PSE&G

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November 20, 1981

RECEIVED NOV 25 1981 U.S. NUCLEAR REGULATORY COMMISSION

Director of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20014

Attention: Mr. S. A. Varga, Chief
Operating Reactors Branch 1
Division of Licensing

Gentlemen:

INSTRUMENT TRIP SETPOINT METHODOLOGY
NO. 2 UNIT
SALEM NUCLEAR GENERATING STATION
DOCKET NO. 50-311

PSE&G hereby submits five (5) copies of its report related to Reactor Protection System and Engineered Safety Features Actuation System Setpoint Methodology, pursuant to paragraph 2.c(5) of Facility Operating License DPR-75.

This report contains information which is proprietary to the Westinghouse Electric Corporation. Accordingly, we request that this report be withheld from public disclosure pursuant to section 2.790 of the Commission's regulations.

In order not to delay this submittal of information requested by the Commission, we will comply with the requirements of 10CFR2.790 to provide proprietary and non-proprietary versions together with an affidavit, as soon as Westinghouse specifically identifies the proprietary information contained in the report and provides us with an affidavit. We will submit ten (10) copies each of the proprietary and non-proprietary versions of the report and the required affidavit at that time. In the meantime,

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we are providing the enclosed copies of the proprietary report for your review. Westinghouse has advised us that this procedure has been discussed with Mr. E. Shomaker of the Office of the Executive Legal Director, and that he concurs.

A copy of this submittal is being sent to Westinghouse requesting them to specifically identify the proprietary information and to supply the required affidavit. Westinghouse has advised us that they will be able to return the report and affidavit to us within a week of their receipt of the report. Westinghouse advises us that the file number for the pending and properly executed format will be CAW-81-84.

Very truly yours,

E. A. Liden
Manager - Nuclear Licensing

Enclosures

CC Mr. Leif Norrholm
Senior Resident Inspector
Mr. Gary C. Meyer
Licensing Project Manager

NOVEMBER 1981

PSE&G

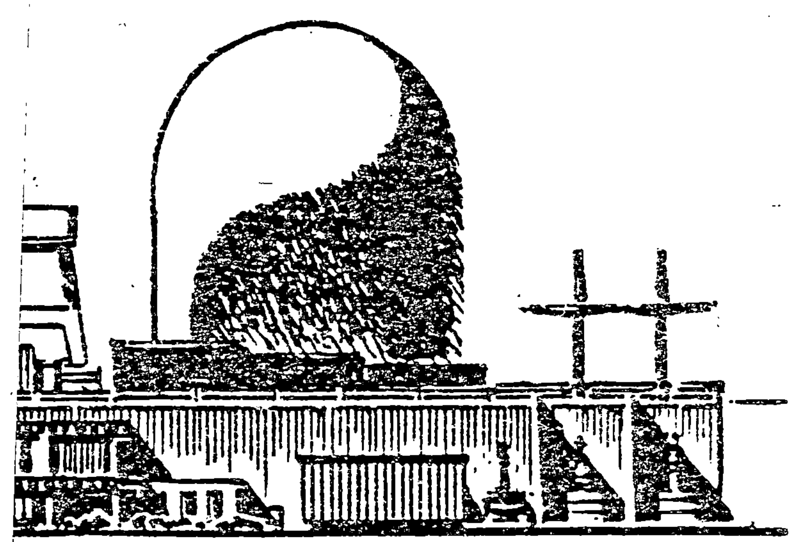
The Energy People

SALEM NUCLEAR GENERATING STATION

UNIT NO. 2

REACTOR PROTECTION SYSTEM AND ENGINEERED SAFETY FEATURES ACTUATION SYSTEM SETPOINT METHODOLOGY

PROPRIETARY



PROPRIETARY

REACTOR PROTECTION SYSTEM
AND
ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
SETPOINT METHODOLOGY
SALEM UNIT #2

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1.0 INTRODUCTION

The Salem No. 2 full power operating license contains Condition 2.c(5) which requires PSE&G to submit a response to a series of NRC questions on setpoint methodology. This document contains the Westinghouse and Public Service Electric and Gas response to those questions.

The information desired pertains to the various instrument channel components' analysis assumptions, i.e., a channel breakdown and values, for the Reactor Protection System (RPS) and the Engineered Safety Features Actuation System (ESFAS). Some of the information requested is already available in public documents, e.g., Chapter 14 of the Safety Analysis Report. The rest of the information has not been released and is drawn from equipment specifications or analysis assumptions. This information is considered proprietary by Westinghouse and is noted as such.

The basic underlying assumption used is that several of the error components and their parameter assumptions act independently, e.g., [rack versus sensors and pressure/temperature assumptions]$^{+a,c}$. This allows the use of a statistical summation of the various breakdown 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 arithmetic summation, e.g., [drift and calibration error]$^{+a,c}$. The explanation of the overall approach is provided in Section 2.

Section 3 presents the information requested along with three examples of individual channels, T_{avg}, Overtemperature ΔT, and Overpower ΔT. Also located

in this section are descriptions, or definitions, of the various parameters used. This insures a clear understanding of the breakdown presented; in nearly all cases a significant margin exists between the statistical summation and the total allowance.

2.0 COMBINATION OF ERROR COMPONENTS

2.1 Methodology

The methodology used to combine the error components for a channel is basically the appropriate statistical combination of those groups of components which are statistically independent, i.e., not interactive. Those errors which are not independent are summed arithmetically into groups. The groups themselves are independent effects which can then be systematically combined.

The methodology used for this combination is not new. Basically it is the ["square root of the sum of the squares"] +a,c,e which has been utilized in other Westinghouse reports. This technique, or other statistical approaches of a similar nature, have been used in WCAP-9180[1] and WCAP-8567[2]. It should be noted that WCAP-8567 has been approved by the NRC Staff thus noting the acceptability of statistical techniques for the application requested. It should also be recognized that the approach used in this document was submitted on the D. C. Cook Unit No. 2 Docket (50-316) and approved by the NRC Staff in a letter dated February 12, 1981. Thus it can be seen that the use of statistical approaches in analysis techniques is becoming more and more widespread.

The relationship between the error components and the total statistical error allowance for a channel is,

$$\left[\text{Total Error} = EA + \sqrt{(PMA)^2 + (PEA)^2 + (SCA+SD)^2 + (STE)^2 + (SPE)^2 + (RCA+RCSA+RD)^2 + (RTE)^2} \right]^{+a,c} \qquad \text{(Eq. 2.1)}$$

(1) Little, C. C., Kopelic, S. D., and Chelemer, H., "Consideration of Uncertainties in the Specification of Core Hot Channel Factor Limits." WCAP-9180 (Proprietary), WCAP-1981 (Non-proprietary), September, 1977.

(2) Chelemer, H., Bowman, L. H., and Sharp, D. R., "Improved Thermal Design Procedure, "WCAP-8567 (proprietary), WCAP-8763 (Non-proprietary), July, 1975.

where:

PMA = Process Measurement Accuracy
PEA = Primary Element Accuracy
SCA = Sensor Calibration Accuracy
SD = Sensor Drift
STE = Sensor Temperature Effects
SPE = Sensor Pressure Effects
RCA = Rack Calibration Accuracy
RCSA = Rack Comparator Setting Accuracy
RD = Rack Drift
RTE = Rack Temperature Effects
EA = Environmental Allowance

As can be seen in Equation 2.1, [drift and calibration accuracy] +a,c allowances are interactive and thus not independent. The [environmental allowance] +a,c is not necessarily considered interactive with all other parameters, but as an added degree of conservatism is added arithmetically to the statistical sum.

2.2 Sensor Allowances

Four parameters are considered to be sensor allowances, SCA, SD, STE, and SPE (see Table 3-4). Of these four parameters, two are considered to be independent, [STE and SPE] +a,c, and two are considered interactive [SD and SCA] +a,c. [STE and SPE] +a,c are considered to be independent due to the manner in which the instrumentation is checked, i.e., the instrumentation is [calibrated and drift determined under conditions in which pressure and temperature are assumed constant] +a,c. An example of this would be as follows: [let's say a sensor is placed in some position in the containment during a refueling outage. After placement, an instrument technician calibrates the sensor. This calibration was performed at ambient pressure and temperature] +a,c

[conditions. Some time later with the plant shutdown, an instrument technician checks for sensor drift. Using the same technique as for calibrating the sensor, the technician determines if the sensor has drifted or not. The conditions under which this determination is made are again at ambient pressure and temperature conditions. Thus the temperature and pressure have no impact on the drift determination and are, therefore, independent of the drift allowance]+a,c. [SD and SCA]+a,c are considered to be interactive for the same reason that [STE and SPE]+a,c are considered independent, i.e., due to the manner in which the instrumentation is checked. [Instrument calibration techniques use the same process as determining instrument drift, that is the end result of the two is the same. When calibrating a sensor, the sensor output is checked to determine if it is representing accurately the input. The same is done for a determination of the sensor drift. Thus it is impossible to determine the differences between calibration errors and drift when a sensor is checked the second or any subsequent time]+a,c. Based on this reasoning, [SD and SCA]+a,c have been added to form an independent group which is then factored into Equation 2.1. An example of the impact of this treatment is; for Pressurizer Water Level-High (sensor parameters only):

+a,b,c

$$\left[\begin{array}{lcl} SCA & = & 0.5 \\ SD & = & 1.0 \\ STE & = & 0.5 \\ SPE & = & 0.5 \end{array}\right]$$

Using Equation 2.1 as written gives a total of;

+a,c

$$\left[\begin{array}{l} \sqrt{(SD + SCA)^2 + (STE)^2 + (SPE)^2} \\ \sqrt{(1.0 + 0.5)^2 + (0.5)^2 + (0.5)^2} \end{array}\right] = 1.66 \text{ percent}$$

Assuming no interactive effects for any of the parameters gives the following results:

$$\left[\begin{array}{l}\sqrt{(SCA)^2 + (SD)^2 + (STE)^2 + (SPE)^2} \\ \sqrt{(0.5)^2 + (1.0)^2 + (0.5)^2 + (0.5)^2} = 1.32 \text{ percent}\end{array}\right]^{+a,c} \qquad \text{(Eq. 2.2)}$$

Thus it can be seen that the approach represented by Equation 2.1 which accounts for interactive parameters results in a more conservative summation of the allowances.

2.3 Rack Allowances

Four parameters, as noted by Table 3-4, are considered to be rack allowances, RCA, RCSA, RTE, and RD . Three of these parameters are considered to be interactive (for much the same reason outlined for sensors in 2.2), [RCA, RCSA, and RD]+a,c. [When calibrating or determining drift in the racks for a specific channel, the processes are performed at essentially constant temperature, i.e., ambient temperature. Because of this, the RTE parameter is considered to be independent of any factors for calibration or drift. However, the same cannot be said for the other rack parameters. As noted in 2.2, when calibrating or determining drift for a channel, the same end result is desired, that is at what point does the bistable change state. After initial calibration it is not possible to distinguish the difference between a calibration error, rack drift or a comparator setting error]+a,c. Based on this logic, these three factors have been added to form an independent group. This group is then factored into Equation 2.1. The impact of this approach (formation of an independent group based on interactive components) is significant. For the same channel using the same approach outlined in Equations 2.1 and 2.2 the following results are reached:

+a,b,c

RCA = 0.5 percent
RCSA = 0.25 percent
RTE = 0.5 percent
RD = 1.0 percent

using Equation 2.1 the result is:

+a,c

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

$$\sqrt{(0.5 + 0.25 + 1.0)^2 + (0.5)^2} = 1.82 \text{ percent}$$

Assuming no interactive effects for any of the parameters yields the following less conservative result;

+a,c

$$\sqrt{(RCA)^2 + (RCSA)^2 + (RD)^2 + (RTE)^2} \qquad \text{(Eq. 2.3)}$$

$$\sqrt{(0.5)^2 + (0.25)^2 + (1.0)^2 + (0.5)^2} = 1.25 \text{ percent}$$

Thus the impact of the use of Equation 2.1 is even greater in the area of rack effects than for the sensor. Therefore, accounting for interactive effects in the statistical treatment of these allowances insures a conservative result.

Finally, the PMA and PEA parameters are considered to be independent of both sensor and rack parameters. PMA provides allowances for the non-instrument related effects, e.g., neutron flux, calorimetric power error assumptions, fluid density changes, and temperature stratification assumptions. PEA accounts for errors due to metering devices, such as elbows and venturies. Thus, these parameters have been statistically factored into Equation 2.1.

3.0 RESPONSE TO NRC QUESTIONS

3.1 Approach

As noted in Section One, Westinghouse utilizes a statistical summation of the various components of the channel breakdown. This approach is valid where no dependency is present. An arithmetic summation is required where an interaction between two parameters exists, Section Two provides a more detailed explanation of this approach. The equation used to determine the margin, and thus the acceptability of the parameter values used, is:

+a,c

$$\left[\text{Margin} = (TA) - \left(EA + \sqrt{(PMA)^2 + (PEA)^2 + (SCA+SD)^2 + (SPE)^2 + (RCA+RCSA+RD)^2 + RTE)^2} \right) \right] \quad \text{(Eq. 3.1)}$$

where:

TA = Total Allowance , and

all other parameters are as defined for Equation 2.1.

Tables 3-1 through 3-3 provide examples of individual channel breakdowns and margin calculations for Tavg., Overtemperature ΔT, and Overpower ΔT. It should be noted that only those channels which Westinghouse takes credit for in the analysis are provided with detailed breakdowns. For those channels not assumed to be primary trips, there are no Safety Analysis Limits, thus no Total Allowance or Margin can be determined.

3.2 Definitions for Protection System Setpoint Tolerances

To insure a clear understanding of the channel breakdown used by Westinghouse in this report, the following definitions are noted:

1. Trip Accuracy

The tolerance band containing the highest expected value of the difference between (a) the desired trip point value of a process variable and (b) the actual value at which a comparator trips (and thus actuates some desired result). This is the tolerance band, in percent of span, within which the complete channel must perform its intended trip function. It includes comparator setting accuracy, channel accuracy (including the sensor) for each input, and environmental effects on the rack-mounted electronics. It comprises all instrumentation errors; however, it does not include process measurement accuracy.

2. Process Measurement Accuracy

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.

3. Actuation Accuracy

Synonymous with trip accuracy, but used where the work "trip" does not apply.

4. Indication Accuracy

The tolerance band 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. An indication must fall within this tolerance band. It includes channel accuracy, accuracy of readout devices, and rack environmental effects, but not process measurement accuracy such as fluid stratification. It also assumes a controlled environment for the readout device.

5. 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. Rack environmental effects are not included here to avoid duplication due to dual inputs, however, normal environmental effects on field mounted hardware is included.

6. Sensor Allowable Deviation

The accuracy that can be expected in the field. It includes drift, temperature effects, field calibration and for the case of d/p transmitters, an allowance for the effect of static pressure variations.

The tolerances are as follows for the original sensors installed in the Westinghouse supplied systems:

a. Reference (calibration) accuracy - [±0.5] +abc percent unless other data indicates more inaccuracy. This accuracy is the SAMA reference accuracy as defined in SAMA standard PMC-20-1-1973[1].

b. Temperature effect - [0.5] +abc percent based on a nominal temperature coefficient of [±1] +abc percent/100°F and a maximum assumed change of 50°F.

c. Pressure effect - usually calibrated out because pressure is constant. If not constant, nominal [±0.5] +abc percent is used. Present data indicates a static pressure effect of approximately [±1.0] +abc percent/1000 psi.

d. Drift - change in input-output relationship over a period of time at reference conditions (e.g., [constant temperature] +a,c - [±1 percent] +abc of span).

The above values are based on Westinghouse test data.

PSE&G has replaced the original Westinghouse supplied sensors with Rosemount sensors in the following protection channels:

Pressurizer Pressure - Low Reactor Trip
Pressurizer Pressure - High
Low Trip System Pressure - Turbine Trip
Pressurizer Pressure - Low Safety Injection
Differential Pressure Between Two Steamlines - High
Steam Flow in Two Steamlines - High
Steamline Pressure - Low

The tolerances for the sensors in the above protection channels, based on Rosemount specifications, are as follows:

a. Reference (calibration) accuracy is ±.25 percent. This is the reference accuracy as defined in SAMA Standard PMC-20-1-1973[1].

b. Temperature effect - ±.625 percent based on ±1.25 percent/100°F and maximum assumed change of 50°F.

c. Pressure effect - usually calibrated out because pressure is constant. If not constant, nominal ±.625 percent based on a static pressure effect of ±1.25 percent/1000 psi.

d. Drift - Change in input-output relationship over a period of time at reference conditions (e.g. [constant temperature]+a,c) - ±.25 percent of upper range limit for six months.

PSE&G is planning to install Rosemount transmitters with the above tolerances into the following protection channels:

Pressurizer Water Level - High
Steam Generator Water Level - Low Low
Steam Generator Water Level - Low
Containment Pressure - High
Containment Pressure - High High
Steam Generator Water Level - High High

Table 3-4A is included herein to reflect the planned changeout of presure transmitters in the above channels.

7. Rack Allowable Deviation

The tolerances are as follows:

a. Rack Calibration Accuracy

The accuracy that can be expected during a calibration at reference conditions. This accuracy is the SAMA reference accuracy as defined in SAMA standard PMC-20-1-1973[1]. This includes all modules in a rack and is a total of [±0.5] +abc percent of span assuming the chain of modules is tuned to this accuracy. For simple loops where a power supply (not used as a converter) is the only rack module, This accuracy may be ignored. All rack modules individually must have a reference accuracy within [±0.5] +abc percent.

b. Rack Environmental Effects

Includes effects of temperature, humidity, voltage, and frequency changes of which temperature is the most significant. An accuracy of [±0.5] +abc percent is used which considers a nominal ambient temperature of 70°F with extremes to 40°F and 120°F for short periods of time.

c. Rack Drift (instrument channel drift) - change in input-output relationship over a period of time at reference conditions (e.g., [constant temperature] +a,c) - ±1 percent of span.

d. Comparator Setting Accuracy

Assuming an exact electronic input, (Note that the channel accuracy takes care of deviations from this ideal), the tolerence on the precision with which a comparator trip value can be set, within such practical constraints as time and effort expended in making the setting.

(1) Scientific Apparatus Manufacturers Association, Standard PMC-20-1-1973, "Process Measurement and Control Terminology."

The tolerances are as follows:

(a) Fixed setpoint with a single input - [±0.25] +abc percent accuracy. This assumed that comparator nonlinearities are compensated by the setpoint.

(b) Dual input - an additional [±0.25] +abc percent must be added for comparator nonlinearities between two inputs. Total [±0.5] +abc percent accuracy.

Note: The following four definitions are currently used in the Standardized Technical Specifications (STS).

8. Nominal Safety System Setting

The desired setpoint for the variable. Initial calibration and subsequent recalibrations should be made at the nominal safety system setting ("Trip Setpoint" in STS).

9. Limiting Safety System Setting

A setting chosen to prevent exceeding a Safety Analysis Limit ("Allowable Values" in STS). (Violation of this setting represents an STS violation).

10. Allowance for Instrument Channel Drift

The difference between (8) and (9) taken in the conservative direction.

11. Safety Analysis Limit

The setpoint value assumed in safety analyses.

12. Total Allowable Setpoint Deviation

Same definition as 9, but the difference between 8 and 12 encompasses [6 and 7]. +a,c

3.3 NRC Questions

The information requested by the NRC for each channel is:

1. What is the technical specification trip setpoint value?
2. What is the technical specification allowable value?
3. What instrument drift is assumed to occur during the interval between technical specification surveillance tests?
4. What are the components of the cumulative instrument bias (e.g., instrument calibration error, instrument drift, instrument error, etc.)?
5. What is the margin between the sum of the channel instrumentation error allowances and the total instrumentation error allowance assumed in the accident analysis?

The Westinghouse and PSE&G response to these questions is:

a. The response to Question 1 will be found as Column 14 of Table 3-4 in this section.
b. Column 13 of Table 3-4 provides the information requested in Question 2.
c. The instrument drift assumed is the difference between the trip setpoint and the allowable value in the technical specifications, this can be found as Column 11 of Table 3-4.
d. The bulk of Table 3-4 provides the breakdown values required by Question 4.
e. The margin requested by Question 5 is noted in Column 17 of Table 3-4.

It should be remembered that responses are provided only for those channels for which credit is taken in the accident analysis. Again this is due to the fact that Question 5 cannot be answered if the channel is not a primary trip.

TABLE 3-1

Tavg Channel Accuracy

Parameter	Allowance*
Sensor Calibration	
[2 RTDs ±0.2°F $\left(\frac{T_h + T_c}{2}\right)$] †a,c	±0.2 †abc
Sensor Drift	
[RTDs - no drift] †a,c	0.0
Comparator	
One input	±0.25
Rack Calibration	
[RTD R/I converter (0.5% of 120°F span) Tavg ±0.36% + ±0.36% (gain = 0.6)] †a,c	±0.72
Rack Accuracy	
Tavg channel	±0.5
Total Tavg	±1.22
Rack Temperature Effect	±0.5
Rack Drift	±2.0
Process Measurement Error	
[Tavg ±1°F] †a,c	±1.0

*in percent of span.

The margin, based on Equation 3.1, is calculated as follows:

$$\left[\sqrt{(1.0)^2+(0.0)^2+(0.0+0.2)^2+(0.0)^2+(1.22+0.25+2.0)^2+(0.5)^2+0.0}\right]^{\dagger abc}$$

+ [3.7%] †abc. The Total Allowance is 4.0%, thus the margin is [+0.3%] †a,b,c of span.

TABLE 3-2

Overtemperature ΔT Channel Accuracy

Parameter	Allowance*
Sensor Calibration	
2 RTDs ±0.2 ^{o}F $\left(\frac{T_h + T_c}{2}\right)$ †a,c	±0.2 †abc
Pressure Sensor ±0.5% (4 psi) with a gain of 0.05 ^{o}F/psi	±0.2
Sensor Temperature Effect	
Pressure Sensor ±0.5% (4 psi) with a gain of 0.05 ^{o}F/psi †a,c	±0.2
Sensor Drift	
RTDs no drift †a,c	0.0
Pressure Sensor ±1.0% (8 psi) with a gain of 0.05 ^{o}F/psi	±0.4
Rack Calibration	
RTD R/I converters (0.5% of 120 ^{o}F span) †a,c	
ΔT ±0.6% + ±0.6% (gain = 1)	±1.2
Tavg ±0.36% + ±0.36% (gain = 0.6)	±0.72
Rack Accuracy	
ΔT Channel	±0.5
Tavg Channel	±0.5
Total	
ΔT Channel	±1.7
Tavg Channel	±1.22
Comparator	
Two inputs	±0.5
Rack Temperature Effects	±0.5
Rack Drift	
ΔT Channel	±1.0
Tavg Channel	±1.0
Calorimetric Error (used to calibrate ΔT)	
2% of nominal full power (~65 ^{o}F) †a,c	±1.3
Process Measurement Error	
Tavg ±1.0 ^{o}F x (1.0) typical gain †a,c	±1.0

*in percent of span, (100 ^{o}F span = 150% power)

TABLE 3-2 (Cont'd)

The Margin, based on Equation 3.1, is calculated as follows:

$$\left[\sqrt{(1.0)^2+(1.3)^2+(0.4+0.4)^2+(0.0)^2+(0.2)^2+(1.7+0.25+1.0)^2+(1.22+0.25+1.0)^2+(0.5)^2+0.0}\right]^{+a,b}$$

$= \left[4.3\%\right]^{+a,c}$. The Total Allowance is 7.0%, thus the margin is $\left[2.7\%\right]^{+a,c}$ of span.

TABLE 3-3

Overpower ΔT Channel Accuracy

Parameter	Allowance*	
Sensor Calibration		
[2 RTDs ±0.2^{o}F $\left(\frac{T_h + T_c}{2}\right)$] †a,c	±0.2	†abc
Sensor Drift		
[RTDs - no drift] †a,c	0.0	
Rack Calibration		
[RTD R/I converter (0.5% of 120^{o}F span)		
ΔT ±0.6% + ±0.6% (gain = 1)	±1.2	
Tavg ±0.36% + ±0.36% (gain = 0.6)] †a,c	±0.72	
Rack Accuracy		
ΔT Channel	±0.5	
Tavg Channel	±0.5	
Total		
ΔTChannel	±1.7	
Tavg Channel	±1.22	
Comparator		
Two inputs	±0.5	
Rack Temperature Effect	±0.5	
Rack Drift		
ΔT Channel	±1.0	
Tavg Channel	±1.0	
Calorimetric Error (used to calibrate ΔT)		
[2% of nominal power (~65^{o}F)] †a,c	±1.3	
Process Measurement Error		
[Tavg ±1.0^{o}F x (0.01) typical gain] †a,c	±0.1	

*in percent of span, (100^{o}F span = 150% power)

TABLE 3-3 (Cont'd)

The margin based on Equation 3.1 is calculated as follows:

$$\left[\sqrt{(1.3)^2+(0.1)^2+(0.2)^2+(0.0)^2+(0.0)^2+(1.7+0.25+1.0)^2+(1.22+0.25+1.0)^2+(0.5)^2+0.0}\right]^{+abc}$$

$= \left[4.1\%\right]^{+abc}$. The Total Allowance is 4.5%, thus the margin is $\left[0.4\%\right]^{+abc}$ of span.

NOTES FOR TABLE 3-4

(1) All values in percent span.

(2) As noted in Table 14.1-3 of SAR.

(3) As noted in Table 2.2-1 and 3.3-4 of Westinghouse STS.

(4) Included in [1.7% Calorimetric allowance in Process Measurement Accuracy.] +a,c

(5) Not used in the Safety Analysis.

(6) As noted in Figure 14.1-1 of SAR.

(7) As noted in Notes 1 and 2 of Table 2.2-1 of Westinghouse STS.

(8) [Calorimetric allowance.] +a,c

(9) Venturi.

(10) Not Westinghouse scope.

(11) Included in [Process Measurement Accuracy.] +a,c

(12) As noted in Table 3.3-4 of Westinghouse STS.

(13) Does not impact Safety Analysis results.

(14) Trip setpoint function of note (12) plus 10%.

(15) Included in [Process Measurement Accuracy.] +a,c

(16) Not found in Table 14.1-3 of SAR but used in Safety Analysis.

(17) [Environmental Allowance on one transmitter only because of location.] +a,c

(18) [Use of a rate (derivative) eliminates sensor steady state errors.] +a,c

TABLE 3-4

REACTOR PROTECTION SYSTEM/ENGINEERED SAFETY FEATURES ACTUATION SYSTEM CHANNEL ERROR ALLOWANCE

	1	2	3	4	5	6	7	8
			Sensor					
Protection Channel	(PMA) Process Measurement Accuracy (1)	(PEA) Primary Element Accuracy (1)	(SCA) Calibration Accuracy (1)	(SPE) Pressure Effects (1)	(STE) Temperature Effects (1)	(SD) Drift (1)	(EA) Environmental Allowance (1)	(RCA) Calibration Accuracy (1)
Power Range, Neutron Flux-High Setpoint	1.7(8) & 4.2	--	(4)	(4)	(4)	(4)	--	0.5
Power Range, Neutron Flux-Low Setpoint	1.7(8) & 4.2	--	(4)	(4)	(4)	(4)	--	0.5
Power Range, Neutron Flux-High Positive Rate	(18)	--	(18)	(18)	(18)	(18)	--	0.5
Power Range, Neutron Flux-High Negative Rate	(18)	--	(18)	(18)	(18)	(18)	--	0.5
Intermediate Range, Neutron Flux	8.4	--	(15)	(15)	(15)	(15)	--	0.5
Source Range, Neutron Flux	10.0	--	(15)	(15)	(15)	(15)	--	0.5
Overtemperature ΔT ΔT Channel	1.3(8)	--	--	--	--	--	--	1.7
T_{avg} Channel	1.0	--	0.2	--	--	--	--	1.22
Pressurizer Pressure Channel	--	--	0.2	--	0.2	0.4		
Overpower ΔT ΔT Channel	1.3(8)	--	--	--	--	--	--	1.7
T_{avg} Channel	0.1	--	0.2	--	--	--	--	1.22
Pressurizer Pressure-Low Reactor Trip	--	--	0.25	--	0.625	0.5	--	0.5
Pressurizer Pressure-High	--	--	0.25	--	0.625	0.5	--	0.5
Pressurizer Water Level-High	2.0	--	0.5	0.5	0.5	1.0	--	0.5
Loss of Flow	--	0.5	0.5	0.5	0.5	1.0	--	0.5
Steam Generator Water Level - Low-Low	2.0	--	0.5	0.5	0.5	1.0	+13.0	0.5
Steam/Feedwater Flow Mismatch Steam Flow	3.0	--	0.5	0.5	0.5	1.0	+10.0(17)	0.5
Feed Flow	--	0.5(9)	0.5	0.5	0.5	1.0	--	0.5
Steam Generator Water Level-Low	2.0	--	0.5	0.5	0.5	1.0	--	0.5
Undervoltage - RCP	--	--	--	--	--	--	--	--
Underfrequency - RCP	--	--	--	--	--	--	--	--
Low Trip System Pressure-Turbine Trip	--	--	--	--	--	--	--	--
Turbine Stop Valve Closure-Turbine Trip	--	--	--	--	--	--	--	--
Containment Pressure-High	--	--	0.5	--	0.5	1.0	--	0.5
Pressurizer Pressure-Low Safety Injec.	--	--	0.25	--	0.625	0.5	--	0.5
Differential Pressure Between Two Steamlines - High	--	--	0.25	--	0.625	0.5	--	0.5

+a,c

PROPRIETARY

TABLE 3-4 (Cont'd)

+a,c

9	10	11	12	13	14	15	16	17
Rack Mounted Electronics								
(RCSA) Comparator Setting Accuracy (1)	(RTE) Temperature Effects (1)	(RD) Drift (1)	Safety Analysis Limit (2)	STS Allowable Value (3)	STS Trip Setpoint (3)	Total Allowance (1)	Channel Statistical Allowance (1)	Margin (1)
0.25	0.5	1.0	118% RTP	110% RTP	109% RTP	7.5	4.9	+2.6
0.25	0.5	1.0	35% RTP	26% RTP	25% RTP	8.3	4.9	+3.4
0.25	0.5	1.0	(5)	5.5% RTP	5.0% RTP	--	1.8	--
0.25	0.5	1.0	(5)	5.5% RTP	5.0% RTP	--	1.8	--
0.25	0.5	4.2	(5)	30% RTP	25% RTP	--	9.8	--
0.25	0.5	3.0	(5)	1.3 x 10^5 cps	1.0 x 10^5 cps	--	10.7	--
0.25	0.5	1.0	function (6)	function (7)	function (7)	7.0	4.3	+2.7
0.25		1.0						
0.25	0.5	1.0	(5)	function (7)	function (7)	--	4.1	--
0.25		1.0						
0.25	0.5	1.0	1845 psig	1855 psig	1865 psig	2.5	2.1	0.4
0.25	0.5	1.0	2410 psig	2395 psig	2385 psig	3.1	2.1	+1.0
0.25	0.5	1.0	(5)	93% span	92% span	--	3.2	--
0.25	0.5	0.8	87% design	89% design	90% design	2.5	2.4	+0.1
0.25	0.5	1.0	0% span (16)	17% span	18% span	18.0	16.2	+1.8
0.25	0.5	0.6	(5)	42.5% steamflow	40% steamflow	--	14.3	--
0.25		0.5						
0.25	0.5	1.0	20% span	24% span	25% span	5.0	3.2	1.8
--	--	--	68% bus volt. (13)	65% bus volt.	70% bus volt.	5.0	0	5
--	--	--	53.9 Hz (16)	56.4 Hz	56.5 Hz	1.3	0	1.3
--	--	--	(5)	45 psig	45 psig	--	--	--
--	--	--	(5)	15% open	15% open	--	--	--
0.25	0.5	0.9	7.9 psig	4.5 psig	4.0 psig	6.5	2.3	+4.2
0.25	0.5	1.0	1735 psig	1755 psig	1765 psig	3.8	2.1	+1.7
0.25	0.5	0.5	(5)	112 psi	100 psi	--	2.3	--

+a,c

PROPRIETARY

TABLE 3-4 (Cont'd)

	1	2	3	4	5	6	7	8
			Sensor					
Protection Channel	(PMA) Process Measurement Accuracy (1)	(PEA) Primary Element Accuracy (1)	(SCA) Calibration Accuracy (1)	(SPE) Pressure Effects (1)	(STE) Temperature Effects (1)	(SD) Drift (1)	(EA) Environmental Allowance (1)	(RCA) Calibration Accuracy (1)
	--	--	0.25	--	0.625	0.5	--	0.5
Steam Flow in Two Steamlines - High	3.0	(11)	0.25	0.625	0.625	0.5	-10.0	0.5
			0.25		0.625	0.5		0.5
T_{avg} - Low-Low	1.0	--	0.2	--	--	--	--	1.22
Steamline Pressure - Low	--	--	0.25	--	0.625	0.5	--	0.5
Containment Pressure - High-High	--	--	0.5	--	0.5	1.0	--	0.5
Steam Generator Water Level - High-High	2.0	--	0.5	0.5	0.5	1.0	--	0.5

+a

PROPRIETARY

TABLE 3-4 (Cont'd)

Rack Mounted Electronics

+a,c

9	10	11	12	13	14	15	16	17
(RCSA) Comparator Setting Accuracy (1)	(RTE) Temperature Effects (1)	(RD) Drift (1)	Safety Analysis Limit (2)	STS Allowable Value (3)	STS Trip Setpoint (3)	Total Allowance (1)	Channel Statistical Allowance (1)	Margin (1)
0.25		0.5						
0.25		0.6						
	0.5		(5)	function (12)	function (12)	--	12.5	--
0.25		0.6						
0.25	0.5	2.0	(5)	541°F	543°F	--	3.7	--
0.25	0.5	1.3	~~480~~ psig	480 psig	500 psig	8.3	2.3	+6.0
0.25	0.5	0.9	26.7 psig	24 psig	23.5 psig	5.3	2.3	+3.0
0.25	0.5	1.0	75% span	68% span	67% span	8.0	3.2	+4.8

+a,c

PROPRIETARY

TABLE 3-4A

PLANNED REVISION TO TABLE 3-4

+a,c

	1	2	3	4	5	6	7	8
			Sensor					
Protection Channel	(PMA) Process Measurement Accuracy (1)	(PEA) Primary Element Accuracy (1)	(SCA) Calibration Accuracy (1)	([illegible]) Pressure Effects (1)	(STE) Temperature Effects (1)	(SD) Drift (1)	(EA) Environmental Allowance (1)	(RCA) Calibration Accuracy (1)
Pressurizer Water Level - High	2.0	--	0.25	0.625	0.625	0.5	--	0.5
Steam Generator Water Level - Low-Low	2.0	--	0.25	0.625	0.625	0.5	+13.0	0.5
Steam Generator Water Level - Low	2.0	--	0.25	0.625	0.625	0.5	--	0.5
Containment Pressure - High	--	--	0.25	--	0.625	0.5	--	0.5
Containment Pressure - High-High	--	--	0.25	--	0.625	0.5	--	0.5
Steam Generator Water Level - High-High	2.0	--	0.25	0.625	0.625	0.5	--	0.5

PROPRIETARY

TABLE 3-4A (Cont'd)

+a,c

9	10	11	12	13	14	15	16	17
Rack Mounted Electronics								
(RCSA) Comparator Setting Accuracy (1)	(RTE) Temperature Effects (1)	(RD) Drift (1)	Safety Analysis Limit (2)	STS Allowable Value (3)	STS Trip Setpoint (3)	Total Allowance (1)	Channel Statistical Allowance (1)	Margin (1)
0.25	0.5	1.0	(5)	93% span	92% span	--	2.9	--
0.25	0.5	1.0	0% span	17% span	18% span	18.0	15.9	+2.1
0.25	0.5	1.0	20% span	24% span	25% span	5.0	2.9	+2.1
0.25	0.5	0.9	7.9 psig	4.5 psig	4.0 psig	6.5	2.0	+4.5
0.25	0.5	0.9	26.7 psig	24 psig	23.5 psig	5.3	2.0	+3.3
0.25	0.5	1.0	75% span	68% span	67% span	8.0	2.9	+5.1

+a,c

PROPRIETARY