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SOUTHERN COMPANY

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NL-11-1559

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Vogtle Electric Generating Plant, Units 1 & 2
NRC Request for Additional Information for
License Amendment Request for Steam Generator Water Level High-High
(P-14) Setpoint Change

Ladies and Gentlemen:

By letter dated March 3, 2011 (ADAMS Accession Number ML 110660458), Southern Nuclear Operating Company (SNC) submitted a license amendment request for Steam Generator Water Level High-High (P-14) Setpoint Change. Subsequently, by letter dated June 15, 2011 (ADAMS Accession Number ML 11158A256), the NRC submitted a Request for Additional Information (RAI) to enable completion of the review. NRC letter dated July 18, 2011 (ADAMS Accession Number ML 11193A003), provided an additional 30 calendar days for a total of 60 days, from June 15, 2011, to respond to the original RAIs. The responses to the RAIs are provided in Enclosure 1. NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions" is provided as Enclosure 2.

This letter contains no NRC commitments. If you have any questions, please contact Jack Stringfellow at (205) 992-7037.

Respectfully submitted,

Mark J. Ajluni

M. J. Ajluni
Nuclear Licensing Director

MJA/GAL

Sworn to and subscribed before me this 12th *day of* August, *2011.*

Gail A. Hicks

Notary Public
Gail A. Hicks

My commission expires: July 16, 2014

A001
NRR

Enclosures:

1. Vogtle Electric Generating Plant, Units 1 and 2, License Amendment Request for Steam Generator Water Level High-High (P-14) Setpoint Change Response to RAIs
2. NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions"

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. J. T. Gasser, Executive Vice President
Mr. T. E. Tynan, Vice President – Vogtle
Ms. P. M. Marino, Vice President – Engineering
RType: CVC7000

U. S. Nuclear Regulatory Commission
Mr. V. M. McCree, Regional Administrator
Mr. P. G. Boyle, NRR Project Manager - Vogtle
Mr. L. M. Cain, Senior Resident Inspector – Vogtle

Vogtle Electric Generating Plant, Units 1 & 2
NRC Request for Additional Information for
License Amendment Request for Steam Generator Water Level High-High
(P-14) Setpoint Change

Enclosure 1

Vogtle Electric Generating Plant, Units 1 and 2, License Amendment Request for Steam Generator Water Level High-High (P-14) Setpoint Change
Response to RAIs

Vogtle Electric Generating Plant, Units 1 and 2, License Amendment Request for Steam Generator Water Level High-High (P-14) Setpoint Change Response to RAIs

The Nuclear Regulatory Commission (NRC) staff has reviewed the information provided by Southern Nuclear Operating Company, Inc. (SNC, the licensee), for Vogtle Units 1 and 2, in its letter dated March 3, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML110660458). However, the NRC staff has reviewed the licensee's submittal and determined that additional information is needed to complete the review, as follows:

1. **NRC RAI**

On May 27, 2005, Vogtle reported that the setpoint for the P-14 function may not be accomplished in response to a feedwater malfunction event as described in Final Safety Analysis Report Section 15.1.2.1. The License Event Report (LER) 1-2005-002 (ADAMS Accession No. ML051530400) states that Westinghouse had determined that the SG Water high-high level setpoint be reduced from 86.0% to 83.1 %. However, the License Amendment Request (LAR) submitted by SNC states that the SG Water high-high level setpoints should be reduced from ≤87.9% to ≤82.5%. Please clarify why the values identified in the LAR are different than the values identified by Westinghouse in the LER.

SNC RESPONSE

The Westinghouse recommendation to reduce the Nominal Trip Setpoint (NTS) from 86.0% to 83.1% was provided in a letter from Westinghouse dated April 4, 2005. In this same letter, the recommended change in the Allowable Value (AV) was from ≤87.9% to ≤83.6%. These recommended values, while providing maximum operating margin, provided minimal margin between the Analytical Limit and the NTS (design margin). During implementation of the Setpoint design change, the conservative value of 82% was chosen for the NTS to provide additional margin to the Analytical Limit and to provide a value that was easy to read on the control board indication. The corresponding Allowable Value was changed accordingly to ≤82.5%. These values of 82% for the NTS and ≤82.5% for the AV are the values provided in the LAR submitted via SNC letter NL-11-0280 dated March 3, 2011.

2. **NRC RAI**

Enclosure 6, Basic Westinghouse Uncertainty Methodology (pg 1), describes that the algorithm used to calculate the channel uncertainty was based on a Westinghouse paper (Reference 1 of Enclosure 6). However, this section notes that there are differences between the algorithm presented in the paper and the equation used for the calculations due to Vogtle specific characteristics.

a) Please describe the differences in the Vogtle design that require a modification to the algorithm to combine the uncertainty components for a channel.

b) Please describe how the uncertainty terms were combined in the equation and how these terms represent their contribution to total error. Also, please identify the terms considered to be random and independent, and which are random and dependent, and which are non-random, and provide the reasons why these terms are to be so classified.

SNC RESPONSE (2.a)

The paper referenced is a 1992 presentation, ("The Significance of Verifying the SAMA PMC 20.1-1973 Defined Reference Accuracy for the Westinghouse Setpoint Methodology"), in which Westinghouse describes the general issues associated with instrumentation reference accuracy uncertainties and how Westinghouse would intend to address those issues with a change to the Westinghouse general uncertainty algorithm. This generic algorithm is still a basic Square Root Sum of Squares (SRSS) approach; however, each Reactor Trip System (RTS) or Engineered Safety Feature Actuation System (ESFAS) function can be unique due to variations in process conditions, plant specific procedures and/or processes, instrumentation, drift or calibration data, etc. Therefore, the generic algorithm discussed in the referenced 1992 paper is modified, as necessary, to reflect the RTS or ESFAS function and plant specific characteristics. For the Vogtle Electric Generating Plant (VEGP), the algorithm in the referenced 1992 paper was revised to that shown on page 1 of Enclosure 6, "Setpoint Methodology Used for the Steam Generator Water Level High-High Function," and the equation on page 1 is further refined as shown on Table 1 of Enclosure 6 to reflect the Steam Generator Water Level High-High (P-14) function specific Process Measurement Allowable (PMA) and bias terms. This modification was made to reflect the input documents reviewed as noted in the SNC response to question 3.a.

SNC RESPONSE (2.b)

Table 1 of Enclosure 6, "Setpoint Methodology Used for the Steam Generator Water Level High-High Function," reflects the treatment of the various uncertainty terms. The equation presented in Table 1 (page 7) of Enclosure 6, provides the relationship of dependent and independent random terms and bias terms. These terms are treated in this manner after a review of plant specific instruments, procedures, data review and consideration of operating and environmental conditions associated with the P-14 function. An example of term dependency is (RCA + RMTE). Westinghouse concluded that Rack Calibration Accuracy (RCA) is dependent with Rack Measurement and Test Equipment (RMTE) due to the calibration process. In this case, the ability to meet the calibration accuracy is dependent on the type and accuracy of the RMTE. An example of a single independent term is Rack Temperature Effect (RTE). In this case, the temperature effect is not directly dependent on any other uncertainty component. RTE is a function of the equipment design and is therefore considered an independent term. Each component of the equation is reviewed in this manner for dependencies and then addressed appropriately as shown on

Table 1 (page 7 of Enclosure 6, "Setpoint Methodology Used for the Steam Generator Water Level High-High Function").

3. NRC RAI

The sample calculation for the SG Water high-high level setpoint, provided in Enclosure 6, does not provide sufficient information to make a determination that adequate margin has been established between the Analytical Limits and the Nominal Setpoints to allow for all instrument channel performance uncertainties.

a) Provide the source or data sheet for the values identified in Table 1 of Enclosure 6. This table only provides the individual component uncertainties.

b) Provide data and/or analysis to show that the tolerance limits for this calculation have been based on a statistically sufficient quantity of sample data to bound these values and state the confidence level associated with the interval that contains 95 percent of the population of interest. Provide a basis for demonstrating why the confidence level used is appropriate.

c) The summary calculation should provide the basis for calculating the channel statistical allowance, analytical limit (AL), nominal trip setpoint (NTSP), field trip setpoint, allowable value (AV), as found tolerance, and as left tolerance. Demonstrate that with the instrument "as-found" value at the AV, under the worst-case condition the channel trip function will be achieved with a 95% probability before the AL is reached, with a 95% confidence level.

SNC RESPONSE (3.a)

The following source data was reviewed to determine the magnitude and treatment for each uncertainty term provided in Table 1 of Enclosure 6, "Setpoint Methodology Used for the Steam Generator Water Level High-High Function,":

- Process Measurement Accuracy Biases; PMA_{PP}, PMA_{RL}, PMA_{FV}, PMA_{DL}, PMA_{SC}, PMA_{ID}, PMA_{FR}, and PMA_{MD} are based on calculations of the Westinghouse model F steam generator thermal hydraulic performance code. This code calculates the internal pressure drops that affect the level taps and thus, affect the indicated water level. Each term is calculated at multiple conditions to determine the bounding set that affects the P-14 function. In addition to the steam generator thermal hydraulic code calculations, local reference leg ambient temperature conditions are considered for reference leg heatup effects. Feedwater malfunction transients that result in high water level effects are reviewed to determine any effects on the P-14 function.

- Primary Element Accuracy (PEA); this term is reserved for flow elements such as orifice plates used specifically for flow functions. Since this is a level measurement function, this term does not apply.

- Sensor Calibration Accuracy (SCA); this term is the as left tolerance value for the level transmitters and is defined by the as left tolerance used in the VEGP plant specific SG level surveillance procedures used to calibrate the transmitters.

- Sensor Reference Accuracy (SRA); this term is the basic reference accuracy of the level transmitter and is based on transmitter vendor specific information.

- Sensor Measurement and Test Equipment (SMTE); this term is based on the VEGP plant specific required SMTE used in the plant surveillance procedures for the SG level transmitters.

- Sensor Pressure Effects (SPE); this term is based on the transmitter vendor specific design information and is based on the SG process conditions and the VEGP specific scaling procedures.

- Sensor Temperature Effects (STE); this term is based on the transmitter vendor specific design information and the transmitter ambient temperature conditions.

- Sensor Drift (SD) and (SD_B); these terms are based on a 95/95 statistical evaluation of VEGP specific as found minus as left transmitter data recorded in the plant surveillance procedures. SD represents the random drift term and SD_B represents a bias noted in the plant data.

- Rack Calibration Accuracy (RCA); this term is the as left tolerance value for the process racks and is defined by the as left tolerance used in the VEGP plant specific SG level surveillance procedures used to calibrate the process racks.

- Rack Measurement and Test Equipment (RMTE); this term is based on the VEGP plant specific required RMTE used in the plant surveillance procedures for the SG level process racks.

- Rack Temperature Effects (RTE); this term is based on the process rack vendor specific design information and the process rack ambient temperature conditions.

- Rack Drift (RD); this term is a conservative allowance used to bound the expected process rack drift over a 6 month surveillance period. The process racks installed at VEGP are Westinghouse 7300 design and Westinghouse has evaluated as found minus as left data from multiple plants to determine that this a conservative allowance. VEGP specific surveillance data has been reviewed to conclude that this allowance is being satisfied.

SNC RESPONSE (3.b)

Westinghouse uses a conservative approach for surveillance procedure data evaluation to determine an overall bounding 95/95 uncertainty allowance. Recorded surveillance procedure data is evaluated typically from at least three operating/fuel cycles, and as found minus as left is calculated to determine drift allowances, and as left minus desired is calculated to verify calibration tolerances characteristics. The Westinghouse data evaluation process uses a conservative approach to determine both random and non-random (bias) values. As examples, Westinghouse considers the following points as part of the data evaluation process:

- Sample size weighted 95/95 two sided tolerance factors are used in conjunction with the mean and standard deviations.
- Distribution function characteristics are reviewed because not all samples are normal.
- Data is seldom removed based on outlier tests only. Mechanistic causes are generally determined to remove data from a sample population.
- Data is plant specific and not pooled with other plants or vendor hardware.
- Data is evaluated for time dependency using regression techniques.
- 18 month as well as 6 month surveillance test data is evaluated to verify that all applicable data has been accounted for.

The above process assures that the data evaluation process has a rigorous statistical basis with a sample size sufficient to provide 95/95 results for input to the uncertainty analysis.

SNC RESPONSE (3.c)

On page 7 of Enclosure 6 ("Setpoint Methodology Used for the Steam Generator Water Level High-High Function"), at the bottom of Table 1, values are provided for the following terms:

- NTS (same as the field trip setpoint in the Westinghouse setpoint methodology)
- SAL (safety analysis limit)
- As Left Tolerance (ALT)As Found Tolerance (AFT)
- CSA (Channel Statistical Allowance)
- Margin
- Allowable Value (AV)

The relationship of these terms to each other is presented in Figure 1 on page 5 of Enclosure 6. In the Westinghouse setpoint methodology, the as left tolerance and the as found tolerance are the same magnitude and are based on the same criterion (AFT = ALT = RCA). Therefore, the Allowable Value is the same value as the ALT and AFT. If a check calculation were to be performed to show that (NTS + CSA + AFT) ≤ SAL, this can be demonstrated to be true because a review of the values on page 7 of Enclosure 6 concludes that margin is greater than the AFT. If margin is greater than the AFT, then the identified check calculation is always satisfied.

However, Westinghouse disagrees with the identified check calculation approach for the following technical reasoning. The basic Westinghouse methodology uses an SRSS approach, as defined on page 1 of Enclosure 6. With this approach, the various uncertainty terms are determined to be either two-sided, random terms that are combined into sets of independent terms within the SRSS, or are treated as bias terms outside of the SRSS as noted in the response to Question 2.b. above. In the Westinghouse setpoint methodology, the Rack Calibration Accuracy (RCA) term is defined as the two-sided, random as left calibration tolerance (ALT), defined in the plant calibration procedures and is the same as the as found tolerance (AFT) defined in the plant surveillance procedures. Therefore, the RCA term is the ALT and the (AFT). For calculation purposes, the RCA/ALT/AFT term is defined as the maximum permitted procedure tolerance value. However, in actual practice, the magnitude is typically much less, $1/4^{th}$ to $1/3^{rd}$ of the allowed tolerance on a 95/95 basis and demonstrates the characteristics of a truncated Logistic or Laplace distribution (very centralized). The magnitude and the random characteristics of this term are confirmed by evaluations of plant data.

The following should be noted about the check equation defined above; NTS + AFT + CSA.

1. CSA is a 95/95 statistical combination of the uncertainties, as identified by the equation on page 1 of Enclosure 6.
2. The CSA equation includes the independent, two-sided, random quantity $(RMTE + RD)^2$.
3. RD is summed with RMTE due to the inherent dependent nature of the two terms.
4. AFT = RD, thus the check equation, NTS + AFT + CSA = NTS + RD + CSA. Thus, the check equation treats RD twice.

   a. Once, as a two-sided, random term within CSA.

   b. Once, as a one-sided, systematic term, a presumption of the summation.

Thus, the check equation is overly conservative for the following reasons:

1. It treats the RD term twice.
2. It presumes the RD term is systematic and one-sided, contrary to supporting plant data.
3. It does not recognize the conservative treatment of the CSA equation (dependent with RMTE).
4. It does not recognize the conservative nature of the typical RD probability distribution function characteristics, supported by typical plant data.
5. The treatment of the check equation is deterministic, rather than statistical in nature.

In addition, to presume a simple deterministic evaluation ignores the basic SRSS assumption that other terms may be in the opposite direction or at lower than assumed magnitudes that can offset the presumed RD/AFT magnitude and direction. For example, RD/AFT could be at its maximum allowed value, however, the temperature effect for the process racks could be in the opposite direction at the same time, or the PMA terms could be lower due to varying plant operating conditions. It should be recognized that anytime a deterministic evaluation is compared to an SRSS statistical evaluation, the magnitude of margin determined for each evaluation will be different, with the deterministic margin always less than the statistical margin. Thus, it would be expected that there would be instances where positive margin is demonstrated with a statistical evaluation, but not for a deterministic evaluation.

For this P-14 function, sufficient margin exists so the check calculation is satisfied, but for those times when the check calculation may not be satisfied, the Westinghouse method of performance based equipment operability criterion provides confidence that with properly working equipment and appropriate determination of the uncertainty terms, the check calculation is not necessary to provide confidence that the safety analysis limit will be preserved.

4. NRC RAI

Note (j) of Table 3.3.2-1 (page 5 of 7) in the TS markups provided in Enclosure 2 states "that the methodologies used to determine the as-found and the as-left tolerances are specified in NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions." Further, Enclosure 4, Technical Specification Bases Markup Pages, state that "a detailed description of the methodology used to calculate the Allowable Values and NTSP is provided in the "RTS/ESFAS [Reactor Trip System/Engineered Safety Feature Actuation System] Setpoint Methodology Study" (WCAP-11269). Please provide copies (prefer electronic copy) of the following documents:

- NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions."
- WCAP-11269, "RTS/ESFAS Setpoint Methodology Study" as supplemented by Amendments 34 and 14.

SNC RESPONSE

A copy of NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions" is included in this submittal as Enclosure 2.

WCAP-11269 would not provide relevant information to the P-14 setpoint methodology. The WCAP was the original methodology for the Vogtle Reactor Protection System (RPS) and Engineered Safety Features Actuation System (ESFAS) setpoints. When SNC revised the P-14 setpoint, the methodology that was used, and described in our submittal, superseded that of WCAP-11269. Therefore, WCAP-11269 is not relevant to the P-14 setpoint revision.

Vogtle Electric Generating Plant, Units 1 & 2
NRC Request for Additional Information for
License Amendment Request for Steam Generator Water Level High-High
(P-14) Setpoint Change

Enclosure 2

NMP-ES-033-006, "Vogtle Setpoint Uncertainty Methodology and Scaling Instructions"

Peer Team Champion/Procedure Owner: David Whitehurst / Electrical I&C Manager/ Corporate
(Print: Name / Title / Site)

Approved By: Original signed by David Whitehurst on 06/16/2010
(Instruction Owner's Approval Signature / Date)

Effective Dates:	06/18/2010	N/A	N/A	06/18/2010
	Corporate	FNP	HNP	VEGP

Writer(s): Dan Hines

PROCEDURE USAGE REQUIREMENTS		SECTIONS
Continuous Use:	Procedure must be open and readily available at the work location. Follow procedure step by step unless otherwise directed by the procedure.	
Reference Use:	Procedure or applicable section(s) available at the work location for ready reference by person performing steps.	
Information Use:	Available on site for reference as needed.	ALL

Revision Description

Version Number	Revision Description
1.0	Initial Issue
2.0	Revised due to 2006 SNC Organization Re-alignment
3.0	Revised to require a review of Plant Technical Data Book as part of scaling an instrument. Add additional information and details along with updating references. Addresses issue documented in Corporate CR 2007100724. Incorporated Site VP Re-Organization AI 2008200141
4.0	Revised References 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.1.7, 3.1.8, 3.1.9, 3.1.10, 3.1.11, and editorial changes to Sections 6.1.2, 6.1.3, 6.2.2, 6.2.4, 6.2.9, 7.0, and Appendix B per A/I 2008201444.
5.0	Revised section 6.2.19 to add more details involving maintenance support activities for cycle-specific scaling changes. Per Hatch AI 2009203529 added section 6.3.1 to provide instructions in obtaining documentation of accurate elevation data via performance of survey when instrument accuracy may be affected by mounting elevation.

Table of Contents

1.0 Purpose

The purpose of this procedure is to provide general Instrumentation and Controls engineering guidance to be used as an aide in completing engineering activities which are generally conducted under other procedures. In the event of a conflict between this procedure and the requirements of another procedure applicable to the particular design activity, the requirements of the other procedure will take precedence. This procedure contains no procedural requirements and is applicable to Vogtle only.

2.0 Applicability

This procedure is applicable to corporate and Vogtle site personnel, who are performing nuclear plant, related engineering activities (e.g. DCP and MDCP production, RER response, ABN review, etc.).

This procedure is maintained under the direction of the Design Support Electrical / I&C Manager.

3.0 References

3.1 SNC Procedures and Documentation

3.1.1 DC-1000J, General Design Criteria (Instrumentation and Controls)
3.1.2 DC-1000G, General Design Information
3.1.3 DS-DC-002, Domestic Document Preparation, Update, and Transmittal
3.1.4 NMP-GM-007-001, Design Computer Program Control
3.1.5 NMP-ES-039-001, Calculations Preparation and Revision
3.1.6 NMP-ES-039-002, Documentation of Engineering Judgment
3.1.7 NMP-ES-038-GL01, General Engineering Guidance
3.1.8 NMP-ES-038-GL02, Electrical Design Guideline
3.1.9 NMP-ES-050, Requests For Engineering Review
3.1.10 NMP-ES-044, Preparation Of Design Change Packages
3.1.11 NMP-ES-041, Minor Design Change Packages
3.1.12 NMP-ES-031, Oversight of Margin Management Process
3.1.13 NMP-ES-033, Setpoint Control Program
3.1.14 NMP-ES-033-001, Setpoint Control Program Graded Approach
3.1.15 NMP-ES-033-GL01, Setpoint Control Program Definitions
3.1.16 NMP-ES-033-GL04, Vogtle Setpoint Control Program Database

3.2 United States Nuclear Regulatory Commission (NRC) Regulations

3.2.1 NRC Regulatory Guide 1.105 Revision 1, Instrument Setpoints for Safety-Related Systems
3.2.2 NUREG 0700, Human Factors

3.3 American National Standards Institute (ANSI) Standards

3.3.1 ANSI B31.1.0, 1967, Power Piping with 1971 Addenda

3.4 Institute of Electrical and Electronic Engineers (IEEE) Standards

3.4.1 IEEE-279, 1971, Criteria for Protection Systems for Nuclear Power Generating Stations
3.4.2 IEEE-308, 1974, Criteria for Class 1E Electrical Systems for Nuclear Power Generating Stations
3.4.3 IEEE-338, 1975, Criteria for the Periodic Testing of Nuclear Power Generating Station Protective Systems

3.5 Instrument Society of America (ISA) Standards

3.5.1 ISA-S67.01, 1994, Transmitter and Transducer Installations for Nuclear Safety Applications
3.5.2 ISA-S67.02, 1996, Nuclear Safety Related Instrument Sensing Line Piping and Tubing Standard
3.5.3 ANSI/ISA-67.04.01-2000, Setpoints for Nuclear Safety-Related Instrumentation
3.5.4 ISA-RP67.04.02-2000, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation
3.5.5 ISA-TR67.04.09-2005, Graded Approaches to Setpoint Determination

3.6 Westinghouse Information

3.6.1 WCAP-07627, SOLID STATE LOGIC PROTECTION SYSTEM DESCRIPTION (1/2X6AA10-00015)
3.6.2 WCAP-07706, EVAL OF SOLID STATE LOGIC REACTOR PROTECTION IN ANTICIPATED TRANSIENTS (1/2X6AA10-00088)
3.6.3 WCAP-10033, Dynamic Analysis of RV for Post LOCA (1X6AA10-00115)
3.6.4 WCAP-10271, Evaluation of Surveillance Frequency and Out of Service Time for RPS and ESFAS (1/2X6AA10-10016)
3.6.5 WCAP-10615, Process Control System Scaling Manual (1/2X6AA10-00132/133)
3.6.6 WCAP-11269, Setpoint Methodology for Protection Systems (1/2X6AA10-00149)
3.6.7 WCAP-11270, Setpoint Methodology for Protection Systems (1/2X6AA10-00150)
3.6.8 WCAP-11325, STEAM GENERATOR LOW WATER LEVEL PROTECTION SYSTEM MOD TO REDUCE FEEDWATER RELATED TRIP (1/2X6AA10-00177)
3.6.9 WCAP-11338, THE NUCLEAR DESIGN AND CORE PHYSICS CHARACTERISTICS (1X6AA10-00157 & 1X6AA10-10013)
3.6.10 WCAP-11342, MODIFICATION OF THE STEAM GENERATOR LOW LOW LEVEL TRIP SETPOINT (1/2X6AA10-00178)
3.6.11 WCAP-11368, GENERIC METHODS AND CIRCUIT DESIGNS FOR TESTING ANALOG PROTECTION CHANNELS (1/2X6AA10-00179)
3.6.12 WCAP-11436, AMSAC GENERIC DESIGN PACKAGE (1/2X6AA10-00183)
3.6.13 WCAP-11462, TRIP REDUCTION AND ASSESSMENT PROGRAM (1/2X6AA10-00184)
3.6.14 WCAP-11640, COLD OVERPRESSURE MITIGATION SYSTEM DELETION REPORT (1/2X6AA10-10055)
3.6.15 WCAP-11737, LOW TEMPERATURE OVER PRESSURIZATION (1/2X6AA10-10053)
3.6.16 WCAP-11882, LICENSING GUIDELINES FOR STEAM GENERATOR LOW WATER LEVEL PROTECTION SYSTEM TRIP REDUCTION (1/2X6AA10-10046)
3.6.17 WCAP-12460, Revised Thermal Design Procedure Instrument Uncertainty Methodology (AX6AA10-00220)

3.6.18 WCAP-12788, RTD Bypass Elimination Licensing Report (AX6AA10-00219)
3.6.19 WCAP-12111, RCS LEVEL GRADIENTS (1/2X6AA10-10064)
3.6.20 WCAP-13117, NSSS Rerating Engineering Report (1/2X6AA10-30029)
3.6.21 WCAP-13869, Power And RCS Flow Uncertainties Using a Steam Flow Indication to Replace the Feedwater Flow Indication (AX6AA10-00221)
3.6.22 WCAP-14040, Methodology used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves
3.6.23 WCAP-14620, 7300 PRINTED CIRCUIT CARD REVISION HISTORY (AX6AU01-01095)
3.6.24 WCAP16115, Steam Generator Level Uncertainty Program
3.6.25 Precautions, Limitations and Setpoints for NSSS (1/2X6AA04-00030)
3.6.26 Westinghouse Functional System Requirements

4.0 Definitions

Definitions are included in Appendix A of this procedure, although reference may be made to various terms established through other procedures, documents or processes.

Other definitions are located in NMP-ES-033-GL01

5.0 Responsibilities

Although this procedure may discuss various actions and responsibilities in a general way, this procedure is not a source document for such and does not assign specific responsibilities.

6.0 Process Description

6.1 Setpoint Uncertainty Calculations

6.1.1 Scope & Purpose

3.6.1 Setpoint uncertainty calculations are generated under the general SNC project guidance for formal calculations. Vogtle-specific uncertainty calculations are based on process measurement, environmental effects, calibration frequency, calibration methods and M&TE specified in maintenance procedures, installed instrumentation, sensor and rack drift, and associated scaling assumptions. Each calculation documents all applicable uncertainty terms for a given instrument loop, summarizes the results of the calculation, and compares the results in terms of margin for a given setpoint to the established analytical limits. This comparison quantifies the margin available for the subject application. If the resultant margin is inadequate, then either the setpoint and/or the analytical limit(s) is (are) changed. If the resultant margin is a low margin condition, then provide input into NMP-ES-031, "Oversight of Margin Management Process." Refer to Attachment 1 for more complete background and basis of scope.

The VNP Setpoint Uncertainty Program scope includes:

- Selected setpoints and specific limits associated with the Technical Specifications such as RTS and ESFAS functions and DNB surveillance limits;

- Setpoints and system process values (i.e., indicated limits) associated with operator actions as directed by the Emergency Operating Procedures (e.g., RCS wide range pressure, Containment Sump level, etc.); and

- Certain instrumentation setpoints, which cannot be justified by engineering judgment and operating experience, designated as important to safety or plant reliability (e.g., an instrumentation modification or setpoint change covered by plant design change).

Future instrument modifications will be evaluated and when necessary, engineering will perform an uncertainty calculation or document the basis for not requiring such calculations following a "graded approach". To ensure appropriate engineering interface, scaling documentation will normally be provided for instrument loops included within the uncertainty calculation program.

Uncertainty methodology is based on the square root of the sum of the square method (SRSS). The determination of what terms are needed in the calculation along with the dependence or independence determination of these terms must be evaluated on a case-by-case determination. Appendix A and B provide standard methodology used by Westinghouse and Betchel that are both used for Vogtle.

Appendix A contains standard uncertainty methodology for evaluating instrument/loop uncertainties. This standard methodology is based on ISA standards and closely mirrors the Westinghouse methodology for determination of instrument uncertainties. Administrative controls incorporated into SNC procedure guidance, as well as plant procedures, address requirements in order to maintain current uncertainty calculations and adequate safety margins.

Appendix B contains another uncertainty methodology that can be used. This standard methodology is based on Bechtel Power Corporation. SCS and Bechtel used this methodology to create uncertainty calculations.

While Appendix A & B are the latest methodology, uncertainty calculations were created using earlier versions of these standards. The creation of new uncertainty calculation should use methodology in Appendix A. The originator of updates to uncertainty calculation is encouraged to bring the calculation up to the latest standard. Justification for not bring the calculation to the latest standard will be provided.

6.1.2 Documentation

The uncertainty calculation methodology described in Appendix A & B is to be documented using a calculation cover sheet and other calculation requirements (numbering, review, approval, etc.) as required by NMP-ES-039-001, Calculation Preparation and Revision. The format and technical content requirements for these documents are contained in Appendix B.

Documentation and/or use of the methodology contained in Appendix A & B are intended to apply to safety-related systems; however, it may be utilized for non-safety related systems.

Any new calculations created for instrumentation must also be reflected in MP5 in the Equipment Workbench. Calculation numbers will be added to MP5 by the preparer of the documents. These are located in the “Calculation Info” Field by selecting the “More Details” Tab on the “Record View” Screen.

6.1.3 Setpoint Uncertainty Calculation Process

Uncertainty calculations are generated for instrumentation according to the program scope discussed in NMP-ES-033. The calculations are generated in the same manner as all formal project calculations per the requirements set forth in NMP-ES-039-001. Using the methodology described in Appendix A & B, the responsible individual shall establish the design bases involving analytical/safety and operating limits, establish the uncertainty terms, perform the calculation and compare the uncertainty results with the limits to establish the safety or operating margin available. If another method is used to calculate uncertainty, the method and the justification for the use of the method shall be documented in the calculation.

Typically, the system/equipment designers provide the analytical and operating limits while the safety analyses analyst supplies safety limits based on the safety analyses assumptions.

The uncertainty allowances are normally based on Vogtle-specific calibration methods, M&TE, drift, operating environment, specific instrumentation, and scaling assumptions, supplemented by manufacturer specifications and industry data as necessary.

Consistent with a “graded approach,” less rigorous calculations are acceptable for safety functions that do not provide protection to core safety limits and for non-safety related functions. NMP-ES-033-001, “SETPOINT CONTROL PROGRAM GRADED APPROACH,” describes the process used for SNC to grade instrumentation. NMP-ES-033-GL04, “VOGTLE SETPOINT CONTROL PROGRAM DATABASE,” then documents the instrument grade and supporting documents required for the determined grade.

If the margin is non-conservative, then either the calculation assumptions can be refined, the setpoint can be changed, the analytical/safety limit can be changed based on updated analysis, or the instrumentation and/or calibration method must be modified.

Procedures NMP-GM-007-001 and NMP-ES-039-001 also outline the requirements for the use of computers in calculation work. Utility computer programs, such as word processing and spreadsheets, used to generate an uncertainty calculation are not subject to the documentation requirements of the more sophisticated analytical software; however, the verifier must be assured of proper computer and software performance.

Additionally, where restrictions to the revisions of computer programs, input files, or data bases are necessary to prevent the possibility of introducing errors (e.g., control of the EQ data base), the originator/review will establish the controls for the continued integrity of the information.

6.2 Scaling Documents

Scaling documents are generated to establish and/or document the basis for calibration data used in plant procedures.

6.2.1 Most scaling is considered "skill of the craft" for Instrumentation and Control Technicians in the Instrument Maintenance Departments. Therefore, Scaling Documents are not produced for all instrumentation. The following are examples of instrumentation loops that should be considered for formal scaling documentation.

- RTS and ESFAS instrumentation channels
- Complex instrumentation channels with non-standard calibrations
- Key NSSS control systems modeled in control system and/or safety analyses (e.g., rod speed, pressurizer level & pressure, steam dump, and SGFP speed)
- Instrument channels supported by instrument uncertainty calculations (e.g., RTS setpoint, RTDP input parameter, and EOP indicated setpoints)
- Certain other instrumentation channels and control loops identified by the plant or corporate staff
- Grade 1 Instruments

6.2.2 Formal Scaling Documents are produced and processed through the use of this Instruction and the accompanying design and engineering procedures (such as NMP-ES-050, and NMP-ES-041); however, this procedure does not dictate that a formal Scaling Document be produced for any particular instrument or loop. The concepts presented in this procedure may be useful in any scaling activity, even if not formally documented. Scaling information may be developed independently of this procedure and transmitted through the RER process (NMP-ES-050) or other appropriate processes. Corporate personnel may also be seconded to site organizations for the development of scaling information and the results applied directly to the site I&C calibration procedures.

6.2.3 Scaling documents produced by this procedure must be checked and verified in accordance with NQA-1 prior to publication for site use. Documents should be page numbered.

6.2.4 Scaling documents are controlled as domestic documents per DS-DC-002. Transmittal of draft scaling information (such as proposed changes) is accomplished in accordance with the requirements of the parent process under which the scaling is being developed. (e.g., through the DCP process – as worksheets in accordance with NMP-ES-044 and DS-DC-002; through the MDC process – in accordance with NMP-ES-041; through the RER process – in accordance with NMP-ES-050; or other processes – as appropriate.)

6.2.5 The typical format and technical content guidelines for these documents are shown in Attachment 4. While the preferred section sequence and content are defined, sections may appear in any order and/or the information may be presented at any level of detail necessary to support understanding of the loop and to communicate the scaling information to the plant site. More detailed discussions and recommendations for each section are provided in Attachment 4.

6.2.6 The Scaling Document scope should include all instrumentation (sensors, signal conditioners, isolators, comparators, indicators, etc.) in a given loop or channel. The scaling calculations should provide "bench" calibration values for the channel sensor, alarm/trip comparators, controllers and dynamic compensation modules, and when required, "string" calibration values for periodic surveillance and/or calibration of the rack modules. Scaling for pressure, level, and flow sensors should include appropriate hydrostatic head correction and density compensation factors. When a given plant curve (e.g., tank curves, operating procedure curves) is a function of the instrument channel scaling, the Scaling Document should include such curve(s) to ensure the plant curve is maintained up-to-date with the current scaling calculations and calibration procedures.

6.2.7 The majority of the source Scaling Documents consist of manually created text documents (referred to as "Native" documents) using Microsoft Word and/or Microsoft Excel. These documents are maintained on shared server disk areas for each Plant. The controlled copy is maintained in Documentum as a PDF format that is usually produced after confirmation of site implementation through an ABN. Native documents should always be revised first, and the controlling Documentum PDF file created from the Native documents.

Storage Area
\\southernco.com\shared data\Workgroups\SNC Southern Nuclear\Corporate\TechSupp\Eng\Products\Scaling

6.2.9 All Scaling Documents produced by this procedure are assigned a document number in the same format as the plant domestic drawing numbers. This document number format was selected at the request of SNC to allow both corporate and site access to the documents through Documentum. New drawing numbers are assigned by the SNC corporate Design Configuration group in accordance with procedure DS-DC-002 and Design Criteria DC1000G.

6.2.10 Any new Scaling Document created for instrumentation should be reflected in MP5 in the Equipment Workbench. Calculation numbers, as well as Scaling Document numbers, should be added to MP5. These are located in the "Calculation Info" Field by selecting the "More Details" Tab on the "Record View" Screen.

6.2.11 Scaling Documents are typically developed and maintained by SNC corporate Design Support I&C engineering personnel. Scaling Documents may be changed by other SNC departments including plant site Engineering Support and Maintenance. Scaling documents generated or changed by other SNC departments should be checked (i.e., reviewed) and approved by SNC corporate engineering. "Preliminary" or "draft" documents should be issued via a formal correspondence process or through a design change process.

6.2.13 Scaling Document changes required to support a design change should be processed in conjunction with the DCP/MDC, and issued as multi-sheet worksheets. Some changes to Scaling Documents and/or plant calibration procedures may not be considered to be a change to the facility, license, or design basis. Such changes do not constitute a design change; therefore, no DCP/MDC is required. Examples might include those changes that conform to the various setpoint documents/indexes and the Westinghouse PLS for Vogtle NSSS.

6.2.14 Draft Scaling Documents are normally transmitted to plant site Engineering Support or I&C Maintenance for review. Upon completion of plant review, applicable calibration procedures are updated. Following performance of calibration procedures, any applicable testing or documentation review, SNC site Engineering Support, Maintenance, or Site Design should submit an ABN to indicate implementation of the scaling. In this step, the site has the opportunity to indicate on the "preliminary" scaling any changes made during the implementation of the new scaling. The receipt of the ABN by SNC corporate engineering provides positive feedback that the scaling has been implemented. This process assures the accuracy of the Scaling Documents in representing the actual calibration conditions of the plant instrument loops.

6.2.15 Changes to Scaling Documents made by the plant staff should be indicated by providing Scaling Document mark-ups with the ABN.

6.2.16 Normally, new Scaling Documents are created under the request for engineering review process or through a design change process. In these cases, the "preliminary" Scaling Document should be transmitted with an RER response or through DCP worksheets. Once the scaling has been incorporated in the plant calibration procedures and implemented in the instrumentation, the plant responds with an as-built notice (ABN) to SNC corporate engineering. Upon completion of the ABN process, the "Version 1.0" Scaling Document is added to Documentum as QA Record.

6.2.17 New or revised Scaling Documents may be required to support a design change package. These documents are included in the DCP worksheets in "preliminary" form. In addition to the normal engineering reviews, the plant staff should review preliminary Scaling Documents. Following resolution of comments and issuance of the DCP, the plant staff should update their calibration procedures and implement the new/revised scaling values.

6.2.18 If the design change impacts setpoints or instrument channels in the original Westinghouse NSSS scope, RTS/ESFAS, RTDP parameters, Westinghouse should provide documented concurrence of any changes with reference to any impacted design basis, uncertainty calculations, license reports, or WCAPs. This review should be referenced as support documentation in the RER/DCP/ABN package.

6.2.18.1 If required, the scaling values are validated with performance testing following/during unit start-up and power ascension to ensure the revised calibration values are acceptable

6.2.18.2 For the DCPs, the Scaling Document update process is similar to other design drawings impacted by the DCP implementation. The site should submit a DCP-related ABN to indicate the final as-left configuration. Upon receipt of the ABN, SNC corporate engineering should revise the impacted documentation including the Scaling Document.

6.2.19 Routine cycle-specific scaling support is done to support maintenance activities and is usually facilitated via the request for engineering review (RER) process. Since cycle-specific scaling is solely used for maintenance activities and does not involve design analysis, this activity does not require the design control requirements of the SNC QATR or NQA-1. Such support includes scaling document revisions (i.e., updates) based on plant data measurements, normalization of RTS/ESFAS and NSSS system instrumentation, control system tuning, or cycle-specific target values for parameters such as the full power best estimate Tref and indicated median Tavg. These new target values are incorporated into "preliminary" scaling documents and sent to the site for review. Included with the scaling document will be a draft ABN, generic Applicablility Determination checklist and a 10CFR50.59 Screening / Evaluation associated with the changes.

6.2.19.1 When control system tuning results in changes to the dynamic calibration values specified in a Scaling Document, then the plant staff is required to provide the as-left calibration values using a ABN. The as-left values should be obtained based on circuit/module performance under controlled calibration conditions. Typically, this requires recording the as-left circuit output response to a defined input test signal and calculating the circuit dynamic settings (i.e., gain, reset, and rate). The specific as-left calibration values should also include applicable thumb wheel setting, toggle switch position, and/or jumper configuration. The ABN process is appropriate in these situations since plant testing provides the basis for scaling/calibration and demonstrates acceptable control loop performance.

6.2.19.2 On Vogtle, since all NSSS setpoints and most NSSS control system dynamic settings are listed in the Westinghouse PLS, ABN packages associated with scaling changes resulting from Technical Specifications amendments or control system tuning should also include applicable PLS markups.

6.3 Documentation

6.3.1 During development/ revision of uncertainty calculations or scaling documentation for elevation-sensitive instruments, precise mounting details are necessary, particularly for Technical Specification related instruments. If the instrument elevation information is questionable or does not exist, a survey will need to be performed by the plant. A condition report (CR) will be generated in the plant database to request that a work order to be created to perform the survey. Information in the CR and the work order should include at a minimum the instrument tag number(s), need date and the individual to be contacted with the completed survey data. It must also be stipulated that the survey data is required to be recorded on the work order and signed as verified by a second qualified individual so the data can be used as a qualified design input. The work order number will then be listed as an input or reference in the document being revised or created. Any documents such as installation details, isometrics, or vendor documents that contain configuration details of the instrument should be revised via an ABN to include the new elevation information, as appropriate.

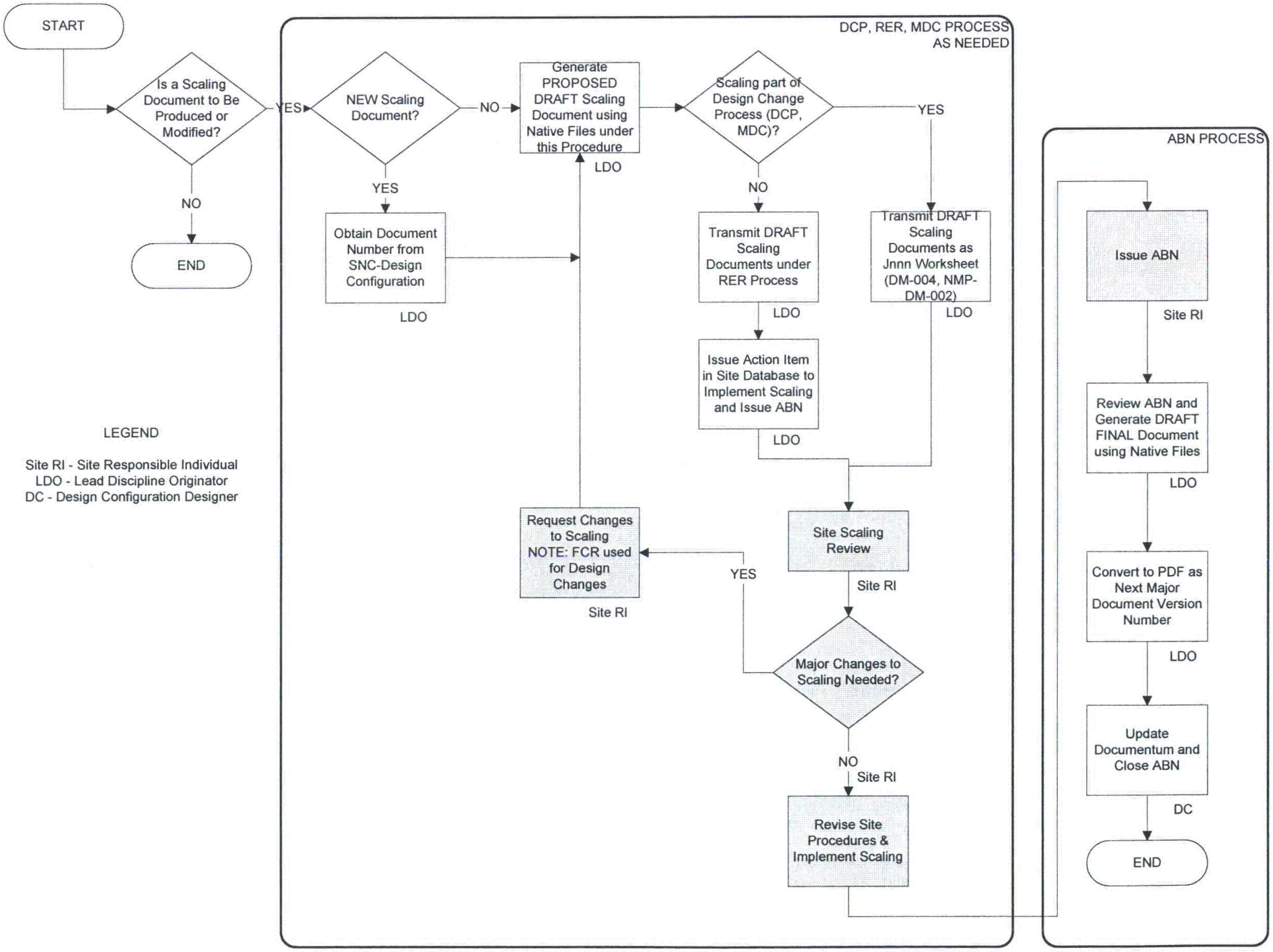
7.0 Records

This procedure does not directly generate Quality Assurance records. It does provide a format for documents that will become domestic drawings in accordance with DS-DC-002. Preliminary (draft) scaling documents are processed with their associated engineering activities, e.g. DCP, MDC etc.

8.0 Commitments

None.

Attachment A – Scaling Document Flowchart



LEGEND

Site RI - Site Responsible Individual
LDO - Lead Discipline Originator
DC - Design Configuration Designer

Appendix A – Westinghouse Based Setpoint Uncertainty Calculation Methodology

TABLE OF CONTENTS

SETPOINT UNCERTAINTY CALCULATION METHODOLOGY

A.1 Introduction

The purpose of this Appendix is to provide background for the instrument loop uncertainty calculation and other calculations described within. This methodology results in calculations, based on the limits of associated with specific instrument loops. These calculations combine instrumentation uncertainty/process measurement and calibration allowances to determine indication and/or available setpoint margin to applicable analytical or safety limits.

A.2 Scope

This methodology derives from ISA S67.04, Part 1 and follows the Westinghouse Setpoint Methodology for Protection Systems - Vogtle Units 1 and 2, as it applies to process trip actuation setpoints. However, ISA P67.04, Part 2 and Westinghouse apply this methodology to indicated action points in the EOP setpoint calculations and selected Technical Specification limits. Therefore, this methodology will also be utilized to determine instrument loop accuracy for indicators and computer indications. This methodology will provide guidelines to:

- Establish the method to apply instrument inaccuracies to determine an instrument loop uncertainty.
- Define and establish instrument loop setpoints and setpoint limits for final actuation devices.
- Define instrument loop accuracy value for indicator loops and utilize these results to establish limits for indicators.
- Define instrument loop accuracy value for computer loops and utilize these results to establish limits for computer readouts.

To ensure that the program is effective and economical, a limited scope program is maintained with selected instrumentation added on a case-by-case basis. The Vogtle Setpoint Uncertainty Program scope includes:

- Selected setpoints and specific limits associated with the Technical Specifications such as RTS and ESFAS functions (e.g., Pressurizer high-pressure reactor trip setpoint, RCS DNB high temperature limit, diesel generator fuel oil day tank minimum level limit, etc.),
- Setpoints and system process values associated with the Emergency Operating Procedures (e.g., RCS wide range pressure, containment sump level, etc.), and
- Certain instrumentation setpoints, which cannot be justified by engineering judgment and operating experience, designated as important to safety or plant reliability (e.g., instrumentation modification or setpoint change covered by plant design change).

Note: Class 1E instruments used to generate alarm actuations or other a system function not required by safety analyses are not required to use this methodology per Regulatory Guide 1.105. However, this procedure may be applied for any setpoint or indicator accuracy calculation as deemed appropriate.

General assumptions in the development of the program scope include the following:

- Uncertainty allowances assumed in setpoint calculations are based on existing calibration procedures, measuring and test equipment, test frequencies, and installed plant instrumentation.

- Instrumentation modifications and setpoint changes will be implemented utilizing the enhanced plant and designer administrative controls developed under this program.

- Plant and engineering personnel implementing and maintaining the program will be knowledgeable of setpoint uncertainty calculation methods and certain fundamental assumptions, such that applicable modifications/changes will be properly assessed for potential impact on the documented uncertainty calculations.

More specific assumptions used in the development of uncertainty calculations are contained in Attachment 1 to this procedure.

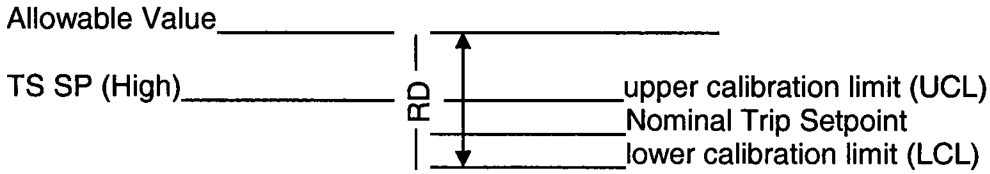
A.3 Definitions

A.3.1 Accuracy Rating - In process instrumentation, a number or quantity that defines a limit that error will not exceed when a device is used under specified operating conditions.

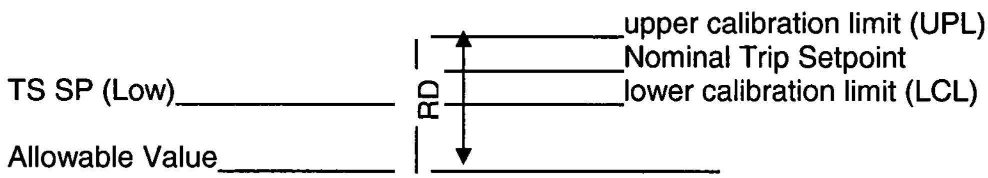
A.3.2 Allowable Value (AV) - AV applies only to reactor protection or ESF actuation function. The AV is a limiting value provided in the Technical Specifications that allows for deviation of the "as found" setting from the Nominal Trip Setpoint during calibration. The magnitude of the AV accounts for a two-sided rack calibration accuracy (RCA) and rack drift (RD) from the most conservative allowed "as left" setting during calibration. A bistable trip setpoint found non-conservative with respect to the AV requires appropriate action by plant operating personnel.

The AV is limited to the magnitude of the RD, as measured from the furthest distant calibration limit. Therefore, an "as found" value less than the AV will always have a RD magnitude less than or equal to that assumed in the uncertainty calculation.

Example of a increasing parameter function: AV =LCL + RD



Example of a decreasing parameter function: AV = UCL- RD



On subsequent surveillance, an "as found" value less than or equal to the AV (high actuation function) provides assurance that the channel process rack drifted less than the RD value in the function uncertainty calculation. Satisfaction of this parameter does not per se demonstrate channel operability but rather that an assumption of the uncertainty calculation used to determine the acceptability of the TS is still valid. At the time the measurement was performed, a reasonable expectation of the transmitter performance, as verified by periodic channel checks, and the "as found" condition of the process racks in conjunction with the functional testing would conclude that the SAL would have been satisfied. However, based on historical data, an "as found" value near or exceeding the AV would be considered an unusual condition and warrant further investigation; therefore, the TS action statements must be followed when a channel is found exceeding the AV.

Following channel calibration, the rack surveillance necessary to satisfy the TS during the operating cycle is either the performance of a Analog Channel Operational Test (ACOT) or a Trip Actuating Device Operational Test (TADOT). For each ACOT or TADOT, the trip setpoint is determined by measuring the magnitude of the signal injected at the input to the process racks which provides actuation of the bistables at the output of the process rack. The following three criteria are applicable to these tests.

1. If the "as found" TS SP is within the RCA, the channel is operable and no action is required.
2. If the "as found" TS SP is greater than the RCA, but less than the AV, the channel may be operable, but must be recalibrated to within the RCA. Presuming the channel can be calibrated, it would then satisfy the calibration criteria and an off-line evaluation of the drift magnitude can confirm that the channel is functioning as expected. Repeated occurrences of a given channel being found outside RCA must be evaluated. If the drift magnitude is greater than expected, further investigation of the channel is warranted. This investigation may include additional surveillance at a shorter interval or additional testing of the channel.
3. If the "as found TS SP is greater than the AV, the channel is declared inoperable and appropriate action shall be taken. The channel is not considered operable until the "as left" TS SP is within RCA. Even if the channel can be calibrated, the magnitude of drift

experienced is unusual and should warrant further consideration. This investigation may include additional surveillance at a shorter interval or additional testing of the channel.

In all cases, the difference between the AV and the TS SP must be at least as large as the rack calibration accuracy (RCA), and if it is not, then the Trip Setpoint must be adjusted.

A.3.3 Analytical Limit (AL) - Limit of a measured or calculated variable established by engineering to ensure that a safety, process, and/or mechanical limit is not exceeded. The analytical limit can be established based on plant operating experiences, vendor data, or original design criteria.

A.3.4 As Found - is the condition in which a sensor, process rack module or process instrument loop is found after a period of operation.

Example: *After a period of operation a sensor was found to deviate from the ideal "as left" condition by +0.5% span. The +0.5% span would be the "as found" condition.*

A.3.5 As Left - is the condition in which a sensor, process rack module or process instrument loop is left after calibration or bistable trip setpoint verification. This condition is better than the calibration accuracy for that piece of equipment.

Example: *The permitted SCA for a transmitter is ±0.5% of span, while the worst measured deviation from the ideal condition (i.e., the specified calibration values) after calibration is +0.1% of span. 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 +0.1% of span.*

A.3.6 Bias - An uncertainty component that consistently has the same algebraic sign and is expressed as an estimated limit of error.

A.3.7 Calibration Accuracy - The two-sided calibration tolerance of a component as reflected in the plant calibration procedures. An additional value added on to the calibration accuracy is permissible in the setpoint uncertainty calculation if the method of calibration or performance monitoring verifies all attributes of the reference accuracy (linearity, hysteresis and repeatability). The calibration accuracy is generally larger than the reference accuracy. The larger value for the calibration accuracy may be substituted for the reference accuracy in the setpoint uncertainty calculation. This will make the reference accuracy equal to zero.

The calibration accuracy is usually based on the reference accuracy of the module being calibrated. However, plant calibration philosophy may specify a different calibration tolerance. The size of the calibration accuracy should be established based on the reference accuracy of the module, the limitations of the technician M&TE in adjusting the module and the need to minimize maintenance time.

A.3.8 Channel Accuracy - The accuracy of an analog channel that includes the accuracy of the primary element and/or transmitter and modules in the loop.

A.3.9 Channel Statistical Allowance (CSA) - Equation that combine process, instrumentation, including sensor, indication, and computer, and rack uncertainties by Square Root of the Sum of the Squares, and includes approximate bias.

A.3.10 Computer Calibration Accuracy (DCA) - DCA is the calibration accuracy or tolerance for a computer based on plant procedures.

A.3.11 Computer Drift (DD) - The change in input-output relationship over a period of time at reference calibration conditions. An example of determination of DD is: for an "as-left" value of +0.1% of span and a subsequent "as found" value of +0.5% of span, the magnitude of the drift would be (+0.5) - (+0.1) = +0.4% of span (in the positive direction).

A.3.12 Computer Measurement and Test Equipment Accuracy (DMTE) - The accuracy of the test equipment used to calibrate a computer in the field or in a calibration laboratory. When the magnitude of DMTE meets the requirements of SAMA PMC 20.1-1973, it is considered an integral part of DCA and is not explicitly included. DMTE values, which are greater than one tenth of the DCA value, are explicitly included in Westinghouse calculations.

A.3.13 Computer Reference Accuracy (DRA) - The basic accuracy published by the manufacturer. DRA includes basic accuracy, conformity, hysteresis, and repeatability of the computer. DRA is introduced into the uncertainty calculation to address repeatability concerns when only performing a calibration (i.e., one up and one down) or to address repeatability and hysteresis when performing a signal pass calibration in only one direction.

A.3.14 Computer Indication/Setpoint Uncertainty Diagram

Analytical Limit

Margin

EA

BIAS

PMA

PEA

Computer Errors

DCA	DRA	DCSA
DMTE	DTE	DD

Sensor Errors

SCA	SRA	SD	SCSA
SMTE	STE	SPE	

Rack Errors

RMTE	RTE	RD
RCSA	RRA	RCA

Indication Value or Setpoint

A.3.15 Computer Temperature Effects (DTE) - The changes in input-output relationship for a sensor due to a change in the ambient environmental conditions (temperature, humidity, voltage and frequency) from the reference calibration conditions. It is assumed that temperature is the most significant of these, with the other parameters being second- order effects.

The DTE uncertainty is considered independent since, when calibrating or determining drift, the process is performed at constant temperature.

A.3.16 Dependent Uncertainty - Uncertainty components are dependent if they possess a significant correlation of interaction.

A.3.17 Drift - An undesired change in output over a period of time. This change is unrelated to the input, environment, or load.

A.3.18 MP5 Equipment Workbench – Syncpower Application that manages Equipment data.

A.3.19 MP5 Equipment Workbench Custom Fields Tab – Computer screen where setpoint information can be obtained. Fields include Setpoint, Reset, Tolerance, and Activation Range. Setpoint and Reset Units should be entered next to the setpoint value (e.g. 30" Increasing, or 14.2 psig). Other information about the instrument is available on selectable screens (tabs) and include drawing and documentation references, and vendor make and model number

A.3.20 Environmental Allowance (EA) - All errors considered when the instrument loop is subjected to the adverse environmental conditions of an accident environment or seismic event. Typically, EA is determined from a conservative set of bounding conditions and may represent any one or combination of the following:

- temperature effects of the sensor or transmitter,
- radiation effects of the sensor or transmitter,
- seismic effects on the sensor or transmitter,
- temperature effects on a level transmitter reference leg,
- temperature effects on signal cable insulation, splices, terminal blocks, connectors and penetration, and/or
- seismic effects on process rack

This information may be found in Equipment Qualification documentation. (CR 2007100724)

A.3.21 Hysteresis - The maximum difference, for the same input, between the up-scale and downscale output values during a full range traverse in each direction.

A.3.22 Independent Uncertainty - Uncertainty components are independent of each other if their magnitudes or algebraic signs are not significantly correlated or interactive.

A.3.23 Uncertainty Diagram (Typical)

Analytical Limit

Margin

EA

BIAS

PMA

PEA

Indicator Errors

ICA	IRA	ICSA
IMTE	ITE	ID

Sensor Errors

SCA	SRA	SD	SCSA
SMTE	STE	SPE	

Rack Errors

RMTE	RTE	RD
RCSA	RRA	RCA

Indication Value or Setpoint

A.3.24 Indicator Accuracy - The band containing the highest expected value of the difference between the value of a process variable read on an indicator or recorder, and the actual value of that process variable. The accuracy includes channel accuracy, accuracy of read-out devices, and rack environmental effects, but not process measurement accuracy.

A.3.25 Indicator Calibration Accuracy (ICA) - ICA is the calibration accuracy or tolerance for the indication based on plant procedures.

A.3.26 Indicator Drift (ID) - The change in input-output relationship over a period of time at reference calibration conditions. An example of determination of ID is: for an "as-left" value of +0.1% of span and a subsequent "as found" value of +0.5% of span, the magnitude of the drift would be (+0.5) - (+0.1) = +0.4% of span (in the positive direction).

A.3.27 Indicator Measurement and Test Equipment Accuracy (IMTE) - The accuracy of the test equipment used to calibrate the indication device in the field or in a calibration laboratory. When the magnitude of IMTE meets the requirements of SAMA PMC 20.1-1973, it is considered an integral part of ICA and is not explicitly included. IMTE values, which are greater than one tenth of the ICA value, are explicitly included in Westinghouse calculations.

A.3.28 Indicator Reference Accuracy (IRA) - The basic accuracy published by the manufacturer. IRA includes basic accuracy, conformity, hysteresis, and repeatability of the indication device. IRA is introduced into the uncertainty calculation to address repeatability concerns when only performing a calibration (i.e., one up and one down) or repeatability and hysteresis when performing a single pass calibration in only one direction.

A.3.29 Indicator Readability (IR) – The most accurate reading attainable from an analog scale by the operator. The generally accepted industry assumption for this value equates to one-half of the smallest increment on the indicator. The value of IR is given in terms of % of full indicator span.

A.3.30 Indicator Temperature Effects (ITE) - The changes in input-output relationship for the indication device due to a change in the ambient environmental conditions (temperature, humidity, voltage and frequency) from the reference calibration conditions. It is assumed that temperature is the most significant of these, with the other parameters being second-order effects.

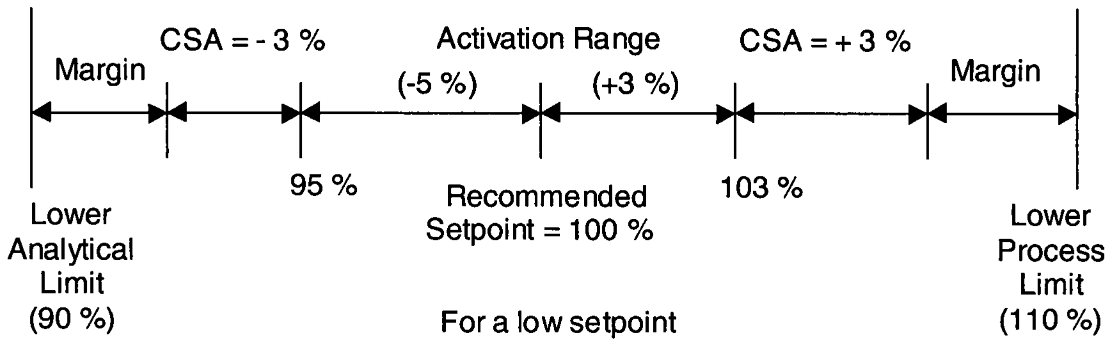
The ITE uncertainty is considered independent since when calibrating or determining drift, the process is performed at essentially constant temperature.

A.3.31 Limiting Safety System Settings (LSSS) - Settings for automatic protective devices related to those variables having significant safety functions (see 10 CFR 50.36). In the Westinghouse setpoint methodology as applied to Vogtle, the Technical Specification trip setpoint is the LSSS.

A.3.32 Linearity - The closeness to which a curve approximates a straight line. It is usually measured as a non-linearity and expressed as linearity.

A.3.33 Lower Analytical Limit (LAL) - Low Limit of a measured or calculated variable established by engineering to ensure that a safety, system, and/or mechanical limit is not exceeded. LAL applies to a low bistable setpoint.

Example:

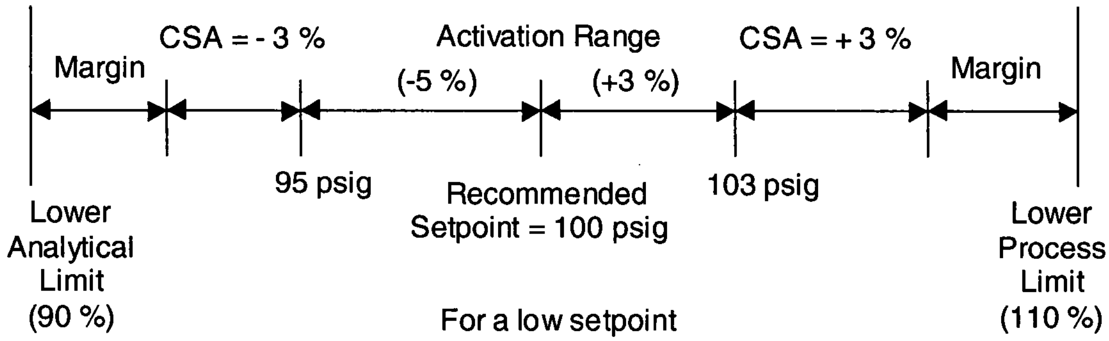


A.3.34 Lower Calibration Limit - The resultant value when the RCA for the specific loop under consideration is subtracted from the Nominal trip setpoint.

TS SP (High) ______ ____________UCL
↑ + RCA ____Nominal Trip Setpoint
↓ - RCA ____LCL

A.3.35 Lower Process Limit (LPL) - Low Limit of a measured or calculated variable established by engineering to ensure that a process limit is not exceeded. The purpose of LPL is to prevent overlap with another setpoint. LPL applies to a low bistable setpoint.

Example:



A.3.36 Margin - The difference between the Total Allowance (TA) and the Channel Statistical Allowance (CSA). M=TA-CSA. Margin moves the setpoint further away from the analytical limit.

A.3.37 Measurement and Test and Equipment Uncertainty (M&TE) - The accuracy of the measurement standards and various test equipment used in the calibration of the devices and instrument loops. Refer to Attachment 3 of this guide for standard M&TE uncertainty values. Vogtle uses the minimum criteria accuracy ratio of 1.5:1 between the test equipment and the unit under test.

SAMA standard PMC 20.1-1973 implies that test equipment, which is 10 times more accurate than the calibration accuracy of the tested device need not be included in the uncertainty calculation, identified in Section A.4.

- For those cases where the M&TE meets SAMA standard PMC 20.1-1973 with regards to allowed exclusion from the uncertainty calculation identified in Section A.4, the M&TE uncertainty can be assumed 0%.
- For those cases which do not meet this exclusion test (typically M&TE for sensors), explicit M&TE uncertainties are included in the uncertainty calculation identified in Section A.4.

A.3.38 Module - An assembly of interconnected components, which constitutes an identifiable device, instrument, or piece of equipment.

A.3.39 Nominal Trip Setpoint - is the nominal value to which the bistable or switch is set ("as left") utilizing the Technical Specifications Trip Setpoint (TS SP) in the conservative direction by the magnitude of the Rack Calibration Accuracy (RCA). The Nominal Trip Setpoint is not the same as the TS SP. The Nominal Trip Setpoint is the specified target value at the midpoint of the calibration limits.

The "as left" value, per the Vogtle I&C calibration procedure, should be as close as reasonably possible (at or near) to the Nominal Trip Setpoint and must be within the Upper and Lower Calibration Limits. When satisfying these conditions, the field setting will always be equal to or conservative with respect to the TS SP, and thus the inequalities associated with the TS SP will be satisfied.

TS SP (High)________	__________	UCL
	↑ + RCA	Nominal Trip Setpoint
	↓ - RCA	LCL

Example *Lo-Lo T_{avg} Setpoint (Increasing T_{avg} & RCA = 0.3%)*

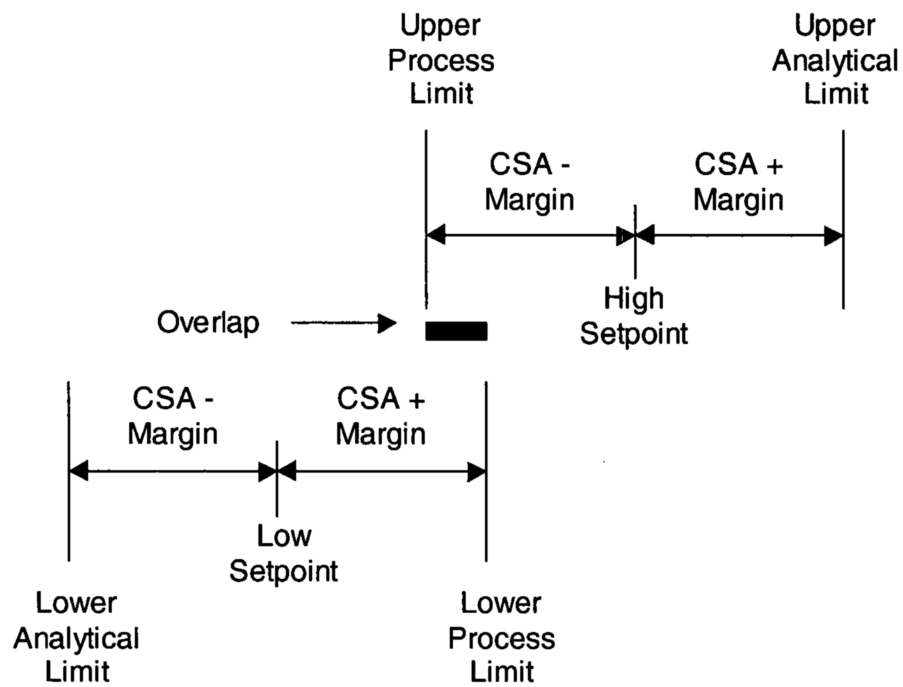
TS SP and calibration procedure upper limit	*545°F*
Nominal Trip Setpoint	*544.7°F*
Calibration procedure lower limit	*544.4°F*

	__________	UCL
	↑ + RCA	Nominal Trip Setpoint
TS SP (Low)________	↓ - RCA	LCL

Example *Lo-Lo T_{avg} Setpoint (Decreasing T_{avg} & RCA = 0.3%)*

Calibration procedure upper limit	*543.6°F*
Nominal Trip Setpoint	*543.3°F*
TS SP and calibration procedure lower limit	*543°F*

A.3.40 Overlap - A condition where the range of a setpoint with CSA and margin taken into consideration interposes with a range of a different setpoint with CSA and margin taken into consideration.



One purpose of the setpoint uncertainty program is to prevent an overlap condition between setpoints when CSA and margin are taken into consideration.

A.3.41 Primary Element Accuracy (PEA) - Errors due to use of a metering device, e.g., venturi, orifice plate or elbow. Typically, this error is a calculated or measured accuracy for the device. PEA is considered to be independent of both sensor and rack parameters. PEA is treated as a random independent parameter.

A.3.42 Process Loop - The process loop (or instrument process loop) refers to all equipment associated with a single channel of a protection or non-protection function. The process loop usually consists of a sensor, a process rack (signal conditioner) or power supply, comparator, and indicator/computer/control output. The driving force of the process loop can be electrical or pneumatic.

A.3.43 Process Measurement Accuracy (PMA) - This error provides allowances for the non-instrument related effects, which have a direct bearing on the accuracy of an instrument channel's reading. PMA includes plant variable measurement errors up to but not including the sensor and rack parameters. PMA effects are normally associated with system operating characteristics, e.g., neutron flux, calorimetric, power uncertainty assumptions, fluid density changes or temperature stratification assumptions. PMA is considered to be an independent parameter. For a given process measurement, the PMA may consist of more than one independent uncertainty allowance. PMA can be treated as a bias.

A.3.44 Process Rack(s) - The analog or digital module or modules downstream of the transmitter or sensing device that power the process loop and/or conditions and act upon a signal.

For Westinghouse process systems, the Process Racks include all the equipment contained in the process equipment cabinets (i.e., the analog downstream of the transmitter or sensing device,

Safety Analysis Limit

Margin

EA

BIAS

PMA

PEA

Sensor Errors
SCA SRA SD SCSA
SMTE STE SPE

Rack Errors
RMTE RTE
RCSA RRA

Allowable Value

RD

TS SP (High)

UCL

↑ + RCA TS Nominal Trip Setpoint

↓ - RCA LCL

which condition a signal and/or act upon it prior to input to a voting logic system, annunciation system, indication system, or computer system). These modules include electronic circuits such as conversion resistors, transmitter power supplies, R/Es, lead/lag, rate or lag function generators, summators, isolators and bistables for analog functions. The Process Racks include the protection channels of the Nuclear Instrumentation System, 7300 Process Protection System, and the RCP and ESF Electrical Switchgear.

A.3.45 Protection and ESF Setpoint Error Diagram -

A.3.46 Rack Calibration Accuracy (RCA) - RCA is the two-sided calibration tolerance of the process racks as reflected in the plant calibration procedures.

For Westinghouse supplied process instrumentation, it is assumed that the individual modules in a loop are calibrated to a particular tolerance and that the process loop as a string is verified to be calibrated to a specific tolerance. This forces calibration of the process loop in such a manner as to exclude a systematic bias in the individual module calibrations, i.e., as left values for the individual modules must be compensating in sign and magnitude when considered as an instrument string.

A.3.47 Rack Comparator Setting Accuracy (RCSA) - The trip setpoint tolerance on the exact value to which a comparator bistable trip may be set. Plant procedures define the setting tolerance of the bistable. At Vogtle, calibration of the bistable is included as an integral part of the rack calibration, i.e., string calibration. This does not preclude calibration of the bistable module by itself, because the "as-left" condition is always verified through the rack string of modules.

For Westinghouse supplied 7300 process instrumentation which are string calibrated through the bistable, the rack calibration accuracy (RCA) identified in plant procedures can encompass the accuracy associated with RCSA effects without an additional allowance. When this is the case, RCSA = 0% of span in the uncertainty calculation.

A.3.48 Rack Drift (RD) - The change in the input-output relationship of the rack over a period of time at reference conditions. An example of determination of RD is: for an "as-left" value of +0.1% of span and a subsequent "as found" value of -0.5% of span, the magnitude of the drift would be (-0.5) - (+0.1) = -0.6% of span (in the negative direction).

A.3.49 Rack Measurement and Test Equipment Accuracy (RMTE) - The accuracy of the test equipment used to calibrate a process loop in the racks. When the magnitude of RMTE meets the requirements of SAMA PMC 20.1-1973, it is considered an integral part of RCA and is not explicitly included. RMTE values, which are greater than one tenth of the SCA value, are explicitly included in Westinghouse calculations

A.3.50 Rack Reference Accuracy (RRA) - RRA is the reference accuracy as defined by SAMA Standard PMC 20.1-1973 for a process loop string. It is defined as the accuracy rating that is achievable by the instrument string as specified in the manufacturer's specification sheets. RRA includes conformity, hysteresis, and repeatability.

For Westinghouse supplied 7300 process instrumentation, the calibration tolerance (RCA) identified in plant procedures can encompass the hysteresis and repeatability effects without an additional allowance. When this is the case, RRA = 0% of span in the uncertainty calculation.

A.3.51 Rack Temperature Effects (RTE) - Change in input-output relationship for the process rack module string due to a change in the ambient environmental conditions (temperature, humidity, voltage and frequency) from the reference calibration conditions. It is assumed that temperature is the most significant of these, with the other parameters being second order effects. For Westinghouse supplied process instrumentation, a value of ±0.5% of span is used for analog channel temperature effects. It is assumed that calibration is performed at a nominal ambient temperature of +70°F +50°F/-30°F (with an upper extreme of +120°F and a lower extreme of +40°F).

RTE is considered to be independent due to the manner in which the instrumentation is checked; i.e., the instrumentation is calibrated and drift determined under condition in which temperature is assumed constant. An example of this would be as follows: Assume a rack is in some position in an area and an instrument technician calibrates the rack component. This calibration is performed at ambient temperature conditions. Some time later, an instrument technician checks the rack's performance using the same technique as for the initial calibration and from the two sets of readings a drift value can be determined. The ambient temperature condition should be essentially the same as those for the initial calibration. Therefore, this condition has no significant effect on the drift determination and is independent of the drift allowance. Variation in calibration temperature conditions can influence the drift results if the temperature variation is large enough. However, Vogtle does not as a general rule record calibration temperature conditions, thus a quantitative treatment of the data is not possible.

A.3.52 Range - The upper and lower limits of the operating region for a device.

A.3.53 Repeatability - The closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions, approaching from the same direction for full range traverses.

A.3.54 Reset Differential - The change in input to a trip unit device required to return the device to its normal state.

A.3.55 Safety Analysis Limit (SAL) - The SAL is the limiting parameter value in the safety and transient analysis at which a reactor trip or ESF actuation function is assumed to be initiated. There may be more than one SAL for a given protection system function.

A.3.56 Sensor Calibration Accuracy (SCA) - SCA is the calibration accuracy or tolerance for a sensor or transmitter based on plant procedures.

A.3.57 Sensor Drift (SD) - The change in input-output relationship over a period of time at reference calibration conditions. An example of determination of SD is: for an "as-left" value of +0.1% of span and a subsequent "as found" value of +0.5% of span, the magnitude of the drift would be (+0.5) - (+0.1) = +0.4% of span (in the positive direction).

A.3.58 Sensor Measurement and Test Equipment Accuracy (SMTE) - The accuracy of the test equipment used to calibrate a sensor or transmitter in the field or in a calibration laboratory. When the magnitude of SMTE meets the requirements of SAMA PMC 20.1-1973, it is considered an integral part of SCA and is not explicitly included. SMTE values, which are greater than one tenth of the SCA value, are explicitly included in Westinghouse calculations.

A.3.59 Sensor Pressure Effects (SPE) - The SPE accounts for either the change in input-output relationship due to a change in the process static pressure conditions from the calibration scaling assumptions (if calibration is performed at line pressure), or the accuracy to which a correction factor is introduced for the difference between the calibration and the process scaling assumptions for a ΔP transmitter.

SPE is 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 is assumed constant. An example of this would be as follows: Assume a sensor is placed in some position in an area. After placement, an instrument technician calibrates the sensor. This calibration is performed at ambient pressure condition. Some time later, an instrument technician checks the sensor's performance using the same technique as for the initial calibration and from the two sets of readings a drift value can be determined. The ambient pressure condition should be essentially the same as those for the initial calibration. Therefore, this condition has no significant effect on the drift determination and is independent of the drift allowance. Variation in calibration pressure condition can influence the drift results if the pressure variation is large enough. However, Vogtle does not as a general rule record calibration pressure condition, thus a quantitative treatment of the data is not possible.

A.3.60 Sensor Reference Accuracy (SRA) - The basic accuracy published by the manufacturer. SRA includes basic accuracy, conformity, hysteresis, and repeatability of the sensor or transmitter. SRA is introduced into the uncertainty calculation to address repeatability concerns when only performing a calibration (i.e., one up and one down) or repeatability and hysteresis when performing a single pass calibration in only one direction.

A.3.61 Sensor Temperature Effects (STE) - The changes in input-output relationship for a sensor due to a change in the ambient environmental conditions (temperature, humidity, voltage and frequency) from the reference calibration conditions. It is assumed that temperature is the most significant of these, with the other parameters being second order effects.

STE is considered to be independent due to the manner in which the instrumentation is checked; i.e., the instrumentation is calibrated and drift determined under condition in which temperature is assumed constant. An example of this would be as follows: Assume a sensor is placed in some position in an area. After placement, an instrument technician calibrates the sensor. This calibration is performed at ambient temperature conditions. Some time later, an instrument technician checks the sensor's performance using the same technique as for the initial calibration and from the two sets of readings a drift value can be determined. The ambient temperature condition should be essentially the same as those for the initial calibration. Therefore, this condition has no significant effect on the drift determination and is independent of the drift allowance. Variation in calibration temperature conditions can influence the drift results if the temperature variation is large enough. However, Vogtle does not as a general rule record calibration temperature conditions, thus a quantitative treatment of the data is not possible.

A.3.62 Setpoint - A predetermined level at which a final actuation device changes state to indicate that the quantity under surveillance has reached the selected value.

A.3.63 Setpoint Tolerance - is the calibration accuracy of the instrument in the loop. If the instrument uncertainty involves a sensor switch, then the setpoint tolerance is SCA. If the instrument uncertainty involves an indicator, then the setpoint tolerance is ICA. If the instrument uncertainty involves a rack bistable, then the setpoint tolerance is RCA.

Example: If SCA is ± 0.5 inches, the Setpoint Tolerance in the MP5 Equipment Workbench Custom Fields (Setpoint Index Screen) is written as follows:

SETPOINT TOLERANCE: -OVER: 0.5 -UNDER: 0.5

A.3.64 Span - The algebraic difference between the upper and lower values of a calibrated range.

A.3.65 Square Root of the Sum of the Squares (SRSS) - SSRS is the mathematical approach, as approved for use in setpoint in calculations by ISA Standard S67.04-1994, utilized by Westinghouse to combine independent uncertainty terms and is expressed by the following:

$$SRSS = (a^2 + b^2 + c^2 \ldots.)^{1/2}$$

A.3.66 Technical Specifications Trip Setpoint (TS SP) - Setpoint found in the Technical Specifications. The TS SP is the limit specified for calibration of protection/ESF bistables.

A.3.67 Tolerance - Allowable range of variation permitted in maintaining a specified setpoint or calibrated range upper or lower limit.

A.3.68 Total Allowance (TA) - The absolute value of the calculated difference between the following:

- Safety Analysis Limit and the Technical Specifications Trip Setpoint (SA ± TS SP) in percent instrument span for protection and ESF loops.

Example	NIS Power Range Neutron Flux - High		
	SAL		118% RTP
	- TS SP	-	109% RTP
	TA		9% RTP

If the instrument span = 120% RTP, then TA = (9% RTP) (100% span/120% RTP) = 7.5% span.

Example	Pressurizer Pressure – Low		
	SAL		1825 psig
	- TS SP	-	1865 psig
	TA		- 40 psig

If the instrument span = 800 psig, then TA = (40 psig) (100% span/800 psi) = 5.0% span.

- Analytical limit and the setpoint (AL ± SP) in percent span for all other loops.

TA can be calculated from the following equations:
TA = SAL ± TS SP with the ± sign depending on the setpoint direction,
TA = AL ± SP with the ± sign depending on the setpoint direction, or
TA = Margin + CSA

A.3.69 Uncertainty - The amount of error in an instrument channel which represents the distribution of possible errors within some probability and confidence level.

A.3.70 Upper Calibration Limit - The resultant value when the RCA for the specific loop under consideration is added to the Nominal trip setpoint.

TS SP (High)		UCL
	↑ + RCA	Nominal Trip Setpoint
	↓ - RCA	LCL

A.4 Methodology

The methodology used is the "square root of the sum of the squares" (SRSS) which is widely utilized in the industry. Various ANSI, American Nuclear Society, and Instrument Society of America standards approve the use of probabilistic and statistical techniques in determining safety related and non-safety related setpoints. The SRSS equation

$$SRSS = (a^2 + b^2 + c^2 \ldots.)^{1/2}$$

is the square root of the sum the squares of independent components.

A.4.1 The basic methodology used to combine the error components for a channel or an instrument loop is an appropriate combination of those groups of components which are statistically independent, i.e., not interactive by the SRSS equation. Drift, calibration accuracy, comparator accuracy, and reference accuracy are interactive and thus not independent. These dependent errors are placed in appropriate groups and mathematically summed, resulting in independent properties. The resultants become variable inputs to the SRSS equation. Environmental Allowance, as a degree of conservatism, and Bias, one directional with a known magnitude, are added to the statistical sum.

The relationship between the error components and the total error for a channel or instrument loop, is noted in Equation 4.1,

$$CSA = \sqrt{\begin{array}{l}(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + \\ (RCA + RRA + RCSA + RMTE + RD)^2 + RTE^2 + \\ (ICA + IRA + ICSA + IMTE + ID)^2 + ITE^2 + IA^2 \\ (DCA + DRA + DCSA + DMTE + DD)^2 + DTE^2 + \\ PEA^2 + PMA^2\end{array}} + \mathit{BIAS} + \mathit{EA}$$

Equation 4.1

where:

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

EA = Environmental Allowance
ICA = Indicator Calibration Accuracy
IRA = Indicator Reference Accuracy
IMTE = Indicator Measurement and Test Equipment Accuracy
ICSA = Indicator Comparator Setting Accuracy
IR = Indicator Readability
REF = Reference signal for automatic control system
ID = Indicator Drift
ITE = Indicator Temperature Effects
CA = Control Accuracy
CMTE = Control Measurement and Test Equipment Accuracy
DCA = Computer Calibration Accuracy
DRA = Computer Reference Accuracy
DMTE = Computer Measurement and Test Equipment Accuracy
DCSA = Computer Comparator Setting Accuracy
DD = Computer Drift
A/D = Analog to Digital Conversion
DTE = Computer Temperature Effects
Bias = Bias (one sided distribution)

Equation 4.1 depicts the equation with sensor, rack, indicator and computer interfaces in the instrument loop. Every loop differs by the design or components. Therefore, Equation 4.1 must be created per the design and components of the loop. Section A.5 demonstrates the building of the CSA equation.

A.4.2 The improved methodology, identified in Equation 4.2, assumes several of the error components and their parameter assumptions act independently, e.g., rack modules versus sensors and their associated environmental and temperature assumptions. This allows the use of a statistical summation of the various components instead of a strictly arithmetic summation. A direct benefit of the use of this technique is increased margin in the total allowance. For those parameter assumptions known to be interactive, the technique uses the standard, conservative approach, arithmetic summation to form groups of independent quantities, e.g., (M&TE and _CA), and ((M&TE and _D), and ((M&TE and _CSA).

Equation 4.2 utilizes parameters, which have closed-loop automatic control systems with no trending of transmitter calibrations and drift. The calculation takes credit for [the long-term steady-state error equal to zero for the closed-loop control system due to integral (reset) capability]. The calculation is based on the premise that the instrument surveillance program at Vogtle consists of a combination of quarterly rack surveillance tests and sensor/relay calibrations performed each refueling outage. Equation 4.2 assumes the site I&C personnel perform multiple pass calibrations. The number of passes is subject to engineering judgment.

In the improved methodology, drift, calibration accuracy, and comparator accuracy allowances are treated as dependent parameters with the M&TE uncertainties. Environmental Allowance, as a degree of conservatism, and Bias, one directional with a known magnitude, are added to the statistical sum. An example of the improved methodology CSA equation is noted in Equation 4.2. See Section A.5 to build the enhanced methodology CSA equation.

$$CSA = \sqrt{\begin{aligned}&(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + \\ &(RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2 + \\ &(ICA + IMTE)^2 + (ID + IMTE)^2 + (ICSA + IMTE)^2 + IRA^2 + ITE^2 + IPE^2 + IA^2 + \\ &(DCA + DMTE)^2 + (DD + SMTE)^2 + (DCSA + DMTE)^2 + DRA^2 + DTE^2 + DPE^2 + \\ &PEA^2 + PMA^2\end{aligned}} + BIAS + EA$$

Equation 4.2

Equation 4.2 depicts the equation with sensor, rack, indicator and computer interfaces in the instrument loop. Every loop differs by the design or components. Therefore, Equation 4.2 must be created per the design and components of the loop. Section A.5 demonstrates the building of the CSA equation.

A.4.3 The enhanced methodology identified in Equation 4.3 is similar to Equation 4.2 with the exception that Equation 4.3 assumes the site I&C personnel perform a signal pass calibration. The drift, comparator accuracy, and calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.3 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Due to the single pass calibration, field calibration practices, and conservatism, the calibration accuracy/M&TE independent grouping is square rooted and treated as a bias term.

$$CSA = \sqrt{\begin{aligned}&(SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + \\ &(RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2 + \\ &(ICA + IMTE)^2 + (ID + IMTE)^2 + (ICSA + IMTE)^2 + IRA^2 + ITE^2 + IPE^2 + IA^2 + \\ &(DCA + DMTE)^2 + (DD + SMTE)^2 + (DCSA + DMTE)^2 + DRA^2 + DTE^2 + DPE^2 + \\ &PEA^2 + PMA^2\end{aligned}} + \left(\begin{aligned}&\sqrt{(SCA + SMTE)^2} + \\ &BIAS + EA\end{aligned}\right)$$

Equation 4.3

Equation 4.3 depicts the equation with sensor, rack, indicator and computer interfaces in the instrument loop. Every loop differs by the design or components. Therefore, Equation 4.3 must be created per the design and components of the loop. Section A.5 demonstrates the building of the CSA equation.

A.4.4 The basic, improved and enhanced methodologies are acceptable means to calculate instrument uncertainty as long as the criteria stated above are met. The basic methodology will result in an uncertainty that is conservative when compared to the enhanced methodology. The improved and enhanced methodologies provide increased margin in the Total Allowance (TA).

A.5 Allowances

As stated in Section A.4, the CSA equation can be created per the design and components of the loop. This section demonstrates the creation of the CSA equation by combining the pertinent allowances per the components in the loop. Section A.5 provides a description, or definition, of each of the various allowances to promote a clear understanding of the methodology. Also provided is a detailed example of each allowance calculation demonstrating the methodology and noting how each parameter value is utilized.

In order to determine the total instrument loop uncertainty, individual device (sensors, converter modules, characterizing modules, etc.) accuracy uncertainties must first be determined. The following component specifications must be addressed for all safety related and non-safety related devices within the instrument loop:

(a) Calibration Accuracy
(b) Drift
(c) Normal Pressure Effects
(d) Normal Temperature Effects
(e) Normal Humidity Effects
(f) Normal Radiation Effects
(g) Power Supply Effects
(h) DBA Pressure Effects
(i) DBA Temperature Effects
(j) DBA Humidity Effects
(k) DBA Radiation Effects
(m) DBA Cable Insulation Resistance
(n) DBA Cable Connection Leakage Current
(s) Seismic Effect
(t) Measurement and Test Equipment Accuracy
(u) Reference Accuracy
(v) Others
(w) Comparator Accuracy

The uncertainties are built using the above parameters based on the components in the loop. For the below examples, Equation 4.1 is used to build up the uncertainties based on the components in the loop. The formation of Equation 4.2 will be similar.

A.5.1 Sensor Allowances

Seven uncertainties are considered to be sensor allowances: SCA, SCSA, SRA, SMTE, SD, STE, and SPE. Of these uncertainties,

SCA = (a)
SCSA = (w)
SD = (b)
SMTE = (t)
SPE = (c)
STE = $[(d)^2 + (e)^2 + (f)^2 + (g)^2]^{1/2}$
SRA = (u)

a) For the basic CSA methodology (Equation 4.1), two parameters are considered to be statistically independent (STE and SPE), and four parameters are considered interactive (SCA, SCSA, SRA, SMTE and SD). The interactive parameters in the basic CSA methodology are arithmetically summed. Excerpting the sensor portion of Equation 4.1 results in the following equation:

$$\sqrt{(SCA + SD + SCSA + SRA + SMTE)^2 + STE^2 + SPE^2}$$

Equation 5.1.1

b) For the improved CSA methodology (Equation 4.2), three parameters are considered to be statistically independent (SRA, STE and SPE).
   - SRA is the manufacturer's reference accuracy that is achievable by the device. This term is introduced to address repeatability and hysteresis concerns when performing a few pass calibrations, i.e., two ups and two downs. The quantity of pass calibration is subject to engineering judgment.
   - STE and SPE are considered to be independent as defined in the definitions in Section A.3.

   Three parameters (SCA, SCSA and SD) are considered interactive and dependent with SMTE, yet independent as a group in the overall CSA equation.
   - When calibrating a sensor, the sensor output is checked to determine if it is accurately representing the input. The sensor response, measured by applying known inputs and recording the sensor output, includes the calibration accuracy of both the sensor and the M&TE. The dependency treatment is considered a conservative approach.
   - Drift is equal to the difference between the "as-found" and the previous "as-left" data and therefore includes the actual sensor drift and the small potential contribution due to the randomization of two M&TE uncertainties. The "as-found" calibration data indicates whether the sensor input/output relationship was within reasonable allowance over the interval since the last calibration. The combination of "as-left" calibration data and plant specific sensor drift provides assurance that the sensor will continue to perform its function for future cycles.
   - When calibrating a switch, the switch actuation is checked to determine if it is accurately representing the setpoint. The switch response, measured by applying the setpoint input

and recording the switch actuation, includes the calibration accuracy of both the switch and the M&TE. The dependency treatment is considered a conservative approach.

The sensor drift, sensor comparator setting accuracy, and sensor calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.2 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Excerpting the sensor portion of Equation 4.2 results in:

$$\sqrt{(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2}$$

Equation 5.1.2

c) For the enhanced CSA methodology (Equation 4.3), three parameters are considered to be statistically independent (SRA, STE and SPE).
   - SRA is the manufacturer's reference accuracy that is achievable by the device. This term is introduced to address repeatability and hysteresis concerns when only performing a single pass calibration, i.e., one up and one down.
   - STE and SPE are considered to be independent as defined in the definitions in Section A.3.

   With a single pass calibration, the three parameters (SCA, SCSA and SD) are considered interactive and dependent with SMTE, yet independent as a group in the overall CSA equation.
   - When calibrating a sensor, the sensor output is checked to determine if it is accurately representing the input. The sensor response, measured by applying known inputs and recording the sensor output, includes the calibration accuracy of both the sensor and the M&TE. The dependency treatment is considered a conservative approach.
   - The plant drift equals the difference between the "as-found" and the previous "as-left" data and therefore includes the actual sensor drift and the small potential contribution due to the randomization of two M&TE uncertainties. The "as-found" calibration data indicates whether the sensor input/output relationship was within reasonable allowance over the interval since the last calibration. The combination of "as-left" calibration data and plant specific sensor drift provides assurance that the sensor will continue to perform its function for future cycles.
   - When calibrating a switch, the switch actuation is checked to determine if it is accurately representing the setpoint. If applicable, the switch response, measured by applying the setpoint input and recording the switch actuation, includes the calibration accuracy of both the switch and the M&TE. The dependency treatment is considered a conservative approach.

   The drift, comparator accuracy, and calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.3 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Due to the single pass calibration, field calibration practices, and conservatism, the calibration accuracy/M&TE independent grouping is square rooted and treated as a bias term. Excerpting the sensor portion of Equation 4.3 results in:

$$\sqrt{(SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2} + \sqrt{(SCA + SMTE)^2}$$

Equation 5.1.3

A.5.2 Rack Allowances

Six uncertainties are considered to be rack allowances: RCA, RMTE, RCSA, RRA, RTE, and RD. Of these uncertainties,

RCA = (a)
RD = (b)
RRA = (u)
RMTE = (t)
RCSA = (a)
RTE = $[(d)^2 + (e)^2 + (f)^2 + (g)^2]^{1/2}$

a) For the basic CSA methodology (Equation 4.1), one parameter is considered to be statistically independent (RTE), and five parameters are considered interactive (RCA, RCSA, RRA, RMTE and RD). The interactive parameters in the basic CSA methodology are algebraically summed. Excerpting the rack portion of Equation 4.1 results in:

$$\sqrt{(RCA + RD + RRA + RCSA + RMTE)^2 + RTE^2}$$

Equation 5.2.1

b) For the improved and enhanced CSA methodologies (Equations 4.2 and 4.3), two parameters are considered to be statistically independent (RRA and RTE).
   - RRA is the manufacturer's reference accuracy that is achievable by the process rack instrument string or rack device (power supply). This term is introduced to address repeatability and hysteresis effects when performing a single or multiple pass calibrations. The number of passes is subject to engineering judgment.
   - RTE is considered to be independent and defined in Section A.3.

   Three parameters (RCA, RCSA and RD) are considered interactive and dependent with RMTE, yet independent as a group in the overall CSA equation.
   - When calibrating a sensor, the sensor output is checked to determine if it is accurately representing the input. The sensor response, measured by applying known inputs and recording the sensor output, includes the calibration accuracy of both the sensor and the M&TE. The dependency treatment is considered a conservative approach.
   - Drift is equal to the difference between the "as-found" and the previous "as-left" data and therefore includes the actual rack drift and the small potential contribution due to the randomization of two M&TE uncertainties. The "as-found" calibration data indicates whether the rack input/output relationship was within reasonable allowance over the interval since the last calibration. The combination of "as-left" calibration data and plant specific rack drift provides assurance that the rack will continue to perform its function for future cycles.
   - When calibrating a rack bistable, the actuation is checked to determine if it is accurately representing the setpoint. If applicable, the bistable response, measured by applying the setpoint input and recording the bistable actuation, includes the comparator calibration accuracy and the M&TE. The dependency treatment is considered a conservative approach.

The rack drift, rack comparator setting accuracy, and rack calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.2 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Excerpting the rack portion of Equation 4.2 results in:

$$\sqrt{(RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2}$$

Equation 5.2.2

A.5.3 Indicator Allowances

Seven parameters are considered to be rack allowances: ICA, IRA, IMTE, ICSA, ITE, IR, and ID.

ICA = (a)
ID = (b)
IMTE = (t)
ICSA = (a)
ITE = $[(d)^2 + (e)^2 + (f)^2 + (g)^2]$ ½
IRA = (u)
IR = Readability = 1/2 smallest division in % span

a) For the basic CSA methodology (Equation 4.1), two parameters are considered to be statistically independent (ITE and IR), and five parameters are considered interactive (ICA, IRA, IMTE, ICSA and ID). The interactive parameters in the basic CSA methodology are algebraically summed. Excerpting the rack portion of Equation 4.1 results in:

$$\sqrt{(\mathrm{ICA} + \mathrm{ID} + \mathrm{IRA} + ICSA + \mathrm{IMTE})^2 + \mathrm{ITE}^2 + IA^2}$$

Equation 5.3.1

b) For the improved and enhanced CSA methodologies (Equations 4.2 and 4.3), two parameters are considered to be statistically independent (IRA, IR, and ITE).
   - IRA is the manufacturer's reference accuracy that is achievable by the indicator device. This term is introduced to address repeatability and hysteresis effects when performing a single pass calibration, i.e., one up and one down or a few pass calibrations, i.e., two ups and two downs. The quantity of pass calibration is subject to engineering judgment.
   - ITE is considered to be independent and defined in Section A.3.
   - IR is considered to be independent and defined in Section A.3.

   Three parameters (ICA, ICSA and ID) are considered interactive and dependent with IMTE, yet independent as a group in the overall CSA equation.
   - When calibrating an indication device, the indication device output is checked to determine if it is accurately representing the input. The indication device response, measured by applying known inputs and recording the indication device output, includes the calibration accuracy of both the indication device and the M&TE. The dependency treatment is considered a conservative approach.
   - Drift is equal to the difference between the "as-found" and the previous "as-left" data and therefore includes the actual rack drift and the small potential contribution due to the randomization of two M&TE uncertainties. The "as-found" calibration data indicates whether the indication device input/output relationship was within reasonable allowance

over the interval since the last calibration. The combination of "as-left" calibration data and plant specific indication device drift provides assurance that the indication device will continue to perform its function for future cycles.

- When calibrating an indication device, the actuation is checked to determine if it is accurately representing the setpoint. If applicable, the indication device bistable response, measured by applying the setpoint input and recording the indication device actuation, includes the indicator calibration accuracy and the M&TE. The dependency treatment is considered a conservative approach.

The indicator drift, indicator comparator setting accuracy, and indicator calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.2 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Excerpting the indicator portion of Equation 4.2 results in:

$$\sqrt{(\mathrm{ICA} + \mathrm{IMTE})^2 + (\mathrm{ID} + \mathrm{IMTE})^2 + (\mathrm{ICSA} + \mathrm{IMTE})^2 + \mathrm{IRA}^2 + \mathrm{ITE}^2 + IA^2}$$

Equation 5.3.2

A.5.4 Computer Allowances

Six parameters are considered to be rack allowances: DCA, DRA, DMTE, DCSA, DTE, and DD.

DCA = (a)
DD = (b)
DMTE = (t)
DCSA = (a)
DTE = $[(d)^2 + (e)^2 + (f)^2 + (g)^2]$ ½
DRA = (u)

a) For the basic CSA methodology (Equation 4.1), one parameter is considered to be statistically independent (DTE), and five parameters are considered interactive (DCA, DRA, DMTE, DCSA and DD). The interactive parameters in the basic CSA methodology are algebraically summed. Excerpting the rack portion of Equation 4.1 results in:

$$\sqrt{(\mathrm{DCA} + \mathrm{DD} + \mathrm{DRA} + \mathrm{DCSA} + \mathrm{DMTE})^2 + \mathrm{DTE}^2}$$

Equation 5.4.1

b) For the improved and enhanced CSA methodologies (Equations 4.2 and 4.3), two parameters are considered to be statistically independent (DRA and DTE).
   - DRA is the manufacturer's reference accuracy that is achievable by the indicator device. This term is introduced to address repeatability and hysteresis effects when performing a single pass calibration, i.e., one up and one down or a few pass calibrations, i.e., two ups and two downs. The quantity of pass calibration is subject to engineering judgment.
   - DTE is considered to be independent and defined in Section A.3.

Three parameters (DCA, DCSA and DD) are considered interactive and dependent with DMTE, yet independent as a group in the overall CSA equation.

- When calibrating a computer device, the computer device output is checked to determine if it is accurately representing the input. The computer device response, measured by applying known inputs and recording the computer device output, includes the calibration accuracy of both the computer device and the M&TE. The dependency treatment is considered a conservative approach.
- Drift is equal to the difference between the "as-found" and the previous "as-left" data and therefore includes the actual rack drift and the small potential contribution due to the randomization of two M&TE uncertainties. The "as-found" calibration data indicates whether the computer device input/output relationship was within reasonable allowance over the interval since the last calibration. The combination of "as-left" calibration data and plant specific indication device drift provides assurance that the computer device will continue to perform its function for future cycles.
- When calibrating a computer function, the actuation is checked to determine if it is accurately representing the setpoint. If applicable, the computer response, measured by applying the setpoint input and recording the computer response, includes the computer calibration accuracy and the M&TE. The dependency treatment is considered a conservative approach.

The computer drift, computer comparator setting accuracy, and computer calibration accuracy values are treated as dependent parameters with the M&TE uncertainties. The equation 4.2 methodology sums the drift, calibration accuracy, comparator accuracy, and M&TE to form several independent groupings. Excerpting the computer portion of Equation 4.2 results in:

$$\sqrt{(DCA + DMTE)^2 + (DD + DMTE)^2 + (DCSA + DMTE)^2 + DRA^2 + DTE^2}$$

Equation 5.4.2

A.5.5 Process Allowances - PMA

The PMA uncertainty is considered to be independent of both sensor and rack uncertainties. PMA provides allowances for the non-instrument related effects, e.g., fluid density changes and temperature assumptions. The uncertainty is factored into Equations 4.1 and 4.2 as an independent quantity. However, PMA can be treated as a random parameter or a bias parameter. As a random parameter, PMA will be an independent parameter within the CSA square root.

$$\sqrt{PMA^2}$$

Equation 5.5.1

As a bias parameter subjected to one-directional movement, PMA will be an independent parameter added to the resultant of the random parameters in the square root equation.

Justification as to the treatment of PMA should be provided in the calculation.

A.5.6 Process Allowances - PEA

The PEA uncertainty is considered to be independent of both sensor and rack uncertainties. PEA accounts for errors due to metering devices. The uncertainty is factored into Equations 4.1 and 4.2 as an independent quantity. PEA is treated as a random parameter.

$$\sqrt{PEA^2}$$

Equation 5.6.1

A.5.7 Environmental Allowances

The EA equation for instrument loop DBA considerations is:

$EA = (h) + (i) + (j) + (k)$ Equation 5.7.1

Note: The straight sum combination of terms is conservative and statistically represents dependent effects.

The EA equation for seismic effects, including non-seismic HVAC loss and environment effects due to cable degradation is:

$EA = (s) + (i) + (j)$ Equation 5.7.2

The greater of the two EA values will be utilized since a DBA concurrent with a SSE is not considered to be a credible plant event.

EA is treated as a bias parameter. As a bias parameter subjected to one-directional movement, EA will be an independent parameter added to the resultant of the random parameters in the square root equation.

A.5.8 DBA Cable Insulation Resistance (CIR) Consideration

Instrument loops used for post-accident monitoring where instrument cable is exposed to the harsh environment must consider CIR losses. This CIR loss is always additive because it will always be present due to an accident. The Setpoint Uncertainty Calculation Format Guideline Reference 4 provides guidance on how CIR would reduce signal strength. The instrument loop uncertainty term is:

DBA Cable Insulation Resistance = (m)

Note: For each Westinghouse instrument loop, the accuracy effect assumed due to cable degradation is less than 0.1 percent of span. This impact was considered negligible and not factored into the analysis. If the error is found to be larger than 0.1 percent of span, it must be added as part of the environmental allowance.

CIR is treated as a bias parameter. As a bias parameter subjected to one-directional movement, CIR is an independent parameter added to the resultant of the random parameters in the square root equation.

Review Vogtle Calculation X5CPS.0006 “INSPECTION REPORT EFFECTS ON INSTRUMENT LOOP ACCURACY” for CIR affects.

A.5.9 DBA Cable Connection Leakage Current Consideration (CCLCC)

Instrument loops used for accident monitoring, where instrument cables terminate via terminal blocks, containment penetrations, or splices are exposed to the accident harsh environment, must be reviewed for the impact of signal losses. The Setpoint Uncertainty Calculation Format Guideline Reference 4 provides guidance to determine signal error due to the harsh environment. The instrument loop uncertainty term is:

DBA Cable Connection Leakage Current = (n)

CCLCC is treated as a bias parameter. As a bias parameter subjected to one-directional movement, CCLCC will be an independent parameter added to the resultant of the random parameters in the square root equation.

Review Vogtle Calculation X5CPS.0006 "INSPECTION REPORT EFFECTS ON INSTRUMENT LOOP ACCURACY" for CCLCC affects.

A.6 Combining Allowances

The allowances described in section A.5 are used to build the CSA equation. The creation of the uncertainty equation will be dependent on the instrument loop and <u>is unique for each loop</u>. Each example below depicts a description of the loop and the uncertainty equation that could be developed.

A.6.1 For an instrument loop with a sensor/switch for an alarm function and PMA treated as a random parameter, the basic CSA methodology (as discussed in section A.4.1) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + PEA^2 + PMA^2} + BIAS + EA$$

Equation 6.1.1

For an instrument loop with a sensor/switch for an alarm function and PMA treated as a random parameter, the enhanced CSA methodology (as discussed in section A.4.2) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + PEA^2 + PMA^2} + BIAS + EA\ E$$

quation 6.1.2

Note: To assess sensor indication accuracy by these methodologies, there is no need to consider SCSA for the instrument loop uncertainty. The value for this parameter will be 0%.

A.6.2 For an instrument loop involving a sensor and the Westinghouse 7300 Comparator Bistable and PMA treated as a random parameter, the basic CSA methodology (as discussed in section A.4.1) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{matrix}(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + \\ (RCA + RRA + RCSA + RMTE + RD)^2 + RTE^2 + \\ PEA^2 + PMA^2\end{matrix}} + BIAS + EA$$

Equation 6.2.1

For an instrument loop involving a sensor and the Westinghouse 7300 Comparator Bistable and PMA treated as a random parameter, the enhanced CSA methodology (as discussed in section A.4.2) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{matrix}(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + \\ (RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2 + \\ PEA^2 + PMA^2\end{matrix}} + BIAS + EA$$

Equation 6.2.2

A.6.3 For an indicator in an instrument loop involving a sensor, the Westinghouse 7300 rack or a power supply, the PMA treated as a random term. For the indicator, the basic CSA methodology (as discussed in section A.4.1) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{matrix}(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + \\ (RCA + RRA + RCSA + RMTE + RD)^2 + RTE^2 + \\ (ICA + IRA + ICSA + IMTE + ID)^2 + ITE^2 + IA^2 \\ PEA^2 + PMA^2\end{matrix}} + BIAS + EA$$

Equation 6.3.1

For an indication instrument loop involving a sensor, the Westinghouse 7300 rack or a power supply, the PMA treated as a random parameter, indicator, the enhanced CSA methodology (as discussed in section A.4.2) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{matrix}(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + \\ (RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2 + \\ (ICA + IMTE)^2 + (ID + IMTE)^2 + (ICSA + IMTE)^2 + IRA^2 + ITE^2 + IPE^2 + IA^2 + \\ PEA^2 + PMA^2\end{matrix}} + BIAS + EA$$

Equation 6.3.2

Note: To assess indication accuracy by these methodologies, there is no need to consider SCSA, RCSA, or ICSA for the instrument loop uncertainty. The value for these parameters will be 0%.

A.6.4 For an computer instrument loop involving a sensor, the Westinghouse 7300 rack or a power supply, and computer, the basic CSA methodology (as discussed in section A.4.1) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{array}{l}(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + \\ (RCA + RRA + RCSA + RMTE + RD)^2 + RTE^2 + \\ (DCA + DRA + DCSA + DMTE + DD)^2 + DTE^2 + \\ PEA^2 + PMA^2\end{array}} + BIAS + EA$$

Equation 6.4.1

For an computer instrument loop involving a sensor, the Westinghouse 7300 rack or a power supply, and computer, the enhanced CSA methodology (as discussed in section A.4.2) associated with a given channel or loop could be calculated as follows:

$$CSA = \sqrt{\begin{array}{l}(SCA + SMTE)^2 + (SD + SMTE)^2 + (SCSA + SMTE)^2 + SRA^2 + STE^2 + SPE^2 + \\ (RCA + RMTE)^2 + (RD + RMTE)^2 + (RCSA + RMTE)^2 + RRA^2 + RTE^2 + \\ (DCA + DMTE)^2 + (DD + SMTE)^2 + (DCSA + DMTE)^2 + DRA^2 + DTE^2 + DPE^2 + \\ PEA^2 + PMA^2\end{array}} + BIAS + EA$$

Equation 6.4.2

Note: To assess computer indication accuracy by these methodologies, there is no need to consider SCSA, RCSA, or DCSA for the instrument loop uncertainty. The value for these parameters will be 0%.

A.7 Setpoint Determination

A.7.1 One method of calculating the loop setpoint is by adding or subtracting the instrument channel uncertainties (CSA) to the Safety Analytical Limit/Analytical Limit, dependent upon the direction of the process variable to cause some control or alarm action, and Margin.

TS SP = SAL ± (CSA + Margin) Equation 7.1.1
Setpoint = AL ± (CSA + Margin) Equation 7.1.2

If it is found that there is not enough difference between the setpoint and the operating point, readjustment of the setpoint may be required based on previous operating experience and/or by removing conservative assumptions in the calculations.

A.8 MP5 Setpoint Uncertainty Calculation Input

Upon completion of a setpoint uncertainty calculation per attached standards, the setpoint uncertainty calculation number will be recorded in the MP5 "Equipment Workbench" under the TPNS tag # for which the calculation was made.

Appendix B – Setpoint Uncertainty Calculation Format Guideline

Introduction

The purpose of this guideline is to provide a common format, a set of assumptions and uniform presentation of the information to be used in all setpoint uncertainty calculations as applicable. The following sections will serve as a guide in new setpoint uncertainty calculation development.

NOTE
Work activities related to project uncertainty calculations SHALL be made in accordance with Project Procedure NMP-ES-039-001, Calculations Preparation and Revision.

General Format

A description and example for each section is included below. Per the procedure mentioned above this format will follow the standard calculation cover sheet.

1.0 Purpose

The purpose of the uncertainty calculation is to determine a suitable setpoint or demonstrate the acceptability of an existing one by quantifying margin between the setpoint value and any analytical or safety analysis limits for a given function or parameter.

Examples: The purpose of this calculation is to:

1. *determine the setpoint uncertainty for loop _____ based on loop component inaccuracies, M&TE, calibration methodology, operating environment, etc. in order to provide a setpoint with margin to analytical/safety limits as well as margin to normal operating conditions to prevent nuisance alarms.*
2. *apply the setpoint uncertainty to the existing setpoint and process limits to verify that all inaccuracies and allowances made will not cause unnecessary alarm/interlock initiation or to allow the process to operate outside safe process limits.*

2.0 Summary of Conclusion:

A summary of the calculations will be shown in tabular form, which indicate the uncertainty both in percent and engineering units. **A statement summarizing the acceptability of the results when compared to the setpoints shall also be included.**

Example:

CSA Results	*Uncertainty in %*	*Uncertainty (" WC)*
Bistable	*2.084*	*9.987*
Single indicator	*3.874*	*18.65*
Average indication	*2.636*	*12.653*
Computer	*2.407*	*11.551*

3.0 Discussion of Methodology

Briefly discuss the loop uncertainty terms that apply to the particular loop of interest, i.e. sensor, rack, computer, environmental, seismic, etc. since not all loops have the same terms in the overall equation. Even though this is intended to be a brief discussion, there must be adequate evidence of the thought process in the justification of the use or exclusion of terms.

Standard assumptions, such as temperature, etc. shall also be pointed out here with a reference to Attachment 2 of this procedure as the source. Departure from any assumption in Attachment 2 will be adequately justified by means of trending of the condition or other concrete method.

Also for multiple loops, any differences in the loop components should be pointed out here.

Example:

Loop XXX consists of 7300 rack, Rosemount DP transmitter, indicator, computer alarm and MCB annunciator. All components are in a controlled environment with exception of the transmitter. The transmitter is in the Ctmt building where temperature is assumed to range from 70 to 120F. CSA is defined as:

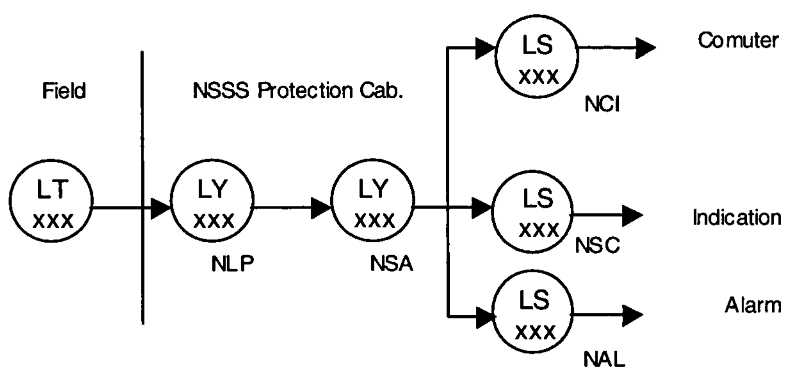
$$\text{CSA} = \sqrt{\begin{array}{l}(\text{SCA} + \text{SRA} + \text{SCSA} + \text{SMTE} + \text{SD})^2 + \text{STE}^2 + \text{SPE}^2 + \\ (\text{RCA} + \text{RRA} + \text{RCSA} + \text{RMTE} + \text{RD})^2 + \text{RTE}^2 + \\ (\text{ICA} + \text{IRA} + \text{ICSA} + \text{IMTE} + \text{ID})^2 + \text{ITE}^2 + \text{IA}^2 \\ (\text{DCA} + \text{DRA} + \text{DCSA} + \text{DMTE} + \text{DD})^2 + \text{DTE}^2 + \\ \text{PEA}^2 + \text{PMA}^2\end{array}} + BIAS + EA$$

4.0 Functional Description

Functional description will include any functional requirements such as PLS setpoints or TS setpoints and a simplified loop diagram.

Example:

The high alarm setpoint per the PLS is 90% of span. The trip setpoint per the PLS is 92%. The trip function protects against loss of pressure control which may lead to an over-pressure condition and a challenge to the code safety valves.



Loop XXX Configuration

1.4 Body of Calculation

Present the information in the following form (Note: The phrase "engineering judgment" with no further explanation is NOT an adequate justification for an assumed term value):

Example

Sensor Tag #: *Q1/2F16LT410*
Manufacturer: *Rosemount 1151*
PM *Once every 18 months*

Environmental/Seismic Conditions	Normal	Design	Calibration
Process temperature	*100°F* *	*150°F*	*70°F*
Process pressure	*10 psig*	*150 psig*	*0 psig*
Humidity	*100%*	*100%*	*N/A*

Remarks

* Standard assumptions, such as temperature, etc. shall also be used here with a reference to Attachment 2 of this procedure as the source.

Parameter	Justification	Uncertainty value (%)
SCA	Provide derivation of value used for SCA. For instance, if procedure data sheet reflect ± 10" WC calibration tolerance, convert the process value into percent value. Identify the calibration procedure or PM task.	±
SRA	Reference vendor document as to the vendor accuracy. Identify the reason for the SRA value, even if the reference accuracy is contained in SCA.	±
SMTE	Identify M&TE component used during the calibration (See Attachment 3). For conservatism, SMTE value to achieve the minimum required ratio of 1.5 to 1 can be use.	±
SD	Identified the methodology per vender information or if data were used, identify the data and display the calculation to determine SD or other reference used to establish SD.	±
SCSA	Reference vendor document as to the comparator accuracy.	
STE	Identified the methodology per vender information or reference plant data and calculation determination of STE or other reference used to establish STE..	±
SPE	Identified the methodology per vender information or reference plant data and calculation determination of SPE or other reference used to establish SPE.	±

Rack TPNS Tag #: *7300 process rack*
Manufacturer: *Westinghouse*
PM *Once every 18 months*

Environmental/Seismic Conditions	Normal	Design	Calibration
Process temperature			
Process pressure	*		
Humidity			

Remarks

* Standard assumptions, such as temperature, etc. shall also be used here with a reference to Attachment 2 of this procedure as the source.

Parameter	Justification	Uncertainty value
RCA	Provide derivation of value used for RCA. For instance, if procedure data sheet reflect ± 10" WC calibration tolerance, convert the process value into percent value. Identify the calibration procedure or PM task.	±
RRA	Reference vendor document as to the vendor accuracy. Identify the reason for the RRA value, even if the reference accuracy is contained in RCA.	±
RMTE	Identify M&TE component used during the calibration (See Attachment 3). For conservatism, RMTE value to achieve the minimum required ratio of 1.5 to 1 can be use.	±
RD	Identified the methodology per vender information or if data were used, identify the data and display the calculation to determine RD or other reference used to establish RD.	±
RCSA	Reference vendor document as to the comparator accuracy.	
RTE	Identified the methodology per vender information or reference plant data and calculation determination of RTE or other reference used to establish RTE..	±

Indicator Tag #: *N1/2F16LI410*
Manufacturer: *International Model 1151*
PM *Once every 18 months*
Location of indicator *Main Control Room*

Environmental/Seismic Conditions	Normal	Design	Calibration
Process temperature	*70°F* *	*150°F*	*70°F*
Process pressure	*N/A*	*N/A*	*N/A*
Humidity	*50%*	*100%*	*N/A*

Remarks

* Standard assumptions, such as temperature, etc. shall also be used here with a reference to Attachment 2 of this procedure as the source.

Parameter	Justification	Uncertainty value
ICA	Provide derivation of value used for ICA. For instance, if procedure data sheet reflect ± 10" WC calibration tolerance, convert the process value into percent value. Identify the calibration procedure or PM task.	±
IRA	Reference vendor document as to the vendor accuracy. Identify the reason for the IRA value, even if the reference accuracy is contained in ICA.	±
IMTE	Identify M&TE component used during the calibration (See Attachment 3). For conservatism, IMTE value to achieve the minimum required ratio of 1.5 to 1 can be use.	±
ID	Identified the methodology per vender information or if data were used, identify the data and display the calculation to determine ID or other reference used to establish ID.	±
ICSA	Reference vendor document as to the comparator accuracy.	
ITE	Identified the methodology per vender information or reference plant data and calculation determination of ITE or other reference used to establish ITE..	±

Computer TPNS Tag #: *Plant Computer*
Manufacturer: *Westinghouse*
PM *Once every 18 months*
Location *Computer room*

Environmental/Seismic Conditions	Normal	Design	Calibration
Process temperature	70°F *	120°F	70°F
Humidity	50%	70%	N/A

Remarks

* Standard assumptions, such as temperature, etc. shall also be used here with a reference to Attachment 2 of this procedure as the source.

Parameter	Justification	Uncertainty value
DCA	Provide derivation of value used for DCA. For instance, if procedure data sheet reflect ± 10" WC calibration tolerance, convert the process value into percent value. Identify the calibration procedure or PM task.	±
DRA	Reference vendor document as to the vendor accuracy. Identify the reason for the DRA value, even if the reference accuracy is contained in DCA.	±
DMTE	Identify M&TE component used during the calibration (See Attachment 3). For conservatism, DMTE value to achieve the minimum required ratio of 1.5 to 1 can be use.	±
DD	Identified the methodology per vender information or if data were used, identify the data and display the calculation to determine DD or other reference used to establish DD.	±
DCSA	Reference vendor document as to the comparator accuracy.	
DTE	Identified the methodology per vender information or reference plant data and calculation determination of DTE or other reference used to establish DTE..	±

Miscellaneous Random Parameters

PEA	Process Parameter Tag #: *FE-412* Description: primary element Description of PEA: orifice Justification	±
PMA	Identified the process, design and calibration conditions. Methodology Justification	±

Bias

EA	Justification	+
Bias	Justification	+

Results

$$CSA = \sqrt{\begin{array}{l}(SCA + SRA + SCSA + SMTE + SD)^2 + STE^2 + SPE^2 + \\ (RCA + RRA + RCSA + RMTE + RD)^2 + RTE^2 + \\ (ICA + IRA + ICSA + IMTE + ID)^2 + ITE^2 + IA^2 \\ (DCA + DRA + DCSA + DMTE + DD)^2 + DTE^2 + \\ PEA^2 + PMA^2\end{array}} \quad + BIAS + EA$$

CSA = 2.0% of span or 9.985782" WC for a 480" span

	At setpoint	At setpoint + activation range	At setpoint - activation range
Safety Analytical Limit (SAL)/Upper analytical limit (UAL) or lower process limit (LPL) depending on the direction of setpoint	58%	58%	58%
Margin	2%	1%	3%
Setpoint + CSA	56%	57%	55%
Setpoint + maximum activation range of setpoint		55%	
Setpoint	54%		
Setpoint - maximum activation range of setpoint			53%
Setpoint - CSA	52%	53%	51%
Margin	2%	3%	1%
Safety Analytical Limit (SAL)/Lower analytical limit (LAL) or upper process limit (UPL) depending on the direction of setpoint	50%	50%	50%

References

(1) Bechtel *Instrument Loop Uncertainty Estimate Calculation Methodology*

(2) ISA Standard ISA-S51, 1979, *Process Instrumentation Terminology*

(3) ISA Standard ISA-S67.04, 1988, *Setpoints for Nuclear Safety-Related Instrumentation*

(4) NUREG/CR-3691, *An Assessment of Terminal Blocks in the Nuclear Power Industry*

(5) Regulatory Guide 1.105, Rev. 1,11/76, *Instrument Setpoints*

(6) SAMA Standard PMC 20.1-1973, *Process Measurement and Control Terminology*

Attachment 1 – Assumptions in the Setpoint Uncertainty Program

General Assumptions

1.1. The RCS total flow rate should be determined to be within its limit by a precision heat balance measurement (flow calorimetric) at the beginning of a cycle at greater than 90% RTP. It is assumed that T_H is at the nominal design value and there is no feedwater flow venturi fouling.

1.2. Static Head pressure effects (a characteristic of the sensor also referred to as static shift of offset) should be compensated for in the calibration of the device.

1.3. Head correction (differences in elevations between primary element and sensor) is normally included in the scaling of instrumentation if the head correction is more than the reference accuracy of the sensing device.

1.4. The trip setpoints for dynamic functions should be determined using low slope ramps or small step changes to approximate steady-state conditions.

1.5. Steam flow transmitters should be normalized to feedwater flow transmitters.

1.6. A string or loop calibration is performed for the racks (i.e., the process channel or loop is calibrated to a specific tolerance from the rack input to output or a final end-to-end verification is performed following module calibration).

1.7. Each RTS/ESFAS instrument loop is left within the calibration tolerance (not just the Allowable Value) at the beginning of each quarterly surveillance interval.

1.8. The Barton transmitters supplied by ITT Barton are not subject to the long term drift or thermal non-repeatability effects observed for previous models or lots.

1.9. Reactor Control System (i.e., RCS temperature control), Pressurizer Pressure & Level Control Systems, and SGWLC System are calibrated every 18 months.

1.10. All RTS/ESFAS transmitters (and sensors) are calibrated every 18 months.

1.11. M&TE used for calibration and surveillance must have accuracy and/or readability capabilities equivalent to or better than the specific M&TE stipulated by a given plant procedure for each range/scale and/or function.

1.12. It is assumed that the transmitters are calibrated at relatively constant ambient temperature conditions and that the conditions are essentially the same each time the transmitter is checked or calibrated.

1.13. It is assumed that the racks are calibrated under controlled temperature conditions, which remain essentially the same each time the rack is checked or calibrated.

1.14. All RCS wide range RTD's should be cross-calibrated to within ±0.7 °F every 36 months in conjunction with the narrow range RTD cross-calibration.

Appendix B – Bechtel Based Setpoint Uncertainty Calculation Methodology

PROJECT INSTRUCTIONS - GEORGIA POWER COMPANY PROJECTS

BECHTEL POWER CORPORATION	PROJECT: VOGTLE ELECTRIC GENERATING PLANT	PI- 10.6-32	REV. NO. 0
	SUBJECT: SETPOINT CALCULATIONS	PAGE 1	OF 18
		DATE ISSUED APR 1 4 1989	
		QE COORDINATOR J. Arbaiza	

PREPARED BY	DATE	DISCIPLINE SUPERVISOR	DATE	PROJECT ENGINEER	DATE
J. R. Bingham/ R. O. Frink	12/19/88 12/30/88	B. Cameron/ R. O. Frink	12/19/88 12/30/88	S. Pietrzyk	2/23/89

1.0 OBJECTIVE

The purpose of this procedure is to provide a uniform method of calculating and verifying instrument accuracy and setpoint as required per methodology presented in Regulatory Guide 1.105, Rev. 2 "Instrument Setpoints for Safety-Related Systems" (Reference 6 Section 8.0 of this PI). The processing of the completed, signed off calculation is in accordance with EDPI 4.37-29.

2.0 SCOPE

The technique utilized by this procedure will follow the "Westinghouse Setpoint Methodology Protection Systems - Vogtle Station (Reference 9, Section 8.0 of this PI) as it applies to process trip actuation switches. This methodology applies to setpoints for comparator bistables or trip switches which have a Safety-Related Actuation Function. Post Accident Monitoring (PAM) Indicator Loops, and Instrument Indication Loops required for Technical Specification Surveillance of the Alvin W. Vogtle Electric Generating Plant Unit 1 are not part of the Reference 9 setpoint calculations. Indicator loops will use this setpoint methodology to determine instrument loop accuracy for an indicator. This procedure will:

2.1 Establish the method to apply instrument inaccuracies to determine the instrument loop uncertainty.

2.2 Define and establish instrument loop setpoints and setpoint limits for comparator bistables or trip switches.

2.3 Define instrument loop accuracy limits for indicators.

Class IE instruments that are used for non-safety related alarms, actuations not required by Safety Analyses but perform a system function such as equipment protection, and Balance of Plant (BOP) bistable trip functions have not used the RG 1.105 methodology. However, this procedure may be used for any setpoint or indicator accuracy calculation.

3.0 DEFINITIONS

Definitions of key terms used in this procedure are provided in the following subsections. Where applicable, Section 8.0 references are shown in parentheses.

Proprietary Note:
These procedures are the property of Bechtel Power Corporation and are to be returned upon request. Where loaned it is on the express agreement that they will not be used in whole or in part except for the limited private use permitted by the Corporation. The Manager, Division Engineering, will stipulate the required degree of proprietary control and will obtain acknowledgement from recipients as a condition of transmittal.

3.1 Accuracy - In process instrumentation, degree of conformity of an indicated value to a recognized accepted standard value or ideal value. (8)

For this Project Instruction, accuracy is understood as the range of actual process values that may exist for a given indicated value, for example, an accuracy of +10 psig to -5 psig means that for an indicated value of 100 psig, the actual process pressure may be anywhere between 95 and 110 psig.

3.2 Allowable Value (AV) - The limiting value that the trip setpoint can be when tested periodically beyond which the instrument channel is declared inoperable and corrective action must be taken by GPC. Allowable value is the Standard Technical Specification value when the AV is listed in the Technical Specifications.

3.3 Channel Accuracy - The accuracy of an analog channel which includes the accuracy of the primary element and/or transmitter and modules in the chain where calibration of modules intermediate in a chain is allowed to compensate for errors in other modules of the chain. (9)

3.4 Channel Statistical Allowance (CSA) - Equation to show the relationship between process component errors and the total statistical error for a channel. See discussion in Section 4.0

3.5 Deadband - the range through which an input signal may be varied, upon reversal of direction, without initiating an observable change in output signal. (3)

3.6 Drift - an undesired change in output over a period of time. This change is unrelated to the input, environment, or load. (3)

3.7 Environmental Allowance (EA) - all errors considered when the instrument loop is subjected to the adverse conditions of an accident environment or seismic event. See Exhibit E for discussion of radiation and seismic effects.

3.8 Hysteresis - when used as a performance specification, the maximum difference for the same input between the upscale and downscale output values during a full range traverse in each direction. (8)

3.9 Indication Accuracy - The uncertainty containing the highest expected value of the difference between (a) the value of a process variable read on an indicator or recorder and (b) the actual value of that process variable. (9)

3.10 Instrument Loop - a combination of one or more interconnected instruments arranged to measure or control a process variable, or both. (2)

3.11 Limiting Safety System Settings (LSSS) - settings for nuclear reactors for automatic protective devices related to variables having significant safety functions. Specific definition given by ISA Standard ISA-S67.04, 1982. (4)

3.12 Linearity - the closeness to which a curve approximates a straight line. It is usually measured as a non-linearity and expressed as linearity. See SAMA Standard PMC 20.1, 1973, for a more in-depth explanation. (8)

3.13 Margin - the difference between the Total Allowance (TA) and the Channel Statistical Allowance (CSA). M = TA - CSA. If a margin exists it may be attributed to, but is not limited to differences between math model and actual system.

3.14 Measurement and Test Equipment (M&TE) Uncertainty - The accuracy of the measurement standards and various test equipment used in the calibration of the devices and instrument loops. (9)

3.15 Primary Element Accuracy (PEA) - errors due to metering devices, such as, elbow sensor taps and venturis as related to primary element uncertainty. These effects may consist of more than one independent error allowance. (9)

3.16 Process Measurement Accuracy (PMA) - Includes plant variable measurement errors up to but not including the sensor. Examples are the effect of fluid stratification on temperature measurements and the effect of changing fluid density on level measurements. (9)

Note: This error provides allowances for the non-instrument related effects, such as, neutron flux and ionizing radiation effects to electronic circuits, calorimetric power error assumptions, fluid density changes, and temperature stratification assumptions. These effects may consist of more than one independent error allowance. (9)

3.17 Range - the region between the limits within which a quantity is measured, received, or transmitted, expressed by stating the lower and upper range values. (8)

3.18 Rack Calibration Accuracy (RCA) - the reference accuracy of the rack as defined by SAMA Standard PMC-20.1-1973. This term considers the entire loop of rack components as a string and requires the rack to be calibrated as a string of components. (9) (See reference accuracy)

3.19 Rack Comparator Setting Accuracy (RCSA) - the trip setpoint tolerance on the precision value to which a comparator bistable trip may be set and limited by such constraints as time and effort expended in making the setting. (9) (See Tolerance)

3.20 Rack Drift (RD) - the change introduced in the input-output relationship of the rack over a period of time at reference conditions. (9) (See Drift)

3.21 Rack Temperature Effects (RTE) - Includes the effects of temperature, humidity, voltage and frequency changes of which temperature is the most significant. (9)

3.22 Random Error - A statistical error that is wholly due to chance. Errors that are not systematic errors.

3.23 Range-limit, Upper - the highest value of the measured variable that a device can be adjusted to measure. (3)

3.24 Reference Accuracy - a number or quantity which defines the limit that err will not exceed when the device is used under reference operating conditio (8)

Reference accuracy includes but is not limited to, basic accuracy, hysteresis, repeatability, and dead band errors.

3.25 Repeatability - the closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions, approaching from the same direction for full range traverses. (3)

NOTE: Repeatability is usually measured as a non-repeatability and expressed as repeatability in percent of span. It does not include hysteresis.

3.26 Reset Differential - the change in input to a trip unit comparator required to return the comparator from its tripped state to its normal state.

3.27 Response Time - an output, expressed as a function of time, resulting from the application of a specified input under specified operating conditions. See Reference 8 Figure 15 for clarification.

3.28 Safety Analysis Limit (SAL) - the limit of a process condition that is necessary to reasonably protect the integrity of physical barriers that guard against uncontrolled release of radioactivity. (1) (7) The setpoint value assumed in Safety Analysis. (9)

3.29 Setpoint - a predetermined level at which a comparator bistable (or switch) device changes state to indicate that the quantity under surveillance has reached the selected value. (An input variable which sets the desired value of the controlled variable.) (4)

Note: Setpoint is the nominal safety system setting called by Westinghouse the Trip Setpoint.

3.30 Sensor Calibration Accuracy (SCA) - the accuracy of the sensor as defined by Reference Accuracy.

3.31 Sensor Drift (SD) - errors introduced in the input-output relationship of the sensor over a period of time under reference conditions. (9) (See Drift)

3.32 Sensor Pressure Effects (SPE) - any pressure effect introduced in the sensor's response which cannot be calibrated out at time of sensor calibration. (9)

3.33 Sensor Temperature Effects (STE) - all errors associated with normal and abnormal plant environmental conditions, such as fluctuation in temperature, humidity, radiation (if applicable) and power supply effects. This parameter typically includes changes from the normal environmental lower limit to the normal upper limit.

Note: The definition above is different than that provided by Reference 9 Section 3.2 in order to suit data available for the BOP hardware.

3.34 Span - the algebraic difference between the upper and lower limits of the range. (8)

3.35 Technical Specification Limit - the limit prescribed as a license condition of a process condition for safe operation. (1) (7)

3.36 Tolerance - Allowable range of variation permitted in maintaining a specified setpoint or calibration point.

3.37 Trip Setpoint - see setpoint.

3.38 Uncertainty - The maximum range of error from the setpoint or maximum indicator error. The region in which the instrument or instrument loop error is expected to be as determined by calculation. See CSA.

4.0 INSTRUMENT LOOP UNCERTAINTY

The setpoint calculation methodology is used to assess changes to the reference accuracy caused by the environment or system process effects. This methodology classifies the various instrumentation errors as independent or dependents effects. Accuracy effects to instrument loop devices that are unique, if the affect is only to one device, are defined as independent effects. Effects that influence more than one instrument simultaneously are called common mode effects and are statistically called dependent effects.

Statistical principles are used to combine the independent errors, namely, the variance of the sum is equal to the sum of the variances. One analytical approach assumes accuracy effects do not occur simultaneously. Therefore a weighted average to combine statistically-independent uncertainty components by use of "square-root ofthe sum of the squares" (SRSS) will be used.

Instruments in a given loop may have accuracy changes caused by the same stress originating outside of the loop. These effects are statistically dependent effects. Dependent effects to instrument accuracy are accounted for by combining the inaccuracy introduced by the common external stress as a straight summation.

When there are dependent and independent accuracy effects within a loop, the independent and the summed dependent accuracies are totaled by the SRSS method. This summation of independent and dependent terms by SRSS is the instrument loop accuracy.

4.1 In order to determine the total instrument loop uncertainty, individual device (sensors, convertor modules, characterizing modules, etc.) accuracy uncertainties must first be determined. The following component accuracies must be addressed for all safety related devices within the instrument Loop:

(a) Reference Accuracy
(b) Drift
(c) Normal Pressure Effects
(d) Normal Temperature Effects
(e) Normal Humidity Effects
(f) Normal Radiation Effects
(g) Power Supply Effects
(h) DBA Pressure Effects
(i) DBA Temperature Effects
(j) DBA Humidity Effects
(k) DBA Radiation Effects
(s) Seismic Effects

4.1.1 Sensor Uncertainty Estimates - defining the terms (a) through (g) to setpoint methodology terms (Reference 9):

SCA = (a)

SD = (b)

SPE = (c)

$$STE = [\ (d)^2 + (e)^2 + (f)^2 + (g)^2\ ]^{\frac{1}{2}} \qquad \text{Equation (4.1)}$$

4.2 Environmental Allowances - relating terms (h) through (k) and (s) to the Westinghouse Environmental Allowance (EA) term requires consideration of two different EA equations considerations.

EA equation for DBA consideration:

$$EA = (h) + (i) + (j) + (k) \qquad \text{Equation (4.2.a)}$$

Note: The straight sum combination of terms is conservative and statistically represents dependent effects.

The EA equation for seismic consideration is:

$$EA = (s) \qquad \text{Equation (4.2.b)}$$

The greater of the two EA values will be utilized since a DBA concurrent with a SSE is not considered to be a credible plant event. (See Exhibit E).

4.2.1 DBA Cable Insulation Resistance (IR) Consideration

Instrument Loops used for accident monitoring where instrument cable is exposed to the harsh environment must consider cable IR losses. This IR loss is always additive because it will always be present due to an accident. Exhibit B provides guidance to how cable IR would reduce signal strength.

The Instrument Loop Uncertainty term is:

(m) DBA Cable Insulation Resistance

Note: For each Westinghouse instrument loop the accuracy effect assumed due to cable degradation is less than 0.1 percent of span. This impact was considered negligible and not factored into the analysis. If the error is found to be larger than 0.1 percent of span it must be added as part of the environmental allowance.

4.2.2 DBA Cable Connection Leakage Current Consideration

Instrument Loops used for accident monitoring, where instrument cable terminations via terminal blocks, containment penetrations or splices are exposed to the accident harsh environment, must be reviewed for the impact of signal losses. Values for these signal losses should be obtained from the VEGP Equipment Qualification Group Central File. Exhibit B provides guidance to determine signal error due to the harsh environment.

The instrument loop uncertainty term is:

(n) DBA Cable Connection Leakage Current

4.2.3 Instrument Loop - Environmental Allowance

The EA equation for instrument loop DBA consideration is:

$$EA = (h) + (i) + (j) + (k) + (m) + (n) \qquad \text{Equation (4.2.3.a)}$$

The EA equation for seismic consideration, including non-seismic HVAC loss and loop environment effects due to cable is:

$$EA = (s) + (i) + (j) + (m) + (n) \qquad \text{Equation (4.2.3.b)}$$

The greater of the two EA values will be utilized since a DBA concurrent with a SSE is not considered to be a credible plant event. (See Exhibit E).

4.3 Rack or Cabinet Modules Temperature Uncertainty Estimates (RTE) - relates the terms (a) through (g) for signal conditioning equipment within an instrument loop (Reference 9):

$$RCA = (a)$$
$$RD = (b)$$
$$RTE = [(d)^2 + (e)^2 + (f)^2 + (g)^2]^{\frac{1}{2}} \qquad \text{Equation (4.3)}$$

4.4 Process Actuated Comparator Bistables or Switches - In addition to the sensor and convertor uncertainty components stated above, an additional allowance shall be added for to account for setting comparator precision, namely, tolerance.

RCSA = Switch or Bistable Comparator Setting Tolerance

4.5 Technical Specification: Comparator Bistable

Although the statistical summation approach is more suited to instrument loops with both sensor and rack components, it can also be applied to an instrument loop with just a sensor. Two approaches are presented for setpoint data. The first approach is a two column format of Trip Setpoint and Allowable Value only (see Reference 9) and the second format is a four column method which is a statistical summation which allows a more flexible approach in determining trip setpoint and technical specification limits to reduce problems associated with channel drift and thus decrease the number of LER's. The setpoint channel breakdown columns used to determine the technical specifications limits are shown in Figure 1 Exhibit A.

- o Total Allowance - (TA)
- o Instrument and Process Measurement Uncertainty - (Z)
- o Sensor Allowance - (S)
- o Rack Allowance - (R)
- o Trip Setpoint - (TS)

In the two column approach, instrument sensor calibration errors are included between the Safety Analysis Limit (SAL) and the Allowable Value, leaving the instrument rack calibration and drift between the Allowable Value and the trip setpoint. Actual calibration errors and drift may be verified in the "as measured" condition during surveillance, the conservative two column approach which considers worst case calibration errors, will not allow a technician to recalibrate the instrument unless the "as measured" values show that the calculated values are exceeded.

The paragraphs below provide the mathematical definitions for the four column format as it applies to instrument sensors.

4.5.1 Sensor Allowance (S) consistent with the Westinghouse Setpoint Methodology (Reference 9) and is a sensor for an instrument loop with a process actuated comparator bistable switch and is defined as:

$$S = SCA + SD + SM\&TE \qquad \text{Equation (4.5.1)}$$

4.5.2 Instrument and Process Measurement Uncertainty (Z) accounts for all errors associated with the application except for those errors directly associated with instrument drift and calibration and is defined as follows:

$$Z = [\,(PMA)^2 + (PEA)^2 + (STE)^2 + (RTE)^2 + (SPE)^2]^{\frac{1}{2}} + EA \qquad \text{Equation (4.5.2)}$$

4.5.3 The total instrument Loop Uncertainty is defined as:

$$TA \geq Z + S + R \qquad \text{Equation (4.5.3)}$$

Where the Loop Uncertainty (TA) is the minimum allowance between the Trip Setpoint (TS) and the Safety Analysis Limit (SAL). Refer to Figure 1 (Exhibit A) for a pictorial relationship of setpoint terms.

4.5.4 Statistical error allowance associated with a given channel or loop is defined (Reference 9) as the Channel Statistical Accuracy (CSA) and is calculated as follows:

$$CSA = EA + [(PMA)^2 + (PEA)^2 + (SCA + SM\&TE + SD)^2 + (STE)^2 + (SPE)^2 + (RCA + RM\&TE + RCSA + RD)^2 + (RTE)^2]^{1/2}$$

Equation (4.5.4)

Where:

CSA = Channel Statistical Allowance
PMA = Process Measurement Accuracy
PEA = Primary Element Accuracy
SCA = Sensor Calibration Accuracy
SM&TE = Sensor Measurement and Test Equipment Accuracy
SD = Sensor Drift
STE = Sensor Temperature Effects
SPE = Sensor Pressure Effects
RCA = Rack Calibration Accuracy
RM&TE = Rack Measurement and Test Equipment Accuracy
RCSA = Rack Comparator Setting Tolerance
RD = Rack Drift
RTE = Rack Temperature Effects
EA = Environmental Allowance

Note: Equation abstracted from Westinghouse Methodology Reference 9.

4.5.5 When CSA and TA have been determined, the margin associated with TA and a given setpoint may be determined by the difference between TA term and CSA term as shown in the following equation:

$$M = TA - CSA \qquad \text{Equation (4.5.5)}$$

Once the terms S, Z and TA are defined in appropriate units, the other values which require consideration in the Technical Specifications can be determined.

4.5.6 Setpoint and Allowable Valve

1) Trip Setpoint equation is

TS = SAL +/- TA Equation (4.5.6.1)

Where the SAL value is the actuation setpoint assumed in the safety analysis. Each SAL value shall be obtained from the Mechanical Engineering Group.

Note: Mechanical Engineering's concurrence with the Trip set point is required for each safety related setpoint calculation This concurrence shall be via signoff on setpoint summary sheet (the format for which is shown in Exhibit D) by the Mechanical Engineering Group supervisor (EGS) or his designee.

2) Allowable Value equation is

AV = SAL +/- [Z + S] Equation (4.5.6.2)

The Allowable Value therefore establishes the acceptance criterion for setpoint surveillance.

Note: The term (Z + S) following the "+/-" sign would be added for a "low" Safety Analysis Limits and, conversely, the term would be subtracted for a "high" Safety Analysis Limits.

4.6 Technical Specification: Indicators

Instrument Loops used for accident monitoring are not defined by the guidelines of Reference 9. However, to assess indicator accuracy by this PI, Instrument Loops used for accident monitoring shall use the guidelines provided by Sections 4.1 through 4.2. There will be no need to consider setpoint or RCSA for the instrument loop uncertainty for instrument indicator loops. (See Exhibit A Figure 2.)

4.6.1 Indicator-Rack or Cabinet Modules Temperature Uncertainty Estimates (ITE) - relates the terms (a) through (g) for signal conditioning equipment within an instrument loop (Reference 9):

ICA = (a)

$$ID = (b)$$
$$ITE = [(d)^2 + (e)^2 + (f)^2 + (g)^2]^{\frac{1}{2}} \qquad \text{Equation (4.6.1)}$$

4.6.2 Statistical error allowance associated with a given channel or instrument loop is defined (reference 1) as the Channel Statistical Accurcy (CSA) and is calculated as follows:

$$CSA = EA + [(PMA)^2 + (PEA)^2 + (SCA + SM\&TE + SD)^2 + (STE)^2 +$$
$$(SPE)^2 + (ICA + IM\&TE + ID)^2 + (ITE)^2]^{\frac{1}{2}} \qquad \text{Equation (4.6.2)}$$

Where:
CSA = Channel Statistical Allowance
PMA = Process Measurement Accuracy
PEA = Primary Element Accuracy
SCA = Sensor Calibration Accuracy
SM&TE = Sensor Measurement and Test Equipment Accuracy
SD = Sensor Drift
STE = Sensor Temperature Effects
SPE = Sensor Pressure Effects
ICA = Indicator Rack Calibration Accuracy
IM&TE = Indicator Rack Measurement and Test Equipment Accuracy
ID = Indicator Rack Drift
ITE = Indicator Rack Temperature Effects
EA = Environmental Allowance

5.0 UNCERTAINTY AND SETPOINT CALCULATION PROCESS

5.1 Determine the calculation sequence number from the Electrical/Control Systems Calculation Setpoint Index Book.

5.2 For each loop, proceed as directed in the following sections:

5.2.1 Locate the applicable data sheet(s) and/or vendor catalog performance specification data and the applicable calibration procedure(s). Each vendor catalogue and calibration procedure shall be separately referenced in the calculation.

5.2.2 Obtain accuracy data from the Vendor Documents.

5.2.3 Fill out the setpoint/uncertainty calculation forms. (Exhibit C)

5.2.4 Using the guidelines in Section 4.0, determine instrument accuracies considering the effects of temperature change, power supply voltage change, humidity change, radiation, seismic forces, etc., on the instruments in the respective loops.

5.2.5 Using the guidelines of Section 4.0, determine which of the accuracy effects obtained above are independent or dependent effects.

5.3 Activity for System Safety Limits - Mechanical Group

Calculate and/or provide the information for the Safety Analysis Limits for the process as described below (See Exhibit D):

a. The process Safety Analysis Limit (SAL)
b. Margin
c. The reset limit (if applicable)
d. Justification and references for the limits given
e. Special instructions as applicable
f. Direction of process parameter actuation

5.4 Activity for Setpoint Determination - Electrical/Control Systems

The PI steps provided below are guidelines to calculate a trip setpoint. Use the limits provided by the Mechanical Group to determine a trip setpoint value that is acceptable.

5.4.1 Evaluate Channel Statistical Allowance (CSA) as follows:

If the rise in the process parameter is unsafe, CSA = TA - margin

or

If the fall in the process parameter is unsafe, CSA = TA + margin.

Any reduced margin allowances will be based on engineering judgement.

5.4.2 Evaluate the trip Setpoint (TS) as follows:

5.4.2.1 A trip setpoint is located such that the safety analysis limit (SAL) is not exceeded. A trip setpoint, based on limiting an increasing process, with a plus or minus channel statistical allowance (CSA) the minus CSA should not cause a trip due to the conditions that allow a CSA due to an operational transient about some normal process control point.

One method to determine a setpoint value is to consider the process range between a peak normal operating transient (PNOT), that is, maximum transient above the normal operating condition, and the safety analysis limit (see Figures 1 and 3 Exhibit A). Consider the CSA value and PNOT value to be equal but opposite direction from the trip setpoint as clarified in Figure 3, Exhibit A for an increasing process trip setpoint. Selection of the setpoint in relationship to safety analysis limit is such that the span of CSA to PNOT is less than or equal to twice the TA span value.

a. An increasing process parameter will have a set point selected as a minimum TS = (SAL - margin) - CSA

b. A decreasing process parameter will have a set point selected as a minimum TS = (SAL + margin) + CSA

If the existing setpoint meets the criteria stated above then the setpoint is acceptable. Otherwise consider the methods given below as guidance to determine a setpoint; however, these methods as presented do not represent all the possible ways to develop a setpoint.

Should the span in Figure 3, Exhibit A between CSA and the process peak normal operating transient (PNOT) be less than twice the TA value, then consider the methods presented below to solve the problem. In addition, EA may be excluded in the evaluation, if possible, in order to provide additional span difference between setpoint and the safety analysis limit.

a. Try to decrease the value of the calibration tolerance (RCSA) so that TA twice equals DF and proceed to determine the trip setpoint in accordance with subsection 5.4.2.1.

b. If subsection 5.4.2.2.a is unsuccessful, review the basis for drift (RD) measurement. See if more test data exists to reduce the value used. Vogtle Test Shop data may be used to determine drift between surveillance periods. Do not reduce the drift value to an equivalent time interval less than the time between surveillance periods stated in VEGP Technical Specification Table 4.3-1 and 4.3-2.

c. If subsections 5.4.2.2.a and b did not completely resolve the trip setpoint selection, subtract the "TA" value from the SAL value. Insure that the setpoint selected does not produce too many spurious trip conditions.

d. If action is to be taken in accordance with a, b and/or c above, approval must be taken from the group leader and/or the engineering group supervisor.

e. If reduction in the calibration tolerance (RCSA) or drift (RD) value is not possible, recommend reviewing other alternates even changing the setpoint or justify keeping the proposed trip setpoint.

f. If changing instrument type or model will allow for a setpoint determination which meets the above criteria, then document reasons why the instrument has to be changed.

5.4.3 Trip switches that have automatic reset, for example, a pressure switch, in which the setpoint and the reset setpoint are considered as safety functions will require a calculation for both trip actions. When there are safety system actions for trip and reset then evaluate the reset setpoint function as follows:

5.4.3.1 For an increasing process trip, the reset value limit shall be less than the trip setpoint. The Reset value must be greater than or equal to the reset limit provided by the Mechanical Group or the Peak Normal operating transient.

Reset = Trip Setpoint - Deadband or differential - TA.

5.4.3.2 For a decreasing process trip, the reset value limit must be less than or equal to the reset limit provided by the Mechanical Group or the normal operating transient.

Reset = Trip setpoint + Deadband or differential + TA

5.4.3.3 If the above stated condition cannot be met, namely, the reset overlaps the operating range or SAL (Figure 1), then try one of the following actions:

a. If the trip device is an adjustable electronic or mechanical type verify that the deadband or differential can be reduced.

b. If the trip device is a mechanical type with a fixed reset differential or electronic deadband recommend changing the trip Setpoint.

c. If the action taken in steps a and b above did not resolve the trip Setpoint and reset selection then seek other alternates or recommend replacement of the trip device.

5.4.4 If the Trip Setpoint and reset calculated in the above steps can be confirmed, finalize the calculation summary sheet (Exhibit C) and forward this summary to the Mechanical Group for the Review.

5.4.5 If the trip setpoints cannot be confirmed by the Mechanical Group (step 5.4.4), document this fact on the calculation summary sheet (Exhibit C as applicable).

5.5 Review Activity - Mechanical Group

The Mechanical Group shall review the calculation summary sheet and then return it to the Electrical/Control Systems Group with their approval and/or comments.

If Bechtel has a DCR for which SCS is to provide trip setpoints, the Mechanical Group shall review the SCS setpoints that are provided with the SCS safety evaluation for the Bechtel DCR. Any comments to the safety evaluation shall be resolved between SCS and Bechtel before the design package is issued.

5.6 Revision Activity - Electrical/Control Systems

The Electrical/Control Systems engineer shall finalize the Bechtel calculation and update the Setpoint drawing by DCR modification drawing.

Setpoint changes and design changes to system setpoints shall be issued in a Design Change Package. Each new setpoint given by design change request shall be incorporated into the Instrument Setpoint Drawings when an As-Built Notice (ABN) is received.

5.6.1 Check that all sheets are properly filled out.

5.6.2 Check that all applicable documentation is attached.

5.6.3 Check that all the figures, data, and mathematical operations are correct.

5.6.4 Obtain calculation signatures and approvals.

5.7 Electrical/Control Systems and Administration

5.7.1 Make a copy of the approved calculation and file the original copy of calculation in accordance with PPM 10604.4-4 or EDPI 4.37-29.

6.0 INCORPORATION OF NEW SETPOINTS FOR NEW EQUIPMENT

Prior to beginning procurement activities for new instruments or instrument loops, the DCR responsible engineer shall perform a setpoint verification calculation in accordance with this procedure in order to determine that the instrument(s) proposed for procurement is suitable for the intended application. The DCR Setpoint(s) will be issued with the DCR as a Modification Drawings. The Setpoints will be incorporated into the Instrument Setpoint Drawings when an ABN is received.

7.0 QUALITY ASSURANCE

The work performed in the engineering office and at the jobsite shall be conducted in accordance with Bechtel Power Corporation and Georgia Power Company Quality Assurance Programs.

8.0 REFERENCES

(1) 10 CFR 50.36, Technical Specifications.

(2) ISA STANDARD ISA-S5.1, 1973, Instrumentation symbols and Identification

(3) ISA STANDARD ISA-S51.1, 1979, Process Instrumentation Terminology

(4) ISA STANDARD ISA-S67.04, 1982, Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants

(5) NUREG/CR-3691 Assessment of Terminal Blocks in Nuclear Power Industry. Charles M. Graft. Sandia National Labs, Albuquerque, NM. October 1984.

(6) Regulatory Guide 1.97 Rev. 3 Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident

(7) Regulatory Guide 1.105, Rev. 2, 2/86, Instrument Setpoints for Safety-Related Systems

(8) SAMA STANDARD PMC 20.1-1973, Process Measurement & Control Terminology

(9) Westinghouse Setpoint Methodology for Protection Systems - Vogtle Station August, 1986, WCAP-11269 (Log No. X6AA10-149).

(10) PVOSPPM 10604.4-4 Preparing and Reviewing Design Calculations

(11) VEGP Technical Specifications

(11) VEGP Technical Specifications

(12) VEGP Central File Equipment Qualification Data Packages (EQDP)

9.0 EXHIBITS

A. Setpoint Limit Relationship, Figures 1, 2, and 3
B. Cable and Connection Insulation Resistance
C. Setpoint Calculation Forms
D. Mechanical Instrument Process Control/Trip Limits
E. Discussion of Radiation and Seismic Effects

Exhibit A
Sheet 1 of 3

FIGURE 1. COMPARATOR SETPOINT UNCERTAINTY RELATIONSHIP FOR COMPLIANCE WITH RG 1.105 SETPOINT DETERMINATION

Safety Analysis Limit (SAL)

TA Total Allowance (TA)				Margin
	Channel Statistical Allowance (CSA) CSA	Z	EA	DBA or Seismic Effects
			PMA	Process Measurement Accuracy
			PEA	Primary Element Accuracy
			STE	Sensor Environmental Effects
			SPE	Sensor Pressure Effects
			RTE	Rack/Cab Effects
		S	SD	Sensor Drift
			SM&TE	Measurement and Test Equipment Errors
	Standardized Technical Specification (STS)		SCE	Sensor Calibration Effects
	or Allowable Value (AV)	R	RD	Rack/Cab Drift
			RCA	Rack/Cab Calibration Accuracy
			RM&TE	Measurement and Test Equipment Errors
	Trip Setpoint (TS)		RCSA	Switch/Comparator Setting Tolerance

<u>Note</u>: This Figure is intended to illustrate the effects of environment, equipment, and calibration equipment considered in the instrument loop uncertainty determination and show their relationship between the Safety Analysis Limit and Trip Setpoint.

Sheet 2 of 3

FIGURE 2. PAM SURVEILLANCE UNCERTAINTY RELATIONSHIP FOR COMPLIANCE WITH RG 1.105 INDICATOR LOOP ACCURACY DETERMINATION

Safety Analysis Limit (SAL)

			Margin
TA Total Allowance (TA); Channel Statistical Allowance (CSA)	CSA / Z	EA	DBA or Seismic Effects
		PMA	Process Measurement Accuracy
		PEA	Primary Element Accuracy
		STE	Sensor Environmental Effects
		SPE	Sensor Pressure Effects
		RTE	Rack/Cab Effects
	S	SD	Sensor Drift
		SM&TE	Measurement and Test Equipment Errors
		SCE	Sensor Calibration Effects
Allowable Value (AV)	I	ID	Indicator Drift
		ICA	Indicator Calibration Accuracy
Surveillance Value (SV)		IM&TE	Measurement and Test Equipment Errors

Note: This Figure is intended to illustrate the effects of environment, equipment, and calibration equipment considered in the instrument Loop uncertainty determination and show their relationship between the Safety Analysis Limit and surveillance requirements.

PI 10.6-32, Rev. 0
Exhibit A
Sheet 3 of 3

FIGURE 3. CALCULATION SUMMARY FOR INCREASING SETPOINT

```
------      ------  SAFETY ANALYSIS LIMIT
  |
  |                 MARGIN
T |
A |    ----- ------ CHANNEL STATISTICAL ALLOWANCE (CSA)
  |        |        See Note 3
  |        |
  |      C |
  |      S | ------ ALLOWABLE VALUE
  |      A |
  |        |
 -----  ---- ------ TRIP SETPOINT
         P|
         N|
         O| ------  (ALLOWABLE VALUE)
         T|
          |
        ---- ------ PEAK NORMAL OPERATING TRANSIENT (PNOT)

             ------ NORMAL OPERATION
```

Notes:

1. This Figure defines the ideal relationship between the Total Allowance (TA) and the trip setpoint.

2. Selection of the setpoint in relationship to safety analysis limit is such that the span of CSA to PNOT is less than or equal to twice the TA span value.

3. Designated the meaning of items between the defined terms shown above refer to Figure 1.

EXHIBIT B

CABLE AND CONNECTION

INSULATION RESISTANCE

B.0 EVALUATION OF SIGNAL LOSS WITHIN AN INSTRUMENT LOOP

This Methodology is abstracted from Reference 5.

B.1 Transmitter Loop Error

Review of Instrument Loop signal losses may be determined for a transmitter loop defined by Figure B1. Where the terms are defined as:

I_{SHLD1} - Leakage current between conductor at positive potential and shield does not effect I_T or I_L.

I_{SHLD2} - Leakage current between conductor at negative potential and shield, which is also negligible due to low potential difference (Max of 5V).

dV_T - Voltage across milliamp transmitter

I_T - Transmitter output current

R_L - Total load resistance (R_{line} + R_{rec}).

I_L - Current through load resistance

V_S - Transmitter loop regulated supply voltage

R_{TL} - Total leakage resistance during HELB, parallel addition of cable IR and terminal block, containment penetration, or splice leakage resistance equal to:

$$(R_{TB} R_{IR} / R_{TB} + R_{IR}).$$

I_{TL} - Current through R_{TL}

B.1.1 Determine the transmitter signal loss for a harsh environment.

Define "e" as the transmitter loop error in known parameters;

$$e = I_{TL} / I_T$$

Where: $I_{TL} = dV_T / R_{TL} = I_L - I_T,$

$$I_{TL} = (V_S - R_L I_L) / R_{TL},$$

$$I_{TL} = [V_S - R_L I_L] / R_{TL},$$

$$I_{TL} R_{TL} = V_S - R_L I_{TL} - R_L I_T,$$

$$I_{TL}(R_L + R_{TL}) = V_S - R_L I_T,$$

$$I_{TL} = \frac{V_S - R_L I_T}{R_L + R_{TL}} \qquad \text{Equation (B.1)}$$

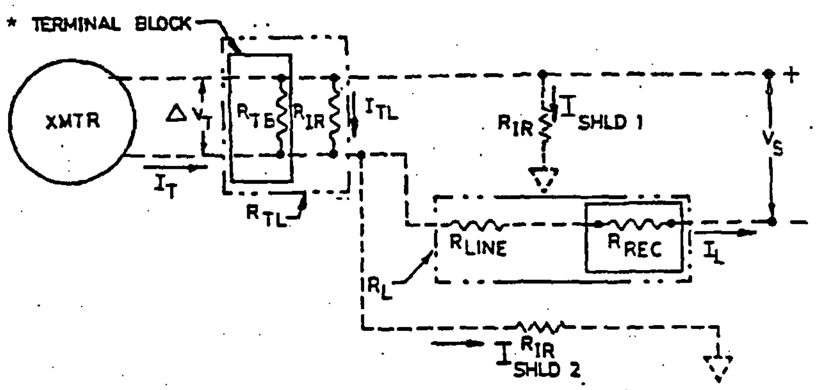
Therefore from Equation B.1 the error is:

$$\text{Error } e = \frac{V_S - R_L I_T}{I_T (R_L + R_{TL})} \qquad \text{Equation (B.2)}$$

Exhibit B
Sheet 4 of 9

FIGURE B1

TYPICAL TRANSMITTER LOOP



* Similar for containment penetration or cable splice.

B.2 RTD Loop Error

Use Figure B2 to review the RTD loop for the defined terms below.

R_{RTD} - Resistance of RTD at given temperature

R_{TB} - Terminal block, containment penetration or splice leakage resistance during DBE.

R_{IR} - Cable insulation resistance during DBE.

The RTD error "e" is defined as:

$$e = \frac{R_{RTD} - R_{EFF}}{R_{RTD}} = 1 - \frac{R_{EFF}}{R_{RTD}} \qquad \text{Equation (B.3)}$$

Where:

$$1/R_{EFF} = 1 / R_{RTD} + 1 / R_{TB} + 1 / R_{IR}$$

$$R_{EFF} = \frac{R_{RTD}\ R_{TB}\ R_{IR}}{R_{RB}\ R_{IR} + R_{RTD}\ R_{IR} + R_{RTD}\ R_{TB}}$$

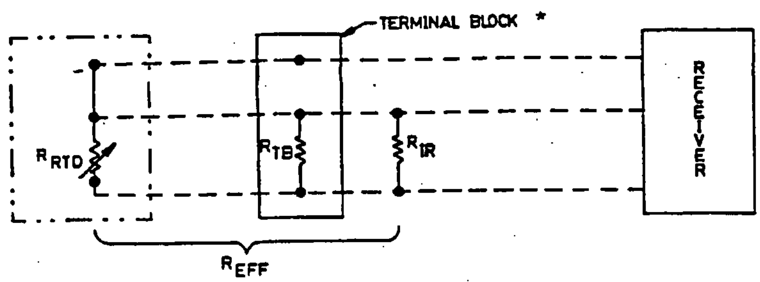
Therefore input R_{EFF} into Equation B.3 gives,

$$e = 1 - \frac{R_{TB}\ R_{IR}}{R_{TB}\ R_{IR} + R_{RTD}\ R_{IR} + R_{RTD}\ R_{TB}} \qquad \text{Equation (B.4)}$$

Exhibit B
Sheet 6 of 9

FIGURE B2

TYPICAL 3-WIRE RTD LOOP



* Similar for containment penetration or cable splice.

B.3 Thermocouple (TC) error is reviewed in relationship to Figure B3 using two shunt paths.

Where the terms in Figure B3 are defined as:

T_M = Temperature of the Measurement Junction

T_{CNMT} = Temperature of the TC wire and extension wire junction

T_{ref} = Temperature of the reference junction

E_1 = Net emf resulting from the temperature difference between the measurement and reference junctions.

R_1 = TC wire resistance (lumped)

E_2 = emf due to temperature gradients in section 2, assume a value of zero.

R_2 = extension wire resistance (lumped)

E_4 = Terminal block or splice emf

R_4 = Terminal block or splice resistance

E_5 = Terminal block, containment penetration or splice emf

R_5 = Terminal block, containment penetration or splice resistance

Section 1 = TC measurement to extension wire junction

Section 2 = extension wire run to reference junction

Section 3 = reference junction to the measurement device

V_2 = Potential across the sensing circuit input. Note for a properly operating, null balanced TC potential V_2 will equal E_1.

The presence of shunt resistance and spurious emfs E_1 and V_2 will be different. This difference is defined as:

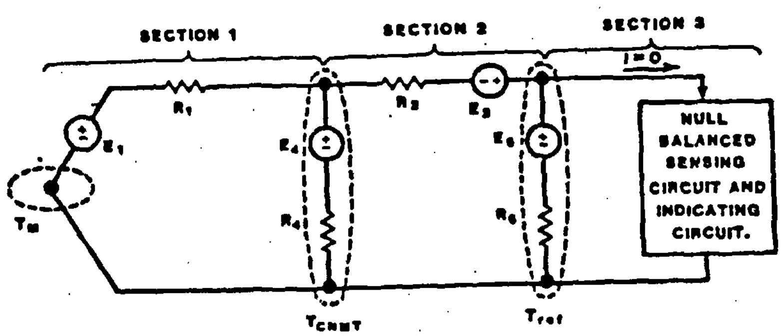
$$e = \frac{E_1 - V_2}{E_1}$$

which is used to derive Equation (B.5).

$$V_2 = \frac{R_4R_5E_1 + R_1R_5E_4 + (R_1R_2 + R_1R_4 + R_2R_4)\,E_5}{R_1R_2 + R_1R_4 + R_1R_5 + R_2R_4 + R_4R_5} \qquad \text{Equation (B.5)}$$

FIGURE B3

THERMOCOUPLE CIRCUIT WITH TWO SHUNT PATHS



INSULATION RESISTANCE IR
EVALUATION METHOD EXAMPLE

Term	Device	EQDP Ref	IR or R Exposed Length	X	Quantity or Length =		Total
R_1	Pigtail	X6A415/ ESE-3C	34.5 megohms	x	1	=	34.5 megohms
R_2	Splice	X3AB05	5 megohms	x	1	=	5 megohms
R_3	Cable CL67H	X3AJ02	9.4 megohms	x	$\frac{*15\text{ ft}}{496\text{ ft}}$	=	284 Kohms
R_4	Splice	X3AB05	5 megohms	x	1	=	5 megohms
R_5	Pene-tration	X3AB03	55 megohms	x	1	=	55 megohms

$$\frac{1}{R_{equiv}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

R_{equiv} = 252 K ohms

* The 15 ft. is the length of cable used in the cable Environmental Qualification Test. The 496 ft. is the actual length of cable for this sample calculation.

Exhibit C was removed and is not required for this NMP.

Exhibit D
Sheet 1 of 1

CALCULATION SHEET

JOB NO.	CALC. NO.	REV. NO.	SHEET NO.

Mechanical Instrument Process Control/Trip Limits

A. W. Vogtle Unit

Plant Tag Number ________ System No. ____________

P&ID ____________

Process Fluid __________ Process Temp (^{o}F) __________
Process Pressure (psi) ________

1. Function

2. Process Limits — Process/Direction

	Process/Direction
Safety Analysis Limit (SAL)	________________
Margin	________________
Re-Set Limit (if appicable)	________________
Technical Specification Limit	________________
Other	________________

3. Justification and Reference for Process Limits

Mech RE ____________ Date _____ Mech Checker ____________ Date _____

EXHIBIT E

DISCUSSION

OF

RADIATION

AND

SEISMIC EFFECTS

E.0 Radiation and Seismic Effects to Instruments

Environmental effects due to of radiation or earthquakes are events for which designs must withstand in order to meet licensing commitments for system operability. Consideration of their effects to meet design requirements are discussed below.

E.1. Discussion

E.1.1 Radiation Effects on Accuracy:

Electronic Devices exposed to radiation which may consist of some or all of gamma rays, beta particles, alpha particles, or a neutron flux, are subject to damage caused by ionization left by radiation traveling through the material. This damaging effect may cause inaccuracies in electronic circuits or solid state components (for example, memory chips, transistors and capacitors).

Equipment utilizing relays or other mechanical actuation devices do not suffer the same inaccuracy effect as the solid state circuit devices. Although one noticeable deterioration effect in these devices is the cracking of the wire insulation which may effect operability.

Radiation ionization effects will be documented by tests and explained in vendor test reports. When calculating a setpoint for an instrument loop that is exposed to radiation use inaccuracy valves provided by the Vendor to determine instrument Loop uncertainty.

E.1.2 Seismic Effects on Accuracy:

Title 10 Code of Federal Regulations part 100, Appendix A Section V(a) 2, requires the nuclear power plants be shutdown if the vibratory ground motion exceeds the site operating basis earthquake (OBE). Therefore each setpoint or indicator loop accuracy calculation will consider seismic effect to instrument loop accuracy.

E.2 Inaccuracy Value for Environmental Allowance (EA)

Design Basis Accidents do not consider the seismic event to occur concurrent with the LOCA. Therefore when reviewing the EA values for DBA radiation and seismic events, only the larger of the two values will be used in the Channel Statistical Allowance uncertainty calculation for accuracy.

Attachment 3 – M&TE Assumed in Vogtle Setpoint Calculations

Equipment	Accuracy
Fluke 8600A (20 ma)	0.1% of Input (20) + 0.01% of Range (20) = 0.022 ma
Fluke 8600A (2 vdc)	0.02% of Input (0.5) = 0.005% of Range (2) = 0.0002 v
Fluke 8600A (20 vdc)	0.02% of Input (10) + 0.005% of Range (20) = 0.003 v
Fluke 8600A (200 vac)	0.2% of Input (77) + 0.015% of Range (200) = 0.18 v
Fluke 8600A (200 ohms)	0.1% of Input + 0.15% of Range
Fluke 8375A (1000 ohms)	0.01% of Input + 0.003% of Range
Multi-Amp Frequency Generator (FG-50M)	0.1% of Reading (60) = 0.06 Hz
Epoch Test Set	1.0% of Reading (93 v for loss of voltage, 105 v for degraded voltage) = 0.9 v or 1.1 v
Gen Rad Decade Resistor	0.01% of Reading (460 ohms) = 0.046 ohms
100 psig Heise	0.1% of Full Scale = 0.1 psi
1000 psig Heise	0.1% of Full Scale = 1.0 psi
1500 psig Heise	0.1% of Full Scale = 1.5 psi
3000 psig Heise	0.1% of Full Scale = 3 psi
280″ Wallace & Tiernan	0.1% of Full Scale = 0.28”
425″ Wallace & Tiernan	0.1% of Full Scale = 0.425”
850″ Wallace & Tiernan	0.1% of Full Scale = 0.85” (93 v for loss of voltage, 105 v for degraded voltage) = 0.9 v or 1.1 v (0.12% of 500” span for Barton FW flow)

Technician should use lowest applicable range without changing ranges during test.
[2] Heise gauges are temperature compensated.

Attachment 4 – Typical Scaling Document Format

A Scaling Document provides a controlled, published reference that reflects the basis for the instrument channel/loop as-left calibration configuration as specified by the controlling calibration procedure. The document contains applicable pressure, voltage, current, and/or resistance values and dynamic time constants used to facilitate calibration of the channel sensor and rack modules by simulation of process inputs and verification of sensor and signal conditioning module outputs for indications and process control signals, and comparator module settings for alarm, trip, actuation, and interlock functions.

1. Title Page

The title page contains the document number; plant/unit applicability; a brief title descriptive of the loop including whether the loop is used for a Protection or Control function; and the preparer, reviewer and approval signature blocks.

2. Table of Contents Page

The table of contents provides an index to correlate each section to a given page number.

3. Introduction (Section 1.0)

The introduction section provides a brief narrative overview of the instrumentation function(s), and it identifies the specific instrument channel(s) within the scope. It should also relate the plant system/process functions to the associated instrument channel(s) . Simplified figures may be added to this section to illustrate the interrelationship between the system components, process, and instrumentation.

4. Technical Requirements (Section 2.0)

List the technical requirements for scaling and calibration based on plant unit-specific hierarchy design and licensing bases documents. Such documents include the plant Technical Specifications, setpoint documents/indexes, Westinghouse PLS, and vendor specifications. The technical requirements scope includes trip setpoint, deadband, and reset values for comparators and switches; variable setpoint, linear or non-linear functions for certain signal conditioning modules; time constants and gains for dynamic signal conditioning modules and controllers; and upper and/or lower calibration limit(s) for certain signal conditioning modules and controllers. The source document for each technical requirement should be referenced in this section.

5. Functional Operation / Loop Configuration (Section 3.0)

The Functional Operation / Loop Configuration section builds on the information and figures provided in Introduction section by providing a more detailed overview of the instrument channel operation and design functions from an instrumentation perspective. The narrative description should be brief and highlight important instrumentation design functions, signal processing modules, and operational applications. It should also note design differences between redundant channels. A simplified loop or block diagram is used to illustrate the instrument channel configuration. The loop diagram should identify the channel sensor (or other channel inputs), signal processing modules, and outputs. Where redundant channels with minor design differences are included in the same Scaling Document, a single loop diagram based on a specific channel is used to represent all channels within the defined scope. Tables, simplified schematics, and/or other figures may be added to clarify/emphasize instrumentation scope, functions, and/or system interfaces.

6. Detailed Scaling Analysis (Section 4.0)

The purpose of this section is to present the scaling methodology applied to the instrument channel(s) with the scope of the Scaling Document. This section contains detailed scaling calculations, assumptions, and discussions necessary to arrive at the resultant sensor and rack module calibration data and, if applicable, plant curves. The resultant calibration data for each sensor and rack module is tabulated in a separate section. In addition, the scaling analysis includes some references and the calculation-specific assumptions.

The scaling-specific references should be documented with the corresponding scaling calculation or in the calibration tables. Typical scaling references include: vendor technical instruction bulletins or manuals; instrument isometric drawings; engineering specifications; intracompany correspondence and letters; and plant data. Sources of plant data include: operator logs; procedure data sheets; and plant computer. When plant data is used, the specific procedure (e.g., STP, IMP, ETP) OTC number or maintenance work order number and test date must be included as a supporting reference document.

NOTE

Plant data used for calibration/normalization should be averaged over time for improved accuracy. If possible such data should be collected using a data acquisition/logger. Refer to Westinghouse ESBU-TB-96-07-RO for additional information.

Assumptions such as reference leg temperature and process fluid density should be stated. In addition, the reference document should be listed, or the assumptions basis should be discussed.

Process ranges and spans, mathematical process equations, scale factors, and voltage equations should be documented in this section.

While jumper configuration is controlled by plant procedures, as a good practice, documentation of selected printed circuit board configuration/settings should be included in the scaling calculation, as applicable. This includes configuration of jumpers, dip sticks, potentiometers, thumb wheel settings, toggle switch positions, etc.

Scaling calculations are typically based on calibration methods where test signals are applied at the sensor process connections and/or at the rack input terminals (or test points), and the output signals are measured at the channel output terminals (or test points) or observed on an indicator or plant computer point. When practical, Input/Output calibration values should reflect the plant-specific calibration methodology and allow for test equipment setup, input signal simulation, and output signal verification with consideration of differences between test/calibration and normal in-service configurations.

Normally, calibration data are generated for 0, 25, 50, 75, and 100 percent of scale range. Calibration data for 10 and 90 percent scale range values may also produced for non-linear scales such as square root flows, logarithmic, and exponential scales. Reverse calibration techniques may require calibration data for other test points based on channel output indications.

7. Detailed Sensor / Transmitter Scaling Analysis (Section 4.1)

Input/Output calibration values should be provided for each sensor to facilitate in situ or bench calibration. Normally these values are the same.

The calibration tolerances for sensors should be based on manufacturer requirements or equipment specifications.

Scaling for pressure, level and flow instruments must include appropriate hydrostatic head correction and density compensation factors (Ref. NRC IN 83-03 & IN 91-75).

Isometric drawings should be used for most level and some pressure transmitter scaling. Improved accuracy (or scaling refinements) may be obtained by performing a new field survey of the as-built instrument and process tap elevations. When such survey data are used in scaling, the associated isometric drawings should be updated to reflect the survey results.

When using differential pressure instruments on level applications, the density of the process fluid gas/vapor phase should be taken into account, particularly at elevated pressures. The effective pressure change per unit change in level is proportional to the difference between liquid and gas/vapor phase density.

The head of sensing line, reference leg, and/or sealed leg fluid should be calculated based on the density associated with ambient temperature expected for normal environmental operating conditions. When multiple instruments are located in the same area, for consistency, the same ambient temperature should be applied to each sensing line / reference leg.

CAUTION

Sensor density compensation factor scaling assumptions must be consistent with the supporting uncertainty calculation assumptions.

For identical instrument channels, when possible, round-off / normalize minor head correction differences so that the transmitter calibration data is standardized. This approach should minimize potential for human performance errors in the translation of scaling / calibration data into plant procedures. Exceptions include certain protection channels (e.g., pressurizer level) and indication channels (e.g., ECCS accumulator level), where precise scaling is required to minimize errors and/or uncertainties.

8. Detailed Rack Module Scaling Analysis (Section 4.2)

Input/Output calibration values should be provided for each rack module to facilitate bench calibration.

Input/Output calibration values should be provided for the rack string to facilitate channel operational tests, functional testing, and indication verifications.

Setpoints should be scaled to match the nominal setting specified in design documents with applicable plus/minus tolerances on either side of the nominal setting that define the upper and lower calibration limits.

The calibration tolerances for rack modules should be based on manufacturer requirements or equipment specifications. String calibration tolerances may be based on the least limiting module tolerance or the summation of multiple module tolerances. However, based on documented operating experience, tolerances can be tightened or relaxed.

Vogtle RTS and ESFAS setpoints should be scaled so that target calibration setting value is the "nominal trip setpoint." This value should equal the Technical Specifications trip setpoint. The high and the low calibration limits are a function of the rack string tolerance used in the Channel Operational Test. The scaled allowable value for calibration and periodic surveillance should be in agreement with the Technical Specifications allowable value, and it should reflect the Technical Specifications inequalities.

The calibration value for the comparator reset point (or deadband) must be included in the scaling calculation.

When applicable, use the signal processing module scaling equations to determine module-specific gain and bias settings.

For complex non-linear devices, a graph of the instrument scaling and associated instrument settings should be considered. This approach provides visual feedback of the loop characteristics in an effort to minimize human performance errors in the origination and verification of the analyses.

The scaling of time constants associated with dynamic settings for lead, lag and/or rate compensation are typically calculated based on the nominal time constants specified in design documentation, with the time constant calibration tolerance being a function of the equipment specifications.

For Vogtle RTS/ESFAS and NSSS control system functions modeled in the safety analysis and/or listed in the Technical Specifications, the dynamic compensation must be scaled to reflect the conservatism associated with the inequalities provided for each time constant listed in the Technical Specification or PLS. This approach is similar to RTS/ESFAS trip setpoints. The upper or lower calibration setting, depending on the direction of conservatism, must be scaled such that the specified time constant equals the high or low calibration limit. The other calibration limit is the specified tolerance for the given compensation circuit with the plant's target value at the mid-point of the band defined by these limits.

9. Detailed Plant Technical Data Book Scaling Analysis (Section 4.3)

Perform a review of the Plant Technical Data Book when creating or revising a Scaling Document. If the scaling impacts any curves, tables, or other data in the Plant Technical Data Book, the scaling calculations should include an updated curve, table, and/or data to ensure the Plant Technical Data Book is maintained up to date with the current Scaling Document and plant calibration procedures.

For tank level instrumentation not included in the current Plant Technical Data Book scope, the scaling calculations should include a new curve indicating the tank volume versus indicated level (in feet, inches, or percent level). The site should include this new curve in the Plant Technical Data Book.

In conjunction with the scaling calculation, provide a brief description of the purpose of the curve.

The resultant curves, tables, and/or data are included as attachments to the Scaling Document,

10. Calibration Data Tables (Section 8.0)

This section tabulates the scaling calculation results in calibration data tables for site I&C procedure writers and technicians. Tables are provided for each sensor and rack module for all instrument channels within the defined scope.

When a specific reference is associated with a given instrument (e.g., isometric drawing for a transmitter sensing line as-built configuration), it is preferred that such references be provided in calibration data summary table in lieu of the detailed scaling calculation section.

The typical sensor/transmitter data table fields include: unit no.; loop no.; manufacturer; style/model no.; protection/control set; TPNS/plant ID; function; references; instrument isometric drawing; range (%); input (inches H_20); and output (ma or mvdc).

Some transmitters also require a scaling data table for the specific elevations associated with the process instrument taps, sensing line configuration, transmitter center-line, etc. These data are used as inputs to the transmitter-specific scaling calculation.

The typical signal processing module data table fields include: unit no.; loop no.; rack location; manufacturer style/model no.; protection/control set; TPNS/plant ID; function; references; range (%); input 1 (ma or mvdc); if applicable, input 2 (ma or mvdc); output 1 (ma or mvdc); and, if applicable, output 2 (ma or mvdc).

The typical comparator module data table fields include: unit no.; loop no.; rack location; manufacturer style/model no.; protection/control set; TPNS/plant ID; function; references; setpoint parameters (TS trip setpoint, nominal trip setpoint, allowable value, & reset point); process values (setting value in % & signal direction for each setpoint parameter); and voltage values (setting value in mvdc & signal direction for each setpoint parameter).

Calibration data for string calibration verification may be provided in the comparator tables or tabulated separately.

The typical controller module data table fields include: unit no.; loop no.; rack location; manufacturer style/model no.; control set; TPNS/plant ID; function; references; setpoint parameters (gain, reset time constant, bias, upper limit, lower limit); and calibration values for each setpoint parameter (gain value, time constant in seconds, & upper/lower limits in mvdc).

11. References (Section 9.0)

A list of reference materials not explicitly referenced in other sections of the Scaling Document should be provided. Such references may include; industry codes, standards and regulations; P&IDs; logic diagrams; loop drawings, electrical elementaries; level set diagrams; vendor technical manuals and specifications; technical reports; and engineering calculations.

12. Version History (Section 10.0)

The change history for each Version is summarized on this table. The table fields include the version number, change date, and comments. The comments should include a brief descriptive summary and reference the source of the change. This history should address physical plant changes that have occurred through design change processes (EDs / MDCs / DCPs) or scaling/calibration changes associated with the RER process or loop tuning efforts performed by the plant staff.

13 Attachments

Curves generated for inclusion in the Plant Technical Data Book or plant operating, surveillance, or emergency procedures are included in the Attachment section of the Scaling Document.