Values." Also, the Model Application issued by the NRC staff with the publication of its approval of the BWR and PWR Owner's Groups Technical Specification Task Force traveler for TSTF-493 describes the use of Surveillance Note 1, pertaining to the use of ALT as a means for determining whether a channel is "functioning as required," rather than "operable."

Please clarify your use of the term "operable" and "inoperable" as described in the quoted sentences from Sections 5.1 and 5.2 above in light of the typical Plant Technical Specification use of these terms. In light of the discussion of Section 5.3 and Point 65 of Section 6.0 of the WCAP, it appears that a possible outcome of the use of the Westinghouse Setpoint Methodology is to compute and list the values representing the non-conservative direction limits of RCA or ALT Terms in the plant Technical Specifications as the "Allowable Values." Is this correct? Is Westinghouse WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, intended to provide a basis for establishing a conservative limit of ALT as a new "Allowable Value" for Westinghouse PWRs? If not, please describe how the limits for RCA, ALT, and AFT relate to the values currently listed in plant Technical Specifications as "Allowable Values"? If so, please describe how this intent would be accomplished?

Westinghouse Response:

To ensure commonality of understanding, noted below is the definition of OPERABLE from NUREG-1431 Vol 1, Rev. 3.0, page 1.1-4:

OPERABLE – OPERABILITY	A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).

Westinghouse would suggest that an instrument channel made up of a sensor/transmitter and an instrument rack (analog ending with a bistable, digital ending with a trip device) could be described as two principle components; 1) sensor/transmitter, 2) instrument rack. Both components must be "capable of performing their function" in order for a trip to take place at the appropriate point (parameter or process value). However, only one component has a setpoint which can be defined in the plant Technical Specifications, Table 3.3.1-1 or Table 3.3.2-1, i.e., the instrument rack bistable or trip device. This leaves open to question and interpretation the definition of operability for the sensor/transmitter. In order to address the rigor required to meet a two-sided 95/95 statement, as identified in RG 1.105 Rev. 3 and clarified in the proposed RG 1.105 Rev. 4, Westinghouse would suggest that a clear definition of operability must be specified for both sensor/transmitter and process racks. This cannot be supplied by the simple definition of an "Allowable Value," as currently utilized in NUREG-1431. With respect to plants with a Westinghouse NSSS, the Allowable Value is defined to be applicable only to the process rack setpoint. In addition, an older version of the Allowable Value was defined in a manner that when exceeded, allows the offsetting of a non-conservative As Found condition for process racks with a conservative As Found condition of the sensor/transmitter, i.e., the "five column methodology." It is far too easy to allow offsetting compensation through paper arithmetic of excessive process rack drift that if experienced should result in serious questioning of continued operability. In the instance of digital process racks with self-check/self-calibration capabilities, an As Found condition outside of the self-calibration As Left limit is a clear definition of an inoperable instrument channel, regardless of the condition of the sensor/transmitter. In fact, the Westinghouse Eagle-21 process racks will alarm when no longer able to satisfy the self-calibration criterion. Thus, allowing an offsetting compensation by a sensor/transmitter would be inappropriate and contrary to the operability definition in the plant Technical Specifications. With respect to analog process racks, Westinghouse has considerable data demonstrating that the expected As Found condition for an operable analog channel is within the As Left tolerance.

In order to address the two-sided nature of the Westinghouse Setpoint Methodology, it is necessary to define the allowed condition (As Left and As Found) of the process racks about the Nominal Trip Setpoint in both the conservative and non-conservative directions, reflecting the Westinghouse two pass evaluation of the As Found condition, i.e.,

As Left condition ≤ (NTS ± As Left Tolerance), where the ALT = RCA,

First Pass As Found condition ≤ (NTS ± As Found Tolerance), where the AFT = ALT (performed in the field) and

Second Pass As Found condition ≤ (As Left ± As Found Tolerance), where the AFT = RD = ALT (performed as part of the evaluation of rack drift).

With respect to a normally operating instrument channel and an instrument technician driving the As Left condition to a near zero % span calibration error, the expected As Found condition would be within the (NTS ± As Left Tolerance), which the Westinghouse evaluation of plant data demonstrates. Thus, for Westinghouse specified process racks, OPERABLE is defined as:

As Left condition ≤ (NTS ± As Left Tolerance), where the ALT = RCA,

First Pass As Found condition ≤ (NTS ± As Found Tolerance), where the AFT = ALT (as initially evaluated in the field) and

Second Pass As Found condition ≤ (As Left ± As Found Tolerance), where the AFT = RD = ALT (as subsequently evaluated as part of the evaluation of rack drift).

INOPERABLE process rack instrumentation would be defined as a condition where the As Left condition or As Found condition is in excess of the above, i.e.,

As Left condition > (NTS ± As Left Tolerance), where the ALT = RCA,

First Pass As Found condition > (NTS ± As Found Tolerance), where the AFT = ALT,

Second Pass As Found condition > (As Left ± As Found Tolerance), where the AFT = RD = ALT.

Examples of the above are: assume an analog pressure channel with an instrument span of 1500 to 2500 psig (1000 psig), NTS = 2000 psig, RCA = ALT = AFT = 0.25 % span = 2.5 psig. Providing a voltage equivalent to 2000 psig at the input to the process racks, an OPERABLE instrument channel would be a bistable trip setpoint As Left and As Found between the voltage equivalents of 2002.5 psig and 1997.5 psig. This is the Channel Operability Test (COT) that is performed every 92 or 184 days, depending on the approved COT surveillance interval. However, this only addresses the bistable. Any modules in front of the bistable must maintain that same as left and as found magnitude (±2.5 psig) about any other calibration and surveillance points, e.g., 0, 25, 50, 75 and 100 % span (or 1500.0, 1750.0, 2000.0, 2250.0 and 2500.0 psig) points. These modules are inherently checked via a string surveillance at the NTS as part of the COT and explicitly checked via the process rack string calibration process once per cycle.

The statement in Section 5.1, "Recalibration is explicitly required any time the As Found condition of the device or channel is outside of the ALT. A device or channel may not be left outside the ALT without declaring the device or channel "inoperable" and appropriate action taken." is intended to identify that plant procedures require the recalibration of a sensor/transmitter or process rack instrument channel when the As Found condition is outside of the ALT. Westinghouse reviews of plant calibration and surveillance procedures confirm this requirement. It is necessary that the sensor/transmitter or instrument channel As Left condition be within the ALT at the beginning of each surveillance interval. This is an initial condition requirement of the Westinghouse Setpoint Methodology. When the As Found condition of the sensor/transmitter or instrument channel is outside the ALT and the As Left condition

cannot be returned to within the ALT, then the sensor/transmitter or the instrument channel must be declared "inoperable" and repaired or replaced.

The statement in Section 5.1, "an ALT may be considered as an outer limit for the purposes of calibration and instrument uncertainty calculations." is intended to identify that since the ALT is a procedure limit <u>that cannot be exceeded</u>, i.e., the As Left condition must be within the tolerance, it becomes better than a 95/95 limit because no "OPERABLE" sensor/transmitter or instrument channel As Left data will be outside that tolerance. Thus, while treated as a 95/95 limit, the ALT actually is a 100/100 limit, because 100 % of the As Left data will be within the ALT. This is substantiated by plant data.

The statement in Section 5.2, "A channel found inside the RCA tolerance (ALT) on an indicated basis is considered to be operable. A channel found outside the RCA tolerance (ALT) is evaluated and recalibrated. The channel must be returned to within the ALT for the channel to be considered operable." is intended to identify the two possible As Found conditions and the subsequent required actions with respect to the ALT, where for the instrument channel (process racks) AFT = ALT = RCA.

- The first is the As Found condition ≤ AFT ≤ ALT. In this instance, the channel is considered operable, the instrument technician may choose to recalibrate if the As Found condition is near the ALT, but it is not required.
- The second is the As Found condition > AFT > ALT. In this instance, the channel is initially declared inoperable and the instrument technician must recalibrate with the As Left condition ≤ ALT.
    - With successful recalibration, the As Left condition ≤ ALT, the channel is considered operable. The As Found condition > AFT > ALT must be entered into the plant's Corrective Action Program for further evaluation.
    - If the channel cannot be recalibrated, i.e., the As Left condition > ALT, the channel must be repaired or replaced. After repair or replacement, the channel must be successfully recalibrated, the As Left condition ≤ ALT, and the channel is then considered operable. The As Found condition > AFT > ALT and the repair/replacement action must be entered into the plant's Corrective Action Program for further evaluation.

With respect to the Allowable Value concept; in 1994, Westinghouse published an ISA paper which effectively withdrew Westinghouse support of the use of the Allowable Value (as defined at that time) for operability determination; please see WCAP-17504 Reference 16. Westinghouse has evaluated sufficient data to demonstrate that process racks operating in an appropriate manner, i.e., within design specifications, do not experience significant drift over a surveillance interval of [

]^{a,c} and therefore, with an As Left condition within the ALT about the NTS, should have an As Found condition within the same ALT about the NTS. It should also be understood that Westinghouse does not define operability of the process racks solely at the NTS; but also across the instrument span and confirmed at a set of calibration points (minimum of five, e.g., 0, 25, 50, 75 and 100 % span). Thus, Westinghouse defines an operable instrument channel (process racks) as an As Left condition within the ±ALT, defined to be the Reference Accuracy specification, and an As Found condition within the ±AFT = ±ALT, again defined to be the Reference Accuracy specification, at a minimum of five calibration

points across the instrument span and at the NTS. This suggests that an operable instrument channel is one that can be calibrated to within the Reference Accuracy specification and does not experience significant drift, i.e., As Found data confirms the instrument channel remains within the Reference Accuracy about the calibration points across the instrument span. An inoperable instrument channel is one that cannot be calibrated to within the Reference Accuracy or experiences significant drift on more than an occasional basis. This also suggests that the current definition of an Allowable Value does not meet the operability requirements of the Westinghouse Setpoint Methodology for several reasons.

- It is not two-sided.
- It is limited in application to the Channel Operability Test and thus to only the bistable calibration point of the NTS.
- The magnitude for the operating plants with a Westinghouse NSSS is greater than the Reference Accuracy.
- It is limited in application to the process racks and thus ignores the operability requirements of the Westinghouse Setpoint Methodology on the sensor/transmitter.

Thus, utilization of the Allowable Value concept is not sufficient to determine a control or protection function is operating within the Westinghouse Setpoint Methodology at a 95/95 basis. While a redefinition of the Allowable Value in the plant Technical Specifications is a possible outcome of the NRC application of the Westinghouse Setpoint Methodology, Westinghouse would not advocate that as a preferred outcome. Westinghouse would discourage reliance on an Allowable Value definition that is indirectly the ALT in the Technical Specifications. Westinghouse would encourage the control of the real parameter of interest, the NTS, in the Technical Specifications. As noted in Section 5.3, Westinghouse would recommend that the parameter of control in Tables 3.3.1-1 and 3.3.2-1 should be the NTS with reference to a plant specific document that provides the ALT and AFT values at calibration points across the instrument span for both the process racks and the sensor/transmitter, and the ALT and AFT values at the NTS for the bistable or digital trip device. This recommendation is applicable to both Option A and Option B of TSTF-493.

In answer to the final question of how the RCA, ALT and AFT relate to the Allowable Values in the current operating plant Technical Specifications – there is no direct relationship. It has been noted above that the currently defined Allowable Value results in an As Found condition that is in excess of that expected for an appropriately operating instrument channel, i.e., is in excess of RCA = ALT = AFT. Utilization of the Westinghouse Setpoint Methodology defined in WCAP-17504 would be expected to eliminate the Allowable Value in the Technical Specifications and definition of an OPERABLE channel as noted above. This is a direct result of the RG 1.105 95/95 requirement and in order to satisfy the basic expectation of how an instrument channel should be operating.

b) The channel statistical allowance equation 2.1 for a protection channel combines the algebraic sum of {sensor drift and sensor M&TE error} with the sum of {rack calibration accuracy and rack M&TE error} and the sum of {rack drift and rack M&TE error} using square root of the sum of the squares methods. For the discussion in

Section 5.5 regarding sensor/transmitter operability assessment, please describe how channel operability should be assessed assuming the sensor/transmitter is found to be at or near (but within) the non-conservative limit of its AFT value, while simultaneously the rack is found to be at its non-conservative ALT limit. Is this combined non-conservative as-found condition for both sensor and rack considered to be an "operable" condition under the Westinghouse Setpoint Methodology? Please describe why or why not.

Westinghouse Response:

[ ]a,c

Given any of the above, and the basic low probability of the occurrence of all six parameters (SCA, SD, SMTE, RCA, RD and RMTE) at the extremes of their allowances, but within their allowances, Westinghouse would suggest that there is no reason to conclude that the sensor/transmitter, process racks and the function were not considered operable.

8. Estimating the Limits of Error at 95/95 Levels

Several paragraphs throughout WCAP-17504-P, Revision 0, and WCAP-17504-NP, Revision 0, use the words "believed to be" when discussing the probability and confidence levels associated with estimates of uncertainty at the 95/95 level, when accounting for uncertainties to be bounded by the Channel Statistical Allowance. Under the conditions described in the WCAP, it appears that when evaluating sufficient historical data sets, [ ] a licensee following the Westinghouse Setpoint Methodology would have sufficient data to ensure that the 95/95 criterion will be achieved. Please provide a clarification or elaboration over what is intended by using the words "believed to be." Under what circumstances would this not be the case? Please provide examples.

Westinghouse Response:

It is certainly true that if a plant:

[ ] a,c

then, the CSA determined by Equations 2.1, 2.2 and 2.3 in WCAP-17504-P will meet the RG 1.105 two-sided 95/95 requirement. The "believed to be" wording noted in WCAP-17504-P was specifically to address equipment not specified by Westinghouse when the WCAP was submitted in February 2012.

[ ] a,c

If a vendor states that the instrument uncertainties provided in the vendor documentation are two-sided 95/95 values, then Westinghouse does not see the need to perform any additional verification.

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That responsibility lies with the licensee. Westinghouse believes the trend program evaluating the As Left and As Found data will confirm any claims with regards to the reference accuracy and drift characteristics. If those two parameters are satisfied, Westinghouse would expect the other parameters to also be acceptable.