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Methodology for South Texas Project Units 3 and 4

ABWR Technical Specification Setpoints

Advanced Boiling Water Reactor
South Texas Project
Units 3 and 4

Westinghouse

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Advanced Boiling Water Reactor South Texas Project – Units 3 & 4

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF TABLES (cont.)

LIST OF FIGURES

ABSTRACT

This document has been prepared to document the instrument uncertainty calculations for the Reactor Protection Systems (RPS) and Engineered Safeguards Features (ESF) functions for the Advanced Boiling Water Reactor (ABWR) plant. This document identifies the general algorithm used as a basis for determining the overall instrument uncertainty and provides typical setpoints for each of the RPS/ESF functions. Reconciliation of the final setpoint study for the plant cannot be performed until the design for the plant is finalized. This document is provided for submission with the Combined Operating License (COL) application, and includes typical industry uncertainty values and assumptions that reflect the ABWR Instrumentation and Control (I&C) design, to the extent that is required to support a COL application. Prior to initial fuel load, a reconciliation of this setpoint study against the final design for the plant will be performed, as required by the ABWR Inspection, Test and Analyses Acceptance Criteria (ITAAC) (Section 3.4, Item 13 of Table 3.4 in U.S. ABWR DCD, Rev. 4).

1 INTRODUCTION

The "South Texas Project (STP) Advanced Boiling Water Reactor (ABWR)" uses extensive Instrument and Control (I&C) equipment to monitor and control the plant. The STP ABWR Combined Operating License Application[1] (COLA), Part 2, Chapter 7 provides a list of reactor functional requirements for the I&C equipment; including all of the safety systems and some non-safety systems. The STP ABWR COLA Part 2 Tier 1, Section 3.4 that references Section 3.4 of ABWR DCD, Rev. 4[2] outlines basic principles to be used for establishing setpoints for safety functions required to initiate during certain events, under the title, Instrument Setpoint Methodology (ISM)[3].

To validate the ISM approach for an ABWR, typical setpoints are calculated for ABWR Technical Specification functions using the methodology in Section 2.0. Setpoints used in Japanese ABWRs are not used in the determination of typical setpoints as this ISM approach considers the updated industry standards used by U.S. plants. Determining acceptability of typical setpoints for the STP ABWR comparable to other operating Boiling Water Reactors validates the use of this ISM approach.

This document has been prepared to document the instrument uncertainty calculations for the Reactor Protection Systems (RPS) and Engineered Safeguards Features (ESF) functions identified on Table 3-80 of this document for the STP ABWR plants. The Combined Operating License (COL) for the STP ABWR design requires that a setpoint study be performed. Reconciliation of the final setpoint study for the plant cannot be performed until the design for the plant is finalized. This document is provided for submission with COL applications, and includes projected uncertainty values and assumptions that reflect the STP ABWR Instrumentation and Control (I&C) design, to the extent that is required to support a COL application. Prior to initial fuel load, a reconciliation of this setpoint study against the final design for the plant will be performed, as required by the STP ABWR Inspection, Test, and Analysis Acceptance Criteria (ITAAC) (Item 13 of Table 3.4 in ABWR DCD, Rev. 4).

This document is divided into four sections, including Section 1 Introduction. Section 2 identifies the general algorithm used as a basis for determining the overall instrument uncertainty for a RPS/ESF function. This approach was defined in a Westinghouse paper presented at an Instrument Society of America/Electric Power Research Institute (ISA/EPRI) conference in June, 1992[4]. This approach is consistent with ANSI/ISA-67.04.01-2006[5]. The basic uncertainty algorithm is the Square-Root-of-Sum-of-the-Squares (SRSS) of the applicable uncertainty terms, which is endorsed by the ISA standard. The appropriate uncertainties, as defined by a review of the plant baseline design input documentation, have been included in each RPS/ESF function uncertainty calculation. ISA-RP67.04-02-2000[6] was utilized as a general guideline, but each uncertainty and its treatment is based on Westinghouse methods which are consistent with or conservative with respect to this document. NRC Regulatory Guide 1.105 (Revision 3[7]) endorses the 1994 version of ISA S67.04, Part I. Westinghouse has evaluated this NRC document and has determined that the RPS/ESF function uncertainty calculations contained in this document are consistent with the guidance contained in Revision 3[7]. It is believed that the total channel uncertainty (Channel Statistical Allowance or CSA) represents a 95/95 value as requested in Regulatory Guide 1.105[7].

Section 3.0 of this document provides definitions and associated acronyms used in the RPS/ESF function uncertainty calculations. Appropriate references to industry standards have been provided where applicable. This section includes detailed tables of the uncertainty terms and values for each RPS/ESF function uncertainty calculation performed by Westinghouse. Each table includes the function specific uncertainty algorithm which notes the appropriate combination of instrument uncertainties to determine the channel statistical allowance. A summary table (Table 3-80) is provided which lists the Safety Analysis Limit (SAL), Allowable Value (AV), Nominal Trip Setpoint (NTS), Total Allowance (TA) (difference between the SAL and NTS, in % span), CSA, and margin. In all cases, it was determined that positive margin exists between the SAL and the NTS after accounting for the channel instrument uncertainties.

Section 4 describes how the NTSs in the STP ABWR technical specifications were determined.

1.1 REFERENCES/STANDARDS

[1] "South Texas Project Advanced Boiling Water Reactor, Combined Operating License Application, Part II," Rev. 2, South Texas Project Nuclear Operating Company, 2008.

[2] "U.S. Advanced Boiling Water Reactor Design Control Document," Rev. 4, GE Nuclear Energy, 1997.

[3] "South Texas Project Advanced Boiling Water Reactor Instrument Setpoint Control Program Plan," Rev. 0, September 2009.

[4] Tuley, C. R., Williams, T. P., "The Significance of Verifying the SAMA PMC 20.1-1973 Defined Reference Accuracy for the Westinghouse Setpoint Methodology," Instrumentation, Controls and Automation in the Power Industry, Vol. 35, Proceedings of the Thirty-Fifth Power Instrumentation Symposium (2nd Annual ISA/EPRI Joint Controls and Automation Conference), Kansas City, MO, June 1992, p. 497.

[5] ANSI/ISA-67.04.01-2006, "Setpoints for Nuclear Safety-Related Instrumentation," May 2006.

[6] ISA-RP67.04.02-2000, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," January 2000.

[7] Regulatory Guide 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation," 1999.

2 COMBINATION OF UNCERTAINTY COMPONENTS

This section describes the setpoint methodology used to combine the STP ABWR uncertainty components to determine the overall CSA for the functions listed in Table 3-80 of this document. All appropriate and applicable uncertainties, as defined by a review of the STP ABWR baseline design input documentation, have been considered for each RPS/ESF 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.

This technique has been used in WCAP-16361-P[1], which is approved by the NRC[7], noting acceptability of the statistical techniques for the application requested. Also, various American National Standards Institute (ANSI), American Nuclear Society (ANS), and International Society of Automation (ISA) standards approve the use of probabilistic and statistical techniques in determining safety-related setpoints[2, 3, 4]. The basic methodology used in this document is essentially the same as that identified in a Westinghouse paper presented at an ISA/EPRI conference in June, 1992[5]. Differences between the algorithm presented in Reference 5 and the equations presented in Tables 3-1 through 3-79 are due to STP ABWR specific characteristics in design and should not be construed as differences in approach.

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

$$\begin{aligned} CSA = \{&(PMA)^2 + (PEA)^2 + (SRA)^2 + (SMTE + SD)^2 + (SMTE + SCA)^2 + \\ &(SPE)^2 + (STE)^2 + (RRA)^2 + (RMTE + RD)^2 + (RMTE + RCA)^2 + \\ &(RTE)^2\}^{1/2} + EA + BIAS \end{aligned} \qquad \text{Eq. 2.1}$$

where:

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

EA	=	Environmental Allowance
BIAS	=	One directional, known magnitude allowance

Each of the above terms is defined in Section 3.2, Definitions for Protection System Setpoint Tolerances.

Eq. 2.1 is based on the following:

1. The sensor and rack measurement and test equipment uncertainties are treated as dependent parameters with their respective drift and calibration accuracy allowances.

2. While the environmental allowances are not considered statistically dependent with all other parameters, the equipment qualification testing generally results in large magnitude, non-random terms that are conservatively treated as limits of error which are added to the statistical summation. Westinghouse generally considers a term to be a limit of error if the term is a bias with an unknown sign. The term is added to 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 added to the statistical summation.

4. The calibration terms are treated in the same radical with the other terms based on the assumption that general trending, i.e., drift and calibration data, are evaluated on a periodic and timely basis. This evaluation should confirm that the distribution function characteristics assumed as part of the treatment of the terms are still applicable. This approach results in a net reduction of the CSA magnitude over that which would be determined if trending was not performed. Consistent with the request of Regulatory Guide 1.105[6], the CSA value from Eq. 2.1 is believed to have been determined at a 95% probability and a 95% confidence level (95/95).

2.2 SENSOR ALLOWANCES

Seven parameters are considered to be sensor allowances: SRA, SCA, SMTE, SD, STE, SPE and EA. Three of these parameters (SRA, STE and SPE) are considered to be independent, two-sided, random with respect to SCA, SMTE and SD (by plant calibration or drift determination processes); vendor supplied terms. Based on vendor supplied data, typically product data sheets and qualification reports, these parameters are treated as 95/95 values unless specified otherwise by the vendor. Three of the remaining parameters (SCA, SMTE and SD) are considered dependent with at least one other term, are two-sided, and are the result of the plant calibration and drift determination process. The SCA and SD terms are treated as 95/95 values based on the calibration and drift data evaluations. The SMTE term is treated as a 95/95 value based on vendor product data sheets. For the calculations in this document, projected sensor allowances are assumed.

The EA term is associated with the sensor exposure to adverse environmental conditions (elevated temperature, insulation resistance effects, and/or radiation) due to mass and energy loss from a break in the piping, or adverse effects due to seismic events. Where appropriate, only the elevated temperature term may be used for this uncertainty. For sensors to be used for the STP ABWR, the EA term magnitudes are conservatively treated as limits of error.

SRA is the manufacturer's reference accuracy that is achievable by the device. This term is introduced to address repeatability and hysteresis effects when performing only a single pass calibration; i.e., one up and one down. 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 determined under conditions in which pressure and temperature are assumed constant. For example, let us assume that 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. Some time later, with the plant shutdown, an instrument technician checks for sensor drift using the same technique as 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 impact on the drift determination and are, therefore, independent of the drift allowance.

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 SCA is functionally dependent with the 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 SD is functionally dependent with the 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. SCA is the difference between the "as left" value and the desired value. SD is the difference between the "as found" value and the "as left" value. It is assumed that a mechanistic cause and effect relationship between SCA and SD has not been demonstrated and that the data evaluation determined the distribution function characteristics for both SCA and SD and confirmed that SD is random and independent of SCA.

2.3 RACK ALLOWANCES

Five parameters are considered to be rack allowances: RRA, RCA, RMTE, RTE, and RD. RRA is the manufacturer's reference accuracy that is achievable by the process rack. This term is introduced to address repeatability and hysteresis effects when performing only a single pass calibration; i.e., one up and one down. RTE is considered to be an independent, two-sided, random with respect to RRA, RCA, RMTE and RD (by plant calibration or drift determination processes); vendor supplied parameter. Process racks are typically located in areas with ambient temperature control, making consistency with the rack evaluation temperature easy to achieve. Based on vendor data, this parameter is treated as a 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. The RCA and RD terms are treated as

95/95 values. The RMTE term is treated as a two-sided, 95/95 value based on vendor product data sheets. 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 occurs is confirmed. 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. 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. Thus the RCA is functionally dependent with the RMTE. In those instances where multiple pieces of measurement and test equipment are utilized, the uncertainties due to individual equipment are combined via SRSS when appropriate.

The RCA term represents the total calibration uncertainty for the process rack. 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 RD is also functionally dependent with the 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. RCA is the difference between the "as left" value and the desired value. RD is the difference between the "as found" and the "as left" values. As digital process racks do not experience significant drift, as found limit and as left limit values are considered the same for digital racks. The RD term represents the drift for all process rack modules in an instrument string, regardless of the channel complexity. For multiple channel inputs there may be multiple RD terms. It is assumed that a mechanistic cause and effect relationship between RCA and RD is not demonstrated and that any data evaluation will determine the distribution function characteristics for RCA and RD and show that RD is random and independent of RCA.

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, calorimetric power uncertainty assumptions, fluid density changes, and temperature streaming. 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. Examples of the use of this type of uncertainty may be found in the measurements of Reactor Water Level and Emergency Core Cooling System Flows. 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 bias. If that is determined 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 instead of SRSS summation.

2.5 MEASUREMENT AND TEST EQUIPMENT ACCURACY

A sample of plant procedures is typically reviewed to determine the Measurement and Test Equipment (M&TE) used for calibration and functional testing of the transmitters and racks. When this evaluation concludes that the M&TE accuracies exceed the ANSI/ISA 51.1 – 1979[2] criterion for M&TE deletion

(10 to 1 ratio or greater of calibration accuracy magnitude to M&TE accuracy magnitude), explicit M&TE uncertainties are considered to be included. For the STP ABWR calculations, allowances based on a 1 to 1 (sensors) and 4 to 1 (racks) ratio of calibration tolerance to M&TE accuracy were employed.

2.6 REFERENCES/STANDARDS

[1] WCAP-16361-P, Revision 0, Westinghouse Setpoint Methodology for Protection Systems – AP1000, May 2006.

[2] ANSI/ISA Standard 51.1, 1979 (R1993), "Process Instrumentation Terminology."

[3] ANSI/ANS Standard 58.4-1979, "Criteria for Technical Specifications for Nuclear Power Stations."

[4] ANSI/ISA-67.04.01-2006, "Setpoints for Nuclear Safety-Related Instrumentation," May 2006.

[5] Tuley, C. R., Williams, T. P., "The Significance of Verifying the SAMA PMC 20.1-1973 Defined Reference Accuracy for the Westinghouse Setpoint Methodology," Instrumentation, Controls and Automation in the Power Industry, Vol. 35, Proceedings of the Thirty-Fifth Power Instrumentation Symposium (2nd Annual ISA/EPRI Joint Controls and Automation Conference), Kansas City, MO, June 1992, p. 497.

[6] Regulatory Guide 1.105, Revision 3, "Setpoints for Safety Related Instrumentation," 1999.

[7] NRC Safety Evaluation, "Westinghouse Setpoint Methodology for Protection Systems – AP1000, (TR28)," TAC No. MD2126, ADAMS No. ML072260620, August, 2007.

3 PROTECTION SYSTEM SETPOINT METHODOLOGY

This section defines the terms used in the STP ABWR RPS/ESF function uncertainty calculations, and includes detailed tables and a summary table of the uncertainty values for each calculation. It was determined that in all cases sufficient margin exists between the NTS and the SAL after accounting for uncertainties.

3.1 INSTRUMENT CHANNEL UNCERTAINTY CALCULATIONS

Tables 3-1 through 3-79 provide individual component uncertainties and CSA calculations for the protection functions noted in following tables of the STP ABWR technical specifications.

Table 3.3.1.1-1	Safety System Logic and Control (SSLC) Instrumentation
Table 3.3.1.4-1	Engineered Safety Features (ESF) Actuation Instrumentation
Table 3.3.4.1-4	Anticipated Transient Without Scram (ATWS) and End of Cycle-Recirculation Pump Trip (EOC-RPT) Instrumentation
Table 3.3.7.1-1	Control Room Habitability Area (CRHA) Emergency Filtration (EF) System Instrumentation
Section 3.3.8.1	Electric Power Monitoring

Table 3-80 of this document provides a summary of the RPS/ESF channel uncertainty allowances for STP ABWR. This table lists the SAL, NTS and AV (in engineering units), the CSA, margin, and TA (in % span). Based on the typical accuracy of input values, e.g., X.Y % of Upper Range Limit + A.B % span, an accuracy with a maximum precision of ±0.1 % span for CSA calculations is recommended. The reported values in Tables 3-1 through Table 3-80 of two decimal places are to allow the user to round off; rounding down values less than 0.05% span and rounding up values greater than or equal to 0.05% span. An exception to this rounding convention is the AV which may be reported to additional decimal places. This is to permit distinguishing the AV from the NTS. Parameters reported as "0" or "--" in the tables are not applicable (i.e., have no value) for that channel.

3.2 DEFINITIONS FOR PROTECTION SYSTEM SETPOINT TOLERANCES

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

- A/D Converter

  Signal conditioning module which converts an analog input from an RTD or transmitter to a digital signal for the process racks.

- Allowable Value

  The Allowable Value is defined as equal to the As Found Tolerance, which equals the As Left Tolerance, which equals the instrument process rack calibration accuracy (RCA) defined in the uncertainty calculations. This defines Operability for the instrument process racks.

- As Found

  The condition in which a transmitter, process rack, or process instrument loop is found after a period of operation. For example, after one cycle of operation, a Reactor Pressure transmitter's output at 50% span was measured to be 12.05 mA. This would be the "as found" condition.

- As Found Tolerance

  The "as found' limit identified in the plant surveillance procedures. This defines the operability criterion for the instrument process rack. The "as found" tolerance equals the instrument process rack calibration accuracy defined in the uncertainty calculations. This is based on the design premise that digital racks do not experience significant drift. The "as found" tolerance for transmitters is defined as the sensor drift magnitude identified in the uncertainty calculations. These values are identified (as RCA or SD) in Table 3-1 through 3-79. On a first pass, channel operability is defined as the ability to maintain calibration or be restored to within the calibration accuracy.

- As Left

  The condition in which a transmitter, process rack, 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. For example, the calibration point for a Reactor Pressure transmitter at 50% span is 12.0 ± 0.08 mA. A measured "as left" condition of 12.03 mA would satisfy this calibration tolerance. In this instance, if the calibration was stopped at this point (i.e., no additional efforts were made to decrease the deviation) the "as left" error would be +0.03 mA or +0.19% span, assuming a 16 mA (4 to 20 mA) instrument span.

- As Left Tolerance

  The "as left" limit identified in the plant calibration procedures. The "as left" tolerance is defined as the appropriate calibration accuracy in the uncertainty calculations for the sensor or associated instrument rack. These values are identified (as SCA or RCA) on Tables 3-1 through 3-79.

  Channel

  The sensing and process equipment, i.e., transmitter and racks, for one input to the voting logic of a protection function. The STP ABWR has protection functions with voting logic made up of multiple channels, e.g., 2 out of 4 Reactor Level 3 Level – Low-channels must be in the tripped condition for the reactor protection system to initiate a trip.

- Channel Statistical Allowance (**CSA**)

The combination of the various channel uncertainties via SRSS and algebraic techniques. It includes instrument (sensor and process rack) uncertainties and non-instrument related effects (process measurement accuracy), see Eq. 2.1. This parameter is compared with the TA for determination of instrument channel margin. The CSA value calculated by (Eq. 2.1) is believed to be determined at a two-sided 95% probability, 95% confidence level (95/95).

- Environmental Allowance (**EA**)

The change in a process signal (transmitter or process rack output) due to adverse environmental conditions from a limiting 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 insulation

- Margin

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

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

- Nominal Trip Setpoint (**NTS**)

The trip setpoint defined in the plant technical specifications and plant procedures. This value is the nominal value programmed into the digital process racks. Noted below is the conceptual relationship between the NTS and the as found and as left values (tolerances). Evaluations of as left and as found data for analog and digital process racks suggest rack drift (RD) is significantly smaller than the procedure allowed as left tolerance. Thus, the expectation that the rack module is found within the as left tolerance, and the definition of AFT =ALT, as noted below.

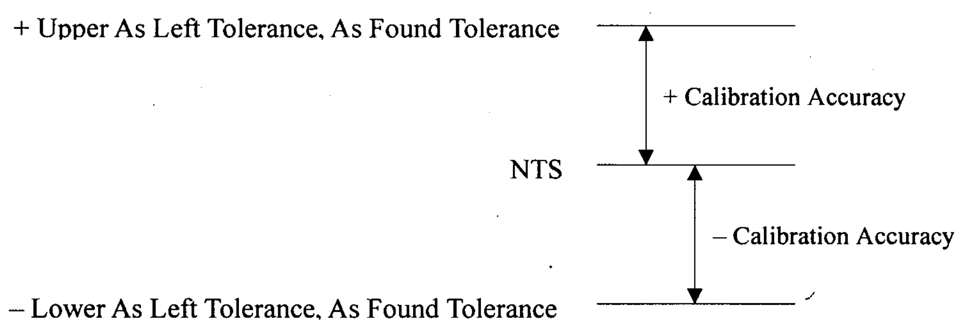

Figure 3-1 Relationship Between NTS, As Left and As Found Tolerance

- 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., the racks are calibrated to trip when a specific voltage is reached. This voltage corresponds to a process parameter magnitude with the relationship established through the scaling process.

- Primary Element Accuracy (**PEA**)

  Uncertainty due to the use of a metering device. For the calculations in this document, 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.

- Process Loop (Instrument Process Loop)

  The process equipment for a single channel of a protection function.

- Process Measurement Accuracy (**PMA**)

  Allowance for non-instrument related effects which have a direct bearing on the accuracy of an instrument channel's reading; e.g., temperature stratification in a large diameter pipe, fluid density in a pipe or vessel.

- Process Racks

  The analog or digital modules downstream of the transmitter or sensing device, which condition a signal and act upon it prior to input to a voting logic. For the process systems in this document, this includes (where applicable) all the equipment contained in the process equipment cabinets; e.g., applies to digital converters, microprocessor and Field Programmable Gate Array (FPGA) modules.

- Rack Calibration Accuracy (**RCA**)

  Rack calibration accuracy is defined as the two-sided calibration tolerance of the process racks as reflected in the plant calibration procedures.

  For the digital racks to be used for the STP ABWR, RCA represents calibration of the signal conditioning – A/D converter providing input to a microprocessor or FPGA. Typically there is only one module present in the digital process loop.

- Rack Drift (**RD**)

  The change in input-output relationship over a period of time at reference conditions; e.g., at constant temperature.

- 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. When the magnitude of RMTE meets the requirements of ANSI/ISA 51.1, 1979 (R1993)[1], it is considered an integral part of RCA. Uncertainties due to M&TE that are 10 times or more accurate than the device being calibrated are considered insignificant and may not be included in the uncertainty calculations.

- Rack Reference Accuracy (**RRA**)

  Rack Reference Accuracy is the same as accuracy rating, as defined by ANSI/ISA 51.1, 1979 (R1993)[1] for the process rack. It is defined as the reference accuracy or accuracy rating that is achievable by the instrument as specified in the manufacturer's specification sheets. Inherent in this definition is the verification of the following under a reference set of conditions; 1) conformity, 2) hysteresis, and 3) repeatability.

- Rack Temperature Effects (**RTE**)

  Change in input-output relationship for the process rack 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.

- Range

  The upper and lower limits of the operating region for a device, e.g., for a Reactor Pressure transmitter, 0 to 10 Megapascals Gage (1450.38 psig), and for a Reactor Level Wide Range Transmitter, 0 to 6.7 m (263.78 inches) where 0 is equivalent to the Top of Active Fuel. 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)[1].

- Safety Analysis Limit (**SAL**)

  The Safety Analysis Limit is defined as a limit on a measured or calculated variable established by the safety analysis to ensure that a safety limit is not exceeded. Thus, this corresponds to the value utilized in the safety analysis. A safety limit is defined as that limit on an important process variable that is necessary to reasonably protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity per paragraph (c).(1).(i).(A) of CFR 50.36. Therefore, an SAL must be conservative with respect to the safety limit. The relationship between Safety Limit, SAL, NTS, and the expected Normal Operation point for an increasing function is provided in Figure 3-2. The SALs, in engineering units, for the STP ABWR functions are noted on Table 3-80.

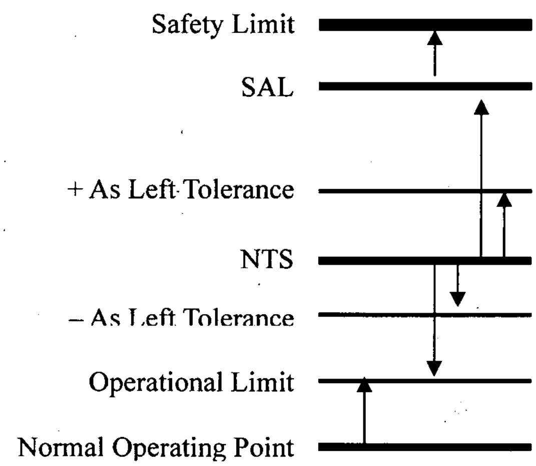

Figure 3-2 Relationship Between Safety Limit, SAL, NTS and Expected Normal Operating Point

- Sensor Calibration Accuracy (**SCA**)

  The calibration accuracy for a sensor or transmitter as defined by the plant calibration procedures. For pressure transmitters, this accuracy is typically [ ].[a,c]

- Sensor Drift (**SD**)

  The change in input-output relationship over a period of time at reference calibration conditions; e.g., at constant temperature. For example, assume that a reactor pressure transmitter at 50% of span (presuming a 4 to 20 mA span) has an "as found" value of 12.05 mA and an "as left" value of 12.01 mA. The magnitude of the drift would be {(12.05 - 12.01)(100/16) = +0.25% span} in the positive direction.

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

  The accuracy of the test equipment (typically a high accuracy local readout gauge and DVM) used to calibrate a sensor or transmitter in the field or in a calibration laboratory. When the magnitude of SMTE meets the requirements of ANSI/ISA 51.1, 1979 (R1993)[1] it is considered an integral part of SCA. Uncertainties due to M&TE that are 10 times or more accurate than the device being calibrated are considered insignificant and may not be included in the uncertainty calculations.

- Sensor Pressure Effects (**SPE**)

  The change in input-output relationship due to a change in the static pressure from the calibration conditions, or the accuracy to which a correction factor is introduced for the difference between calibration and operating conditions for a Δp transmitter.

- Sensor Reference Accuracy (**SRA**)

  The reference accuracy that is achievable by the device as specified in the manufacturer's specification sheets. This term is introduced into the uncertainty calculation to address repeatability effects when performing only a single pass calibration; i.e., one up and one down, or repeatability and hysteresis when performing a single pass calibration in only one direction.

- 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.

- Span

  The region for which a device is calibrated and verified to be operable; e.g., for a Reactor Water Level Wide Range transmitter with a calibrated range of -3.2 m to 3.5 m.

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

  That is

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

  as recommended for use in setpoint calculations by ANSI/ISA-67.04.01-2006[2].

- Total Allowance (**TA**)

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

$$TA = | SAL - NTS |$$

  Two examples of the calculation of TA are:

  – Reactor Pressure – High- Protection System Trip

a,c

SAL
NTS
TA =

If the instrument span = 10 MPaG (1450.38 psig)

a,c

– Drywell Pressure - High Trip

a,c

SAL
NTS
TA =

[ ]

If the instrument span = 68.64 kPaG, (9.96 psig) then

a,c

[ ]

Below is Figure 3-3, providing the conceptual relationship between the SAL, TA, CSA, NTS and Margin.

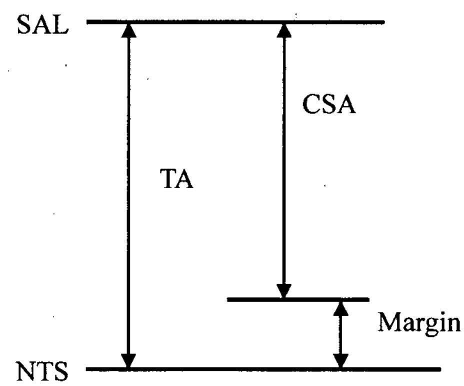

Figure 3-3 Relationship Between SAL, TA, CSA, NTS and Margin

3.3 CONSERVATISM OF ALGORITHM

To demonstrate the conservatism of the Westinghouse algorithm (Eq 2.1), the following evaluation has been performed to compare various uncertainty combination algorithms. The evaluation uses the data presented in Table 3-8 for Reactor Steam Dome Pressure – High – RPS Trip Initiation.

1. For calculating CSA_1, Eq 2.1 is used

$$CSA_1 = \{(PMA)^2 + (PEA)^2 + (SRA)^2 + (SMTE + SD)^2 + (SMTE + SCA)^2 + (SPE)^2 + (STE)^2 + (RRA)^2 + (RMTE + RD)^2 + (RMTE + RCA)^2 + (RTE)^2\}^{1/2} + EA + BIAS$$

a,c

[ ]

2. For calculating CSA_2, all terms are assumed as random and independent.

$$CSA_2 = \{(PMA)^2 + (PEA)^2 + (SRA)^2 + (SMTE)^2 + (SD)^2 + (SCA)^2 + (SPE)^2 + (STE)^2 + (RRA)^2 + (RMTE)^2 + (RD)^2 + (RCA)^2 + (RTE)^2 + (EA)^2\}^{1/2} + BIAS$$

a,c

[ ]

3. For calculating CSA_3, SCA and RCA are considered independent of each other but dependent with respect to the other terms and are placed under a separate radical. All other terms are considered random and independent.

$$CSA_3 = \{(PMA)^2 + (PEA)^2 + (SRA)^2 + (SMTE)^2 + (SD)^2 + (SPE)^2 + (STE)^2 + (RRA)^2 + (RMTE)^2 + (RD)^2 + (RTE)^2 + (EA)^2\}^{1/2} + \{(SCA)^2 + (RCA)^2\}^{1/2} + BIAS$$

a,c

[ ]

In the determination of CSA_2, the algorithm does not consider the functional dependency of SCA and SMTE, SD and SMTE, RCA and RMTE, and RD and RMTE. In order to calibrate or determine the magnitude of drift for either a transmitter or process rack module, direct interaction with the M&TE is required. Thus, it is impossible to determine the magnitude of SCA, SD, RCA or RD without some influence or assumption with regards to the magnitude of the respective M&TE. Thus, CSA_1 is conservative with respect to CSA_2.

In the determination of CSA_3, the algorithm presumes that SCA and RCA are random and independent with respect to each other but dependent with respect to the other transmitter and rack uncertainty terms. Based on evaluation of multiple plants' data, Westinghouse has concluded that the SCA is random and independent of SD, STE and SPE for the multiple-make of transmitters Westinghouse has evaluated. Plant data also demonstrates RCA is random and independent of RD and RTE for Westinghouse supplied process racks. Thus, the application of CSA_3 is not considered necessary.

Conservatism has also been added into those functions requiring a transmitter by using a 1 to 1 ratio for SMTE and SCA, i.e., SMTE is assumed to equal SCA. The same ratio has been applied for RMTE and RCA, i.e., RMTE is assumed to equal RCA. For the final plant specific-setpoints, it is expected that both the SMTE and RMTE values will be significantly reduced based on the procured measurement and test equipment, thus increasing the available margin. To confirm sufficient margin is available for the plant specific calculations, the available margin shall be verified to be greater than or equal to, the as left tolerance (RCA) about the NTS.

3.4 REFERENCES/STANDARDS

[1] ANSI/ISA Standard 51.1, 1979 (R1993), "Process Instrumentation Terminology."

[2] ANSI/ISA-67.04.01-2006, "Setpoints for Nuclear Safety-Related Instrumentation," May 2006.

Table 3-1 Startup Range Neutron Monitors – SRNM Neutron Flux – High	
Parameter	**Allowance**(1) 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent Equivalent Linear Full Scale (ELFS) (10 Volts)

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-2 Startup Range Neutron Monitors – SRNM Neutron Flux – Short Period	
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 Equivalent Linear Full Scale (ELFS) (+99 to + 3 seconds)

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

[ ]

Table 3-3 Startup Range Neutron Monitors – SRNM ATWS Permissive	
Parameter	**Allowance(1)** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	]

1. In percent Equivalent Linear Full Scale (ELFS) (10 Volts)

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

[ ]

Table 3-4	**Average Power Range Monitor – APRM Neutron Flux High Setdown**
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 Reactor Thermal Power (RTP) (125%)

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-5 **Average Power Range Monitors – APRM Simulated Thermal Power – High, Flow Biased (APRM Uncertainties)**	
Parameter	**Allowance(1)** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent Reactor Thermal Power (RTP) (125%)

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

[ ]

Table 3-5 (cont.) Average Power Range Monitors – APRM Simulated Thermal Power – High, Flow Biased (Flow Transmitter Uncertainties)

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 (2.07 MPa dp (300.23 psi dp))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-6 Average Power Range Monitors – APRM Fixed Neutron Flux – High	
Parameter	**Allowance[1]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent Reactor Thermal Power (RTP) (125%)

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

[ ]

Table 3-7 Average Power Range Monitors – APRM ATWS ADS Permissive

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 Reactor Thermal Power (RTP) (125%)

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

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

[ ]

Table 3-9 **Reactor Vessel Steam Dome Pressure High – Isolation 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

[ ]

Table 3-10 Reactor Vessel Steam Dome Pressure – High – SLCS and FWRB Initiation	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

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

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-11 Reactor Steam Dome Pressure – Low (Injection Permissive)	
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

[ ]

Table 3-12 **Reactor Vessel Water Level – High, Level 8**	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (1.8 m (70.87 inches))

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

Table 3-13 Reactor Vessel Water Level Low Level 3 – RPS Trip Initiation		
Parameter	**Allowance(1)**	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		
Environmental Allowance		
Bias		
Rack Reference Accuracy		
Rack Calibration Accuracy		
Rack Measurement & Test Equipment Accuracy		
Rack Temperature Effect		
Rack Drift		]

1. In percent span (1.8 m (70.87 inches))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-14 Reactor Vessel Water Level Low Level 3 – Isolation 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 (1.8 m (70.87 inches))

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

[ ]

Table 3-15 Reactor Vessel Water Level – Low Level 2 – ESF Initiation	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (6.7 m (263.78 inches))

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

[ ]

Table 3-16 Reactor Vessel Water Level – Low Level 2 – Isolation 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 (6.7 m (263.78 inches))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-17 Reactor Vessel Water Level – Low Level 2 – SLCS and FWRB 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 (6.7 m (263.78 inches))

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

[ ]

Table 3-18 Reactor Vessel Water Level – Low Level 1.5 – ESF 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 (6.7 m (263.78 inches))

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

[ ]

Table 3-19 **Reactor Vessel Water Level – Low Level 1.5 – Isolation 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 (6.7 m (263.78 inches))

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

[ ]

Table 3-20 Reactor Vessel Water Level – Low Level 1.5 – ATWS ADS Inhibit

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 (6.7 m (263.78 inches))

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

[ ]

Table 3-21 Reactor Vessel Water Level – Low Level 1 – ADS A, CAMS A, LPFL A and LPFL C 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 (6.7 m (263.78 inches))

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

[ ]

Table 3-22 Reactor Vessel Water Level – Low Level 1 – ADS B, Diesel Generator, RCW, CAMS B and LPFL B 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 (6.7 m (263.78 inches))

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

[ ]

Table 3-23 Reactor Vessel Water Level – Low Level 1 – Isolation 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 (6.7 m (263.78 inches))

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
[ ]

Table 3-24 Main Steam Isolation Valve – Closure

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 (100% Valve Position)

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-25 Drywell Pressure – High – RPS Initiation	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (68.64 kPaG (9.96 psig))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-26 Drywell Pressure – High – ESF 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 (68.64 kPaG (9.96 psig))

Channel Statistical Allowance =

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

a,c

Table 3-27 Drywell Pressure – Feedwater Line Break Mitigation		
Parameter	**Allowance**(1)	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		
Environmental Allowance		
Bias		
Rack Reference Accuracy		
Rack Calibration Accuracy		
Rack Measurement & Test Equipment Accuracy		
Rack Temperature Effect		
Rack Drift		

1. In percent span (68.64 kPaG (9.96 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

[ ]

Table 3-28 Drywell Pressure – High – Isolation Initiation

Parameter	Allowance[(1)] 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (68.64 kPaG (9.96 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

[ ]

Table 3-29 CRD Water Header Charging Pressure – Low

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 (20 MPaG (2900.75 psig))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-30 Turbine Stop Valve-Closure	
Parameter	**Allowance(1)** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (100% Valve Position)

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

[ ]

Table 3-31 Turbine Control Valve Fast Closure, Trip Oil Pressure – Low

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 (8.51 MPaG (1234.27 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

[ ]

Table 3-32 Feedwater Line Differential Pressure – High	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (2.07 MPaD (300.23 psid))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-33 Suppression Pool Temperature – High – RPS 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 (135.60°C (276.08°F))

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

Table 3-34 Suppression Pool Temperature – High – ESF 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 (135.60°C (276.08°F))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-35 Condensate Storage Tank Level – Low	
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 (16 m (629.92 inches))

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

[ ]

Table 3-36 Suppression Pool Water Level – High

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 (1 m (39.37 inches))

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

[ ]

Table 3-37 Main Steam Line Pressure – Low	
Parameter	**Allowance[(1)]**
Process Measurement Accuracy	
Primary Element Accuracy	
Sensor Reference Accuracy	
Sensor Calibration Accuracy	
Sensor Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

a,c

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

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-38 Main Steam Line Flow – High	
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 (2.07 MPa dp (300.23 psi dp))

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

Table 3-39 Condenser Vacuum – Low	
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 (100 cm of Hg (39.37 inches of Hg))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-40 Main Steam Tunnel Temperature – High

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 (200°C (392 °F))

Channel Statistical Allowance =

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

a,c

Table 3-41 Main Turbine Area Temperature – High	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (150°C (302°F))

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

[ ]

Table 3-42 Reactor Building Area Exhaust Air Radiation High	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent of reading

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

[ ]

Table 3-43 Fuel Handling Area Exhaust – Air Radiation – High	
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 of reading

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-44 RCIC Steam Line Flow – High

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 dp span (37.3 kPa dp (5.41 psi dp))

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

[ ]

Table 3-45 RCIC Steam Supply Line Pressure – Low

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 (2.07 MPaG (300.23 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

[ ]

Table 3-46 RCIC Equipment Area Temperature – High

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 (150°C (302°F))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-47 RHR Area Temperature – High	
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 (150°C (302°F))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-48 CUW Differential Flow – High	
Parameter	**Allowance**[(1)] 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (7.46 kPa dp (1.08 psi dp))

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

[ ]

Table 3-49 CUW Regenerative Heat Exchanger Area Temperature – High	
Parameter	**Allowance(1)** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (150°C(302°F))

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

[ ]

Table 3-50 CUW Non-Regenerative Heat Exchanger Area Temperature – High	
Parameter	**Allowance[(1)]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent span (150°C(302°F))

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

[ ]

Table 3-51 CUW Equipment Area Temperature – High	
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 (150°C(302°F))

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

[ ]

Table 3-52 RCW/RSW Heat Exchanger Room Water Level – High	
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 (5m (196.85 inches))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-53 Low Pressure Core Flooder Actuation – LPCF Pump Discharge Pressure – High

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 (2.07 MPaG (300.23 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

[ ]

Table 3-54 Low Pressure Core Flooder Actuation – LPCF Pump Discharge Flow – Low

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 (7.46 kPa dp (1.08psi dp))

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

[ ]

Table 3-55 High Pressure Core Flooder Actuation – HPCF Pump Discharge Pressure – High	
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 (2.07 MPaG (300.23 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

Table 3-56 High Pressure Core Flooder Actuation – HPCF Pump Discharge Flow – Low

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 (7.46 kPa dp (1.08psi dp))

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

[ ]

Table 3-57 High Pressure Core Flooder Actuation – HPCF Pump Suction Pressure – Low	
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 (186.4 kPa (27.04 psi))

Channel Statistical Allowance =

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

a,c

Table 3-58 Reactor Core Isolation Cooling System Actuation – RCIC Pump Discharge Pressure – High

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 (2.07 MPaG (300.23 psig))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-59 Reactor Core Isolation Cooling System Actuation – RCIC Pump Discharge Flow – Low	
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 (7.46 kPa dp (1.08psi dp))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-60 ADS Division I LPCF Pump Discharge Pressure – High

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 (2.07 MPaG (300.23 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

Table 3-61 ADS Division I HPCF Pump Discharge Pressure – High

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 (2.07 MPaG (300.23 psig))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-62 ADS Division II LPCF Pump Discharge Pressure – High

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 (2.07 MPaG (300.23 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

[ ]

Table 3-63 ADS Division II HPCF Pump Discharge Pressure – High	
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 (2.07 MPaG (300.23 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

Table 3-64 Diesel Generator Actuation Division I, II, III Loss Of Voltage – 4.16 kV	
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 of setting

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-65 **Diesel Generator Actuation Division I, II, III Degraded Voltage – 4.16 kV**	
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 of setting

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

[ ]

Table 3-66 Reactor Building Cooling Water/Service Water Actuation Division I, II & III – Loss of Voltage 4.16 kV

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 of setting

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

Table 3-67 Reactor Building Cooling Water/Service Water Actuation Division I, II & III Degraded Voltage – 4.16 kV

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 of setting

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-68 Drywell Sump Drain LCW Radiation – High	
Parameter	**Allowance[1]** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent of reading

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-69 Drywell Sump Drain HCW Radiation – High	
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 of reading

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-70 RCIC Turbine Exhaust Pressure – High	
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 (0.69 MPaA (100.08 psia))

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

[ ]

Table 3-71 ATWS – Feedwater Reactor Vessel Water Level – Low 3	
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 (1.8 m (70.87 inches))

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

[ ]

Table 3-72 ATWS – Reactor Water Vessel Level – Low 2	
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 (6.7 m (263.78 inches))

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-73 ATWS – SB&PC Reactor Steam Dome Pressure – High	
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 =

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

a,c

[ ]

Table 3-74 Control Room Ventilation Radiation Monitors – High

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 of reading

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-75 Emergency Filtration System Low Flow	
Parameter	**Allowance(1)** 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	
Environmental Allowance	
Bias	
Rack Reference Accuracy	
Rack Calibration Accuracy	
Rack Measurement & Test Equipment Accuracy	
Rack Temperature Effect	
Rack Drift	

1. In percent of setting

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-76 Constant Voltage Constant Frequency Power Supply – Undervoltage

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 of setting

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-77 Constant Voltage Constant Frequency Power Supply – Overvoltage

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 of setting

Channel Statistical Allowance =

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

a,c

[ ]

Table 3-78 Constant Voltage Constant Frequency Power Supply – Underfrequency	
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 of setting

Channel Statistical Allowance =

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

a,c

Table 3-79 Constant Voltage Constant Frequency Power Supply - Overfrequency

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	

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1. In percent of setting

Channel Statistical Allowance =

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

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[ ]

Table 3-80 Summary of Typical Setpoints and Allowances

Protection Channel	Safety Analysis Limit	Allowable Value(10)		Nominal Trip Setpoint	Total Allowance(1)	Channel Statistical Allowance(1)	Margin(1)
Startup Range Neutron Monitors – SRNM Neutron Flux – High Mode 2 Trip(2)							
Startup Range Neutron Monitors – SRNM Neutron Flux – Short Period Mode 2 Trip(2)							
Startup Range Neutron Monitors – SRNM ATWS Permissive							
Average Power Range Monitors – APRM Neutron Flux High Setdown							
Average Power Range Monitors – APRM Simulated Thermal Power – High, Flow Biased							
Average Power Range Monitors – APRM Fixed Neutron Flux- High							
Average Power Range Monitors – Rapid Core Flow Decrease	See Note 6						
Oscillation Power Range Monitor	See Note 7						
Average Power Range Monitors – APRM ATWS ADS Permissive							
Reactor Vessel Steam Dome Pressure High – RPS Trip Initiation							
Reactor Vessel Steam Dome Pressure High – Isolation Initiation							

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Table 3-80 Summary of Typical Setpoints and Allowances (cont.)

Protection Channel	Safety Analysis Limit	Allowable Value(10)		Nominal Trip Setpoint	Total Allowance(1)	Channel Statistical Allowance(1)	Margin(1)
Reactor Vessel Steam Dome Pressure High – SLCS and FWRB Initiation							
Reactor Steam Dome Pressure – Low (Injection Permissive)							
Reactor Vessel Water Level – High, Level 8							
Reactor Vessel Water Level Low Level 3 – RPS Trip Initiation							
Reactor Vessel Water Level Low Level 3 – Isolation Initiation							
Reactor Vessel Water Level – Low Level 2 – ESF Initiation							
Reactor Vessel Water Level – Low Level 2 – Isolation Initiation							
Reactor Vessel Water Level – Low Level 2 – SLCS and FWRB Initiation							
Reactor Vessel Water Level – Low Level 1.5 – ESF Initiation							
Reactor Vessel Water Level – Low Level 1.5 – Isolation Initiation							

a,c

Table 3-80 (cont.) Summary of Typical Setpoints and Allowances

Protection Channel	Safety Analysis Limit	Allowable Value[10]		Nominal Trip Setpoint	Total Allowance[1]	Channel Statistical Allowance[1]	Margin[1]
Reactor Vessel Water Level – Low Level 1.5 – ATWS ADS Inhibit							
Reactor Vessel Water Level – Low Level 1 – ADS A, CAMS A, LPFL A and LPFL C Initiation							
Reactor Vessel Water Level – Low Level 1 – ADS B, Diesel Generator, RCW, CAMS B and LPFL B Initiation							
Reactor Vessel Water Level – Low Level 1 – Isolation Initiation							
Main Steam Isolation Valve – Closure							
Drywell Pressure – High – RPS Initiation							
Drywell Pressure – High – ESF Initiation							
Drywell Pressure – Feedwater Line Break Mitigation							
Drywell Pressure – High – Isolation Initiation							
CRD Water Header Charging Pressure – Low							
Turbine Stop Valve-Closure							

a,c

Table 3-80 (cont.) Summary of Typical Setpoints and Allowances

Protection Channel	Safety Analysis Limit	Allowable Value(10)		Nominal Trip Setpoint	Total Allowance(1)	Channel Statistical Allowance(1)	Margin(1)
Turbine Control Valve Fast Closure, Trip Oil Pressure – Low							
Feedwater Line Differential Pressure – High							
Suppression Pool Temperature – High – RPS Initiation							
Suppression Pool Temperature – High – ESF Initiation							
Condensate Storage Tank Level – Low							
Suppression Pool Water Level – High							
Main Steam Line Pressure – Low							
Main Steam Line Flow – High							
Condenser Vacuum – Low							
Main Steam Tunnel Temperature – High							

a,c

Table 3-80 (cont.) Summary of Typical Setpoints and Allowances

Protection Channel	Safety Analysis Limit	Allowable Value(10)		Nominal Trip Setpoint	Total Allowance(1)	Channel Statistical Allowance(1)	Margin(1)
Main Turbine Area Temperature – High							
Reactor Building Area Exhaust Air Radiation – High							
Fuel Handling Area Exhaust Air Radiation – High							
RCIC Steam Line Flow – High							
RCIC Steam Supply Line Pressure – Low							
RCIC Equipment Area Temperature – High							
RHR Area Temperature – High							
CUW Differential Flow – High							
CUW Regenerative Heat Exchanger Area Temperature – High							
CUW Non-Regenerative Heat Exchanger Area Temperature – High							
CUW Equipment Area Temperature – High							

a,c

Table 3-80 Summary of Typical Setpoints and Allowances (cont.)							
Protection Channel	Safety Analysis Limit	Allowable Value[10]		Nominal Trip Setpoint	Total Allowance[1]	Channel Statistical Allowance[1]	Margin[1]
RCW/RSW Heat Exchanger Room Water Level – High							
Low Pressure Core Flooder Actuation – LPCF Pump Discharge Pressure – High							
Low Pressure Core Flooder Actuation – LPCF Pump Discharge Flow – Low							
High Pressure Core Flooder Actuation – HPCF Pump Discharge Pressure – High							
High Pressure Core Flooder Actuation – HPCF Pump Discharge Flow – Low							
High Pressure Core Flooder Actuation – HPCF Pump Suction Pressure – Low							
Reactor Core Isolation Cooling System Actuation – RCIC Pump Discharge Pressure – High							
Reactor Core Isolation Cooling System Actuation – RCIC Pump Discharge Flow – Low							
ADS Division I LPCF Pump Discharge Pressure – High[9]							
ADS Division I HPCF Pump Discharge Pressure – High[9]							
ADS Division II LPCF Pump Discharge Pressure – High[9]							

a,c

Table 3-80 (cont.) Summary of Typical Setpoints and Allowances

Protection Channel	Safety Analysis Limit	Allowable Value(10)		Nominal Trip Setpoint	Total Allowance(1)	Channel Statistical Allowance(1)	Margin(1)
ADS Division II HPCF Pump Discharge Pressure – High(9)							
Diesel – Generator Actuation Division I, II & III Loss of Voltage – 4.16 kV							
Diesel – Generator Actuation Division I, II & III Degraded Voltage – 4.16 kV							
Reactor Building Cooling Water/Service Water Actuation Division I, II & III Loss of Voltage 4.16 – kV							
Reactor Building Cooling Water/Service Water Actuation Division I, II & III Degraded Voltage – 4.16 kV							
Drywell Sump Drain LCW Radiation – High							
Drywell Sump Drain HCW Radiation – High							
RCIC Turbine Exhaust Pressure – High							
ATWS- Feedwater Reactor Vessel Water Level – Low 3							
ATWS – Reactor Water Vessel Level – Low 2							

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Table 3-80 Summary of Typical Setpoints and Allowances (cont.)

Protection Channel	Safety Analysis Limit	Allowable Value[10]		Nominal Trip Setpoint	Total Allowance[1]	Channel Statistical Allowance[1]	Margin[1]
ATWS – SB&PC Reactor Steam Dome Pressure – High							
Control Room Ventilation Radiation – High							
Emergency Filtration System Low Flow							
Constant Voltage Constant Frequency Power Supply – Undervoltage							
Constant Voltage Constant Frequency Power Supply – Overvoltage							
Constant Voltage Constant Frequency Power Supply – Underfrequency							
Constant Voltage Constant Frequency Power Supply – Overfrequency							

a,c

Table 3-80 (cont.) Summary of Typical Setpoints and Allowances

Notes:

1. All values in percent span unless otherwise indicated.
2. Typical Setpoints for Startup Range Neutron Monitors – SRNM Neutron Flux – High and Startup Range Neutron Monitors – SRNM Neutron Flux – Short Period are calculated based on the reactor being in the RUN operational mode.
3. Equivalent Linear Full Scale
4. Reactor Thermal Power
5.
6.
7.
8. Top of Active Fuel
9. For ADS Division I and II Emergency Core Cooling System Discharge Pressure, required for technical specifications, the ADS Division I and II LPCF Pump Discharge Pressure will be used as these values are more conservative then the ADS Division I and II HPCF Pump Discharge Pressure.
10. The Allowable Value is based on the As Found Tolerance which is a two sided parameter, therefore the Allowable Value is shown on both the high and low sides.
11. For determining As Found Tolerances for Radiation Monitoring and Relay Setpoints, the As Found Tolerance is based on the SCA value as these functions do not have sensor drift and use a digital contact in the racks (RCA = 0).

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4 APPLICATION OF SETPOINT METHODOLOGY

4.1 UNCERTAINTY CALCULATION BASIC ASSUMPTIONS/PREMISES

The equations noted in Sections 2 and 3 are based on several basic assumptions about the statistical nature of the calibration accuracy and drift terms for STP ABWR:

1. The instrument technicians will make reasonable attempts to achieve the NTS as the "as left" condition for the process racks and nominal/desired values (sensor/transmitter), at the start of each surveillance interval, and

2. The process rack and sensor/transmitter calibration accuracy and drift allowances are random and can be approximated by normal distributions.

In support of Item 1) it should be noted that recalibration is required any time the "as found" condition of a device or channel is found outside of the procedural "as left" tolerance. A device or channel may not be left outside the "as left" tolerance without declaring the channel "inoperable" and taking appropriate action. Thus, the "as left" tolerance may be considered an outer limit for the purposes of calibration and instrument uncertainty calculations. An instrument technician may choose to recalibrate a device if it is found near the extremes of the "as left" procedural tolerance, but this is not required. Item 2) may be verified by performing a statistical evaluation of "as found" versus "as left" data over several surveillance intervals to confirm that the SCA, SD, RCA, and RD parameter values included in the plant specific uncertainty calculations are satisfied on at least a 95% probability/95% confidence level basis.

4.2 PROCESS RACK OPERABILITY CRITERIA

An approach has been identified to define operability criteria for the digital process racks employed for STP ABWR. The critical parameter is the ability of the process racks to be calibrated within the RCA. These values will be included in the STP ABWR plant calibration procedures as the "as left" calibration accuracy, and must be consistent with the process rack design criteria. The capability of the racks to be calibrated to within these tolerances defines channel operability. The channel will be considered inoperable if it cannot be returned to within the RCA regardless of the "as found" value.