WCAP-17504-NP
Revision 1

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Westinghouse Generic Setpoint Methodology

Westinghouse

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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). [

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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:

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

Eq. 2.1

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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. [

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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. [

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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. [

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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 ($\pm$) 95/95 parameters.

[ ]^{a,c}

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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. [

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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. [

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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.

  $$\text{Margin} = \text{TA} - \text{CSA}$$

  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, [

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- **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. [

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[

]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.

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- **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 $\geq$ 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.

$$\text{TA} = |\text{SAL} - \text{NTS}|$$

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.

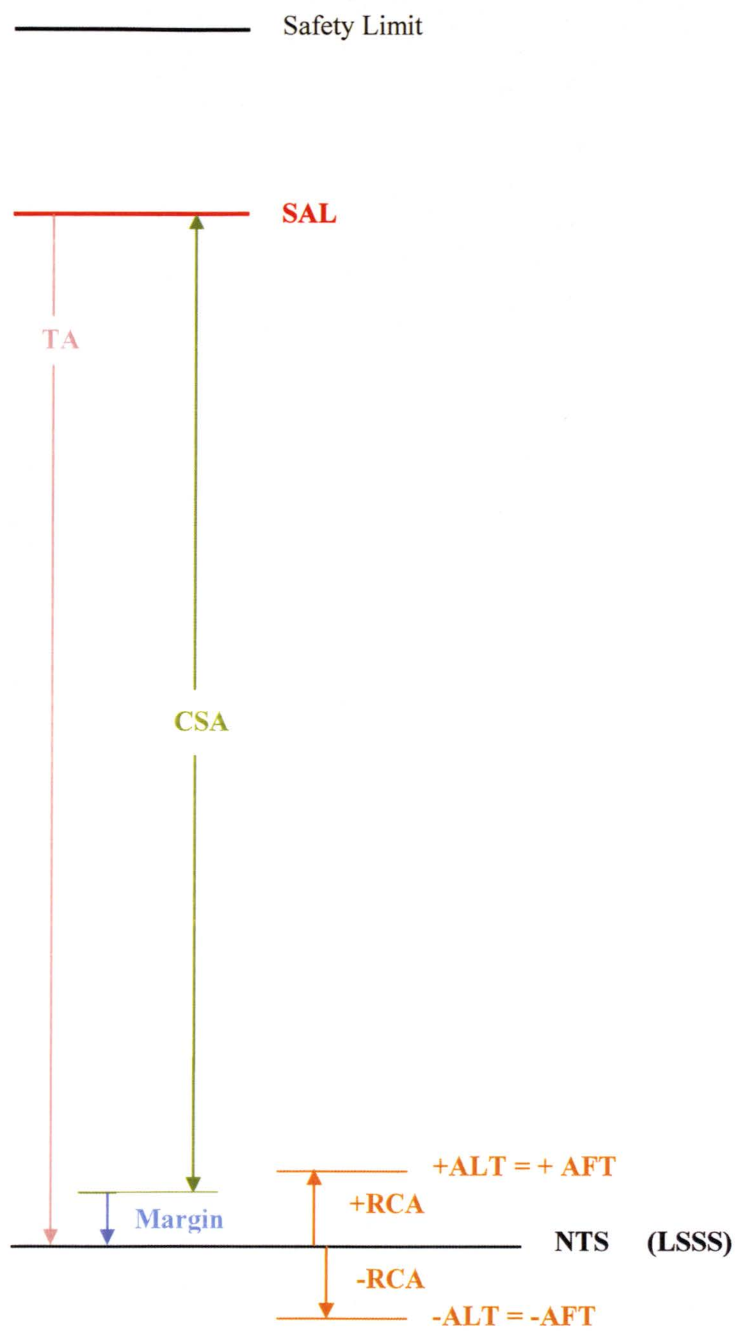

Figure 3-1 Westinghouse Setpoint Parameter Relationship Diagram (Increasing Function)

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 =
Transmitter –ALT =
Transmitter +AFT =
Transmitter –AFT =

a,c

Process Racks +ALT =
Process Racks –ALT =
Process Racks +AFT =
Process Racks –AFT =

a,c

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) Thermal Inertia Allowance (treated as a bias)	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	
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 = [ ] a,c
Transmitter –ALT =
Transmitter +AFT =
Transmitter –AFT =

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

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

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

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

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)

<u>ALT/AFT Determination</u>
NTS = 1850 psig
SPAN = 800 psi
RCA = [4 psi (0.5% span)] ^{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)

<u>ALT/AFT Determination</u>
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

		a,c			a,c
0 % span:	(+) ALT =		(-) ALT =		
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

		a,c			a,c
0 % span:	(+) AFT =		(-) AFT =		
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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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

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U.S. Nuclear Regulatory Commission
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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

LTR-NRC-15-37
Page 2 of 2

bcc: James A. Gresham
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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

<u>AFFIDAVIT</u>

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.

(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).

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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

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,

- 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

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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 =

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

a,c

a,c

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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}

[ ]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.

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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

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

[ ]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. [

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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 that cannot be exceeded, 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.

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.