Westinghouse Energy Systems

Westinghouse Energy Systems

WESTINGHOUSE CLASS 3

WCAP - 12746

WESTINGHOUSE SETPOINT METHODOLOGY FOR PROTECTION SYSTEMS

TURKEY POINT UNITS 3 & 4

FLORIDA POWER & LIGHT COMPANY

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1.0 INTRODUCTION

In March of 1977, the NRC requested several utilities with Westinghouse Nuclear Steam Supply Systems to reply to a series of questions concerning the methodology for determining instrument setpoints. A revised methodology was developed in response to those questions with a corresponding defense of the technique used in determining the overall allowance for each setpoint.

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. 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 the standard, conservative approach, arithmetic summation, to form independent quantities, e.g., drift and calibration error. An explanation of the overall approach is provided in Section 2.0.

Section 3.0 provides a description, or definition, of each of the various components in the setpoint parameter breakdown, to allow a clear understanding of the breakdown. Also provided is a detailed example of each setpoint margin calculation demonstrating the technique and noting how each parameter value is derived. In all cases, margin exists between the summation and the total allowance.

Section 4.0 notes what the current Standard Technical Specifications use for setpoints and an explanation of the impact of the Westinghouse approach on them. Detailed examples of how to determine the Technical Specification setpoint values are also provided. An Appendix is provided noting a recommended set of Technical Specifications using the plant specific data in the Westinghouse approach.

2.0 COMBINATION OF ERROR COMPONENTS

2.1 METHODOLOGY

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

The methodology used is the "square root of the sum of the squares" which has been utilized in other Westinghouse reports. This technique, or others of a similar nature, has been used in WCAP-10395(1) and WCAP-8567(2). WCAP-8567 is approved by the NRC noting acceptability of statistical techniques for the application requested. Also, various ANSI, American Nuclear Society, and Instrument Society of America standards approve the use of probabilistic and statistical techniques in determining safety-related setpoints(3)(4). The methodology used in this report is essentially the same as that used for V. C. Summer in August, 1982; approved in NUREG-0717, Supplement No. 4(5).

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(1) Grigsby, J. M., Spier, E. M., Tuley, C. R., "Statistical Evaluation of LOCA Heat Source Uncertainty", WCAP-10395 (Proprietary), WCAP-10396 (Non-Proprietary), November, 1983.

(2) Chelemer, H., Boman, L. H., and Sharp, D. R., "Improved Thermal Design Procedure," WCAP-8567 (Proprietary), WCAP-8568 (Non-Proprietary), July, 1975.

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

(4) ISA Standard S67.04, 1987, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants."

(5) NUREG-0717, Supplement No. 4, "Safety Evaluation Report related to the Operation of Virgil C. Summer Nuclear Station, Unit No. 1", Docket No. 50-395, August, 1982.

The relationship between the error components and the total error for a channel is noted in Eq. 2.1,

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

where:

CSA	=	Channel Statistical Allowance
PMA	=	Process Measurement Accuracy
PEA	=	Primary Element Accuracy
SCA	=	Sensor Calibration Accuracy
SMTE	=	Sensor Measurement and Test Equipment Accuracy
SD	=	Sensor Drift
SPE	=	Sensor Pressure Effects
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
BIAS	=	Bias

As can be seen in the equation, drift and calibration accuracy allowances are interactive and thus not independent. The environmental allowance is not necessarily considered interactive with all other parameters, but as an additional degree of conservatism is added to the statistical sum. It should be noted that for this document, it is assumed that the accuracy effect on a channel due to cable degradation in an accident environment is less than 0.1 percent of span. This magnitude of impact is considered negligible and is not factored into the calculations. An error due to this cause, in excess of 0.1 percent of span is directly added as an environmental error.

The Westinghouse setpoint methodology, i.e., square root of the sum of the squares, results in a 95% probability with the confidence level defined by the appropriate combination of the various confidence levels of the input values. With the exception of the PMA, EA and RD terms, all uncertainties assumed are at least 2 σ values. Calibration accuracies are the extremes of the ranges and are better than 2 σ values. Rack drift is assumed based on a survey of reported plant LERs and is considered conservative. PMA values are determined or calculated on a conservative basis and are believed to be at least 2 σ values. Transmitter ambient, steady state values are based on vendor specification data and are considered 2 σ values. Transmitter EA values are based on vendor specification data and are reported by the vendor with a high confidence. The values noted in this document, with respect to streaming, are bounding, based on available data, and are treated in a conservative manner. Temperature streaming in the hot and cold legs is under Westinghouse review and no further impact on the trip setpoints is anticipated.

2.2 SENSOR ALLOWANCES

Five parameters are considered to be sensor allowances, SCA, SMTE, SD, STE, and SPE (see Table 3-23). Of these parameters, two are considered to be statistically independent, STE and SPE, and three are considered interactive, SCA, SMTE and SD. STE and SPE are considered to be independent due to the manner in which the instrumentation is checked, i.e., the instrumentation is calibrated and drift determined under conditions in which pressure and temperature are assumed constant. An example of this would be as follows; assume a sensor is placed in some position in the containment during a refueling outage. After placement, an instrument technician calibrates the sensor. This calibration is performed at ambient pressure and temperature conditions. Some time later with the plant shutdown, an instrument technician checks for sensor drift. Using the same technique as for calibrating the

sensor, the technician determines if the sensor has drifted. 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.

SCA, SMTE and SD are considered to be interactive for the same reason that STE and SPE are considered independent, i.e., due to the manner in which the instrumentation is checked. Instrumentation 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 performed for a determination of the sensor drift. Thus unless "as left/as found" data is recorded and used, it is impossible to determine the differences between calibration errors and drift when a sensor is checked the second or any subsequent time. Based on this reasoning, SCA, SMTE and SD have been added to form an independent group which is then factored into Equation 2.1. An example of the impact of this treatment for a level transmitter is (sensor parameters only):

SCA =
SMTE =
SPE =
STE =
SD =
[ ]+a,c

excerpting the sensor portion of Equation 2.1 results in;

$$((SCA + SMTE + SD)^2 + (SPE)^2 + (STE)^2)^{1/2}$$

[ ]+a,c = 2.12%

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

$$((SCA)^2 + (SMTE)^2 + (SD)^2 + (SPE)^2 + (STE)^2)^{1/2} \qquad \text{(Eq. 2.2)}$$

[ ]+a,c = 1.41%

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

Five parameters, as noted by Table 3-23, are considered to be rack allowances, RCA, RMTE, RCSA, RTE, and RD. Four of these parameters are considered to be interactive (for much the same reason outlined for sensors in 2.2), RCA, RMTE, RCSA, and RD. 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, without recording and using "as left/as found" data, it is not possible to distinguish the difference between a calibration error, rack drift or a comparator setting error. Based on this logic, these 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 a level transmitter channel, using the same approach outlined in Equations 2.1 and 2.2 results in the following:

$$
\begin{aligned}
RCA &= \\
RMTE &= \\
RCSA &= \\
RTE &= \\
RD &=
\end{aligned}
\left[\quad\quad\quad\right]^{+a,c}
$$

excerpting the rack portion of Equation 2.1 results in;

$$((RCA + RMTE + RCSA + RD)^2 + (RTE)^2)^{1/2}$$

$$[\quad\quad\quad\quad\quad\quad\quad\quad]^{+a,c} = 1.94\%$$

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

$$((RCA)^2 + (RMTE)^2 + (RCSA)^2 + (RD)^2 + (RTE)^2)^{1/2} \quad \text{(Eq. 2.3)}$$

$$[\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad]^{+a,c} = 1.26\%$$

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 treatment of these allowances insures a conservative result.

2.4 PROCESS ALLOWANCES

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. PMA may consist of more than one independent error allowance. PEA accounts for errors due to metering devices, such as elbows and venturis. Thus, these parameters have been factored into Equation 2.1 as independent quantities.

2.5 MEASUREMENT AND TEST EQUIPMENT ACCURACY

Westinghouse believes that some of the equipment used for calibration and functional testing of the transmitters and racks may not meet SAMA standard PMC 20.1-1973[1] with regards to test equipment accuracy of 10 percent or less of the calibration accuracy (referenced in 3.2.6.a and 3.2.7.a. of this report). This requires the inclusion of the accuracy of this equipment in the basic equations 2.1 and 3.1. Based on information provided by the plant, these additional uncertainties are included in the calculations (as noted on the tables included in this report) with some impact on the final results. On Table 3-23, the values of SMTE and RMTE are identified explicitly.

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(1) Scientific Apparatus Manufacturers Association, Standard PMC 20.1-1973, "Process Measurement and Control Terminology."

3.0 PROTECTION SYSTEM SETPOINT HODOLOGY

3.1 MARGIN CALCULATION

As noted in Section 2, Westinghouse utilizes the square root of the sum of the squares for 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. The equation used to determine the margin, and thus the acceptability of the parameter values used, is:

$$\text{Margin} = TA - ((PMA)^2 + (PEA)^2 + (SCA + SMTE + SD)^2 + (SPE)^2 + (STE)^2 + (RCA + RMTE + RCSA + RD)^2 + (RTE)^2)^{1/2} - EA - Bias \quad \text{(Eq. 3.1)}$$

where:

TA = Total Allowance (Safety Analysis Limit - Nominal Trip Setpoint), and

all other parameters are as defined for Equation 2.1.

Using Equation 2.1, Equation 3.1 may be simplified to:

$$\text{Margin} = TA - CSA \quad \text{(Eq. 3.2)}$$

Tables 3-1 through 3-22 provide individual channel breakdown and CSA calculations for all protection functions utilizing Westinghouse - Hagan 7100 analog process rack equipment, or Westinghouse Eagle digital equipment. Table 3-23 provides a summary of the previous 22 tables and includes Safety Analysis and Technical Specification values, Total Allowance and Margin.

3.2 DEFINITIONS FOR PROTECTION SYSTEM SETPOINT TOLERANCES

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

1. Trip Accuracy

The tolerance band is the region that contains 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 word "trip" does not apply.

4. Indication Accuracy

The tolerance band is the region that contains 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. It does include a controlled environment for the readout device.

5. Channel Accuracy

The accuracy of an analog or digital 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 Δp transmitters, an allowance for the effect of static pressure variations.

The tolerances are as follows:

a. Reference (calibration) accuracy - [ ]$^{+a,c}$ unless other data indicates more inaccuracy. This accuracy is the SAMA reference accuracy as defined in SAMA standard PMC 20.1-1973[1].

b. Measurement and Test Equipment accuracy - usually included as an integral part of (a), Reference (calibration) accuracy, when less than 10 percent of the value of (a). For equipment (DVM, pressure gauge, etc.) used to calibrate the sensor with larger uncertainty values, a specific allowance is made.

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(1) Scientific Apparatus Manufacturers Association, Standard PMC 20.1-1973, "Process Measurement and Control Terminology."

c. Temperature effect - [ ]+a,c based on a nominal temperature coefficient of [ ]+a,c/100°F and a maximum assumed change of 50°F (typical for Westinghouse supplied equipment). Specific calculations for Rosemount transmitters reflect model and range code requirements. For those devices located in containment, a maximum assumed change of 60°F per SECL-88-434 for containment temperature increase to 130°F is utilized for protection system setpoints.

d. Pressure effect - usually calibrated out because pressure is constant. If not constant, a nominal [ ]+a,c is used. Present data indicates a static pressure effect of approximately [ ]+a,c/1000 psi for Westinghouse supplied equipment. Specific calculations for Rosemount transmitters reflect model and range code requirements.

e. Drift - change in input-output relationship over a period of time (12 - 18 months)* at reference conditions (e.g., constant temperature - [ ]+a,c of span). Specific calculations for Rosemount transmitters reflect model and range code requirements for an 18 month period of time.

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

* NRC Generic Letter 89-14, 8/21/89, allows a surveillance internal extension of up to 25%.

accuracy as defined in SAMA standard PMC 20.1-1973(1). For an analog channel, this includes all modules in a rack and is a total of [ ]+a,c 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 analog process modules individually must have a reference accuracy within [ ]+a,c of span.

For a digital channel, this accuracy represents calibration of the signal conditioning - A/D converter providing input to the central processing unit. Each signal conditioning - A/D converter module is calibrated to within an accuracy of [ ]+a,b,c of span (for functions with rack inputs of 4-20 mA), or [ ]+a,b,c of span (for functions with RTD rack inputs).

b. Measurement and Test Equipment Accuracy

Is usually included as an integral part of (a), Reference (calibration) accuracy, when less than 10 percent of the value of (a). For equipment (DVM, current source, voltage source, etc.) used to calibrate the racks with larger uncertainty values, a specific allowance is made.

c. Rack Environmental Effects

Includes effects of temperature, humidity, voltage and frequency changes of which temperature is the most

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(1) Scientific Apparatus Manufacturers Association, Standard PMC 20.1-1973, "Process Measurement and Control Terminology".

significant. An accuracy of [ ]$^{+a,c}$ of span is used for analog racks, and [ ]$^{+a,b,c}$ is used for digital racks, which considers a nominal ambient temperature of 70°F with extremes to 40°F and 120°F for short periods of time.

d. Rack Drift

Instrument channel drift - change in input-output relationship over a period of time at reference conditions (e.g., constant temperature) - ± 1.0 percent of span for analog racks and [ ]$^{+a,c}$ span for digital racks. The time period applicable for analog racks is 30 days. The time period applicable for digital racks is 92 days.

e. Rack Comparator Setting Accuracy

For an analog channel, assuming an exact electronic input, (note that the "channel accuracy" takes care of deviations from this ideal), the tolerance 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.

The tolerances assumed for Turkey Point Units 3 & 4 are as follows for the Westinghouse - Hagan 7100 analog process racks:

(a) Fixed setpoint with a single input - [ ]$^{+a,c}$ of span accuracy. This assumes that comparator nonlinearities are compensated by the setpoint.

(b) Dual input - an additional [ ]$^{+a,c}$ of span must be added for comparator nonlinearities between two inputs. Total accuracy is [ ]$^{+a,c}$ of span.

Digital channels do not have an electronic comparator, therefore no uncertainty is included for this term for these channels.

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 recalibration should be made at the nominal safety system setting ("Trip Setpoint" in Turkey Point Units 3 & 4 Technical Specifications).

9. Limiting Safety System Setting

A setting chosen to prevent exceeding a Safety Analysis Limit ("Allowable Values" in Turkey Point Units 3 & 4 Technical Specifications). Violation of this setting may represent a Technical Specification violation (depending on the condition of all aspects of the instrumentation and analytical margin).

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

Maximum setpoint deviation from a nominal due to instrument hardware effects.

3.3 METHODOLOGY CONCLUSION

The Westinghouse setpoint methodology, i.e., square root of the sum of the squares, results in a 95% probability with the confidence level defined by the appropriate combination of the various confidence levels of the input values. With the exception of the PMA, EA and RD terms, all uncertainties assumed are at least 2 σ values. Calibration accuracies are the extremes of the ranges and are better than 2 σ values. Rack drift is assumed based on a survey of reported plant LERs and is considered conservative. PMA values are determined or calculated on a conservative basis and are believed to be at least 2 σ values. Transmitter ambient, steady state values are based on vendor specification data and are considered 2 σ values. Transmitter EA values are based on vendor specification data and are reported by the vendor with a high confidence. The values noted in this document, with respect to streaming, are bounding, based on available data, and are treated in a conservative manner. Temperature streaming in the hot and cold legs is under Westinghouse review and no further impact on the trip setpoints is anticipated.

TABLE 3-1

POWER RANGE, NEUTRON FLUX - HIGH AND LOW SETPOINTS

Parameter	Allowance*
Process Measurement Accuracy [ ]+a,c	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration [ ]+a,c	
Sensor Pressure Effects	
Sensor Temperature Effects [ ]+a,c	
Sensor Drift [ ]+a,c	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (120% Rated Thermal Power)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-2

INTERMEDIATE RANGE, NEUTRON FLUX

Parameter	Allowance*
Process Measurement Accuracy [ ]+a,c	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration [ ]+a,c	
Sensor Pressure Effects	
Sensor Temperature Effects [ ]+a,c	
Sensor Drift [ ]+a,c	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipme-' Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift 5% RTP	

* In percent span (conservatively assumed to be 120% Rated Thermal Power)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-3

SOURCE RANGE, NEUTRON FLUX

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
[ ]+a,c	
Primary Element Accuracy	
Sensor Calibration [ ]+a,c	
Sensor Pressure Effects	
Sensor Temperature Effects [ ]+a,c	
Sensor Drift [ ]+a,c	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Comparator	
One input	
Rack Temperature Effects	
Rack Drift	
3×10^4 CPS	

* In percent span (1×10^6 CPS)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-4

OVERTEMPERATURE ΔT

Parameter		Allowance*
Process Measurement Accuracy		[ ]+a,c
ΔT - ΔI - ΔI - Tavg -	[ ]+a,c	
Primary Element Accuracy		
Sensor Calibration		
ΔT - Pressure -	[ ]+a,c	
Measurement & Test Equipment Accuracy Pressure - [	]**+a,c	
Sensor Pressure Effects		
Sensor Temperature Effects Pressure - [	]**+a,c	
Sensor Drift		
ΔT - Pressure -	[ ]+a,c	
Bias		
Environmental Allowance		
Rack Calibration (Digital Process Racks)		
ΔT - [ ]+a,c Pressure ΔI		
Measurement & Test Equipment Accuracy		
ΔT Pressure ΔI		

TABLE 3-4 (Continued)

OVERTEMPERATURE ΔT

Parameter	Allowance*
Total Rack Calibration Accuracy	[ ]+a,c
[ ]+a,c	
Rack Temperature Effects	
ΔT - [ ]+a,c	
Pressure	
ΔI	
Rack Drift	
ΔT - [ ]+a,c	
Pressure	
ΔI	

---

* In percent span (Tavg - 75°F, pressure - 1000 psi, power - 120% RTP ΔT - 75°F, ΔI - ± 100% ΔI)

** See Table 3-24 for gain and conversion calculations

\# Number of Hot Leg RTDs used

\## Number of Cold Leg RTDs used

@ [ ]+a,c

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-5

OVERPOWER ΔT

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
ΔT Tavg - [ ]+a,c	
Primary Element Accuracy	
Sensor Calibration ΔT - [ ]+a,c	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift ΔT - [ ]+a,c	
Environmental Allowance	
Rack Calibration (Digital Process Racks) ΔT - [ ]+a,c	
Measurement & Test Equipment Accuracy ΔT	
Total Rack Calibration Accuracy ΔT - [ ]+a,c	
Rack Temperature Effects ΔT - [ ]+a,c	
Rack Drift ΔT - [ ]+a,c	

TABLE 3-5 (Continued)

OVERPOWER ΔT

---

* In percent span (T_{avg} - 75°F, ΔT - 75°F, Power - 120% RTP)

\# Number of Hot Leg RTDs used

\#\# Number of Cold Leg RTDs used

@ [ ]+a,c

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-6

PRESSURIZER PRESSURE - LOW AND HIGH, REACTOR TRIPS

Parameter	Allowance*
Process Measurement Accuracy	+a,c
Low	
High	
Primary Element Accuracy	
Sensor Calibration	
Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Comparator	
One input	
Rack Temperature Effects	
Rack Drift	

* In percent span (1000 psi)

Channel Statistical Allowance =

[ ] +a,c

TABLE 3-7

PRESSURIZER WATER LEVEL - HIGH

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
[ ]+a,c	
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration (Digital Process Racks)	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (100% span)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-8

LOSS OF FLOW

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
[ ]+a,c	
Primary Element Accuracy	
[ ]+a,c	
Sensor Calibration	
[ ]+a,c	
Sensor Pressure Effects	
[ ]+a,c	
Sensor Temperature Effects	
[ ]+a,c	
Sensor Drift	
[ ]+a,c	
Environmental Allowance	
Rack Calibration	
Rack Accuracy [ ]+a,c	
Measurement & Test Equipment Accuracy [ ]+a,c	
Comparator	
One input [ ]+a,c	
Rack Temperature Effects	
[ ]+a,c	
Rack Drift	
1.0% ΔP span	

* In percent flow span (120% Thermal Design Flow) % ΔP span converted to flow span via Equation 3-28.8, with F_{max} = 120% and F_N = 100%

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-9

STEAM GENERATOR WATER LEVEL - LOW-LOW, & LOW TRIP

Parameter	Allowance*
Process Measurement Accuracy Level Density variations with load **	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Accuracy Level	
Measurement & Test Equipment Accuracy Level	
Sensor Pressure Effects Level	
Sensor Temperature Effects Level	
Sensor Drift Level	
Environmental Allowance	
Rack Calibration Rack Accuracy	
Measurement & Test Equipment Accuracy	
Rack Comparator Setting Accuracy	
Rack Temperature Effects	
Rack Drift	

* In percent span (100% span)
** See Table 3-26.

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-10

STEAM/FEEDWATER FLOW MISMATCH

<u>Parameter</u> | <u>Allowance*</u>

Process Measurement Accuracy

[ ]+a,c

[ ]+a,c

Primary Element Accuracy

[ ]+a,c

Sensor Calibration [ ]+a,c

- Steam Flow
- Feed Flow
- Steam Pressure

Measurement & Test Equipment Accuracy

[ ]+a,c

- Steam Flow
- Feed Flow
- Steam Pressure

Sensor Pressure Effects

[ ]+a,c

- Steam Flow
- Feed Flow

Sensor Temperature Effects

[ ]+a,c

- Steam Flow
- Feed Flow
- Steam Pressure

Sensor Drift

[ ]+a,c

- Steam Flow
- Feed Flow
- Steam Pressure

Environmental Allowance

Rack Calibration

Rack Accuracy

- Steam Flow
- Feed Flow
- Steam Pressure [ ]+a,c

TABLE 3-10 (Continued)

STEAM/FEEDWATER FLOW MISMATCH

Parameter	Allowance*
Measurement & Test Equipment Accuracy	[ ]+a,c
Steam Flow	
Feed Flow	
Steam Pressure [ ]+a,c	
Comparator	
Two inputs	
Rack Temperature Effects	
Rack Drift	
Steam Flow	
Feed Flow	
Steam Pressure [ ]+a,c	

---

* In percent span (120% nominal steam flow)

% ΔP span converted to flow span via Eq. 3-28.8,

[ ]+a,c

Channel Statistical Allowance=

[ ]+a,c

TABLE 3-11

UNDERVOLTAGE 4.16KV BUS

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Comparator	
Rack Temperature Effects	
Rack Drift	

* In percent span (1040 VAC)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-12

UNDERFREQUENCY TRIP OF RCP BREAKERS

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Comparator	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (6.7 HZ AC)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-13

TURBINE TRIP-AUTO STOP OIL PRESSURE

Parameter	Allowance*
Process Measurement Accuracy	+a,c
Primary Element Accuracy	
Sensor Calibration	
Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Measurement & Test Equipment Accuracy	
Comparator	
One input	
Rack Temperature Effects	
Rack Drift	

* In percent span (58 psig)

Channel Statistical Allowance =

+a,c

TABLE 3-14

CONTAINMENT PRESSURE - HIGH, SI

Parameter	Allowance*
	+a,c
Process Measurement Accuracy	
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (100 psig)

Channel Statistical Allowance =

[ ] +a,c

TABLE 3-15

PRESSURIZER PRESSURE - LOW, SAFETY INJECTION

Parameter	Allowance*
Process Measurement Accuracy	+a,c
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

* In percent span (1000 psig)

Channel Statistical Allowance =

[ ] +a,c

TABLE 3-16

DIFFERENTIAL PRESSURE BETWEEN STEAM HEADER & STEAM LINES - HIGH, SI

Parameter	Allowance*
	+a,c
Process Measurement Accuracy	
Primary Element Accuracy	
Sensor Calibration	
Steamline	
Header	
Measurement & Test Equipment Accuracy	
Steamline	
Header	
Sensor Pressure Effects	
Sensor Temperature Effects	
Steamline	
Header	
Sensor Drift	
Steamline	
Header	
Environmental Allowance	
Rack Calibration	
Rack Accuracy	
Steamline	
Header	
Measurement & Test Equipment Accuracy	
Steamline	
Header	
Comparator	
Two inputs	
Rack Temperature Effects	
Rack Drift	
Steamline	
Header	

TABLE 3-16 (Continued)

DIFFERENTIAL PRESSURE BETWEEN STEAM HEADER & STEAM LINES - HIGH, SI

---

*In percent span (= 1400 psig)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-17

HIGH STEAM LINE FLOW-SI, STEAM LINE ISOLATION

Parameter		Allowance*
Process Measurement Accuracy	[ ]+a,c	[ ]+a,c
Primary Element Accuracy		
Sensor Calibration Steam Flow Turbine Pressure	[ ]+a,c	
Measurement & Test Equipment Accuracy Steam Flow Turbine Pressure	[ ]+a,c	
Sensor Pressure Effects Steam Flow	[ ]+a,c	
Sensor Temperature Effects Steam Flow Turbine Pressure	[ ]+a,c	
Sensor Drift Steam Flow Turbine Pressure	[ ]+a,c	
Environmental Allowance		
Rack Calibration Rack Accuracy Steam Flow Turbine Pressure	[ ]+a,c	

TABLE 3-17 (Continued)

HIGH STEAM LINE FLOW-SI, STEAM LINE ISOLATION

Parameter	Allowance*
Measurement & Test Equipment Accuracy	[ ]+a,c
Steam Flow [ ]+a,c	
Turbine Pressure	
Comparator	
Steam Flow [ ]+a,c	
Turbine Pressure	
Rack Temperature Effects [ ]+a,c	
Rack Drift	
Steam Flow [ ]+a,c	
Turbine Pressure	

---

* In percent span (120% nominal steam flow)

% ΔP span converted to flow span via Eq. 3-28.8,

where F_{max} = 120%, F_N = 100%

Channel Statistical Allowance=

[ ]+a,c

TABLE 3-18

STEAM LINE PRESSURE - LOW-SI, STEAM LINE ISOLATION

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

* In percent span (1400 psig)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-19

CONTAINMENT PRESSURE - HIGH-HIGH, SPRAY

Parameter	Allowance*
Process Measurement Accuracy	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (100 psig)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-20

CONTAINMENT RADIOACTIVITY - HIGH PARTICULATE, CONTAINMENT ISOLATION

Parameter	Allowance*
Process Measurement Accuracy [ ]+a,c	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

* In percent span (999990.0 CPM)

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-21

TAVG - LOW-LOW,SI, STEAM LINE ISOLATION

Parameter	Allowance*
Process Measurement Accuracy [ ]+a,c	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Accuracy [ ]+a,c	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift [ ]+a,c	
Environmental Allowance	
Rack Calibration (Digital Process Racks) [ ]+a,c	
Measurement & Test Equipment Accuracy	
Total Rack Calibration Accuracy [ ]+a,c	
Rack Temperature Effects	
Rack Drift	

---

* In percent span ($75^{o}F$)
\# Number of Hot Leg RTDs used
\## Number of Cold Leg RTDs used
@ [ ]+a,c

Channel Statistical Allowance =

[ ]+a,c

TABLE 3-22

CONTAINMENT RADIOACTIVITY - HIGH GASEOUS, CONTAINMENT ISOLATION

Parameter	Allowance*
Process Measurement Accuracy [ ]+a,c	[ ]+a,c
Primary Element Accuracy	
Sensor Calibration Measurement & Test Equipment Accuracy	
Sensor Pressure Effects	
Sensor Temperature Effects	
Sensor Drift	
Environmental Allowance	
Rack Calibration Rack Accuracy Measurement & Test Equipment Accuracy	
Comparator One input	
Rack Temperature Effects	
Rack Drift	

---

* In percent span (49990.0 CPM)

Channel Statistical Allowance =

[ ]+a,c

REACTOR PROTECTION SYSTEM/ENG[illegible]
FLORDIA [illegible]

PROTECTION CHANNEL	1 PROCESS MEASUREMENT ACCURACY (1)	2 PRIMARY ELEMENT ACCURACY (1)	3 CALIBRATION ACCURACY (1)	4 MEASUREMENT & TEST EQUIP ACCURACY (1)	5 PRESSURE EFFECTS (1)	6 TEMPERATURE EFFECTS (1)	7 DRIFT (1)	8 ENVIRO[illegible] ALLO[illegible] ([illegible]
1 POWER RANGE, NEUTRON FLUX - HIGH SETPOINT								
2 POWER RANGE, NEUTRON FLUX - LOW SETPOINT								
3 INTERMEDIATE RANGE, NEUTRON FLUX								
4 SOURCE RANGE, NEUTRON FLUX								
5 OVERTEMPERATURE DELTA-T — DELTA-T CHANNEL								
6 Tavg CHANNEL								
7 PRESSURIZER PRESSU[illegible] CHANNEL								
8 F(DELTA-I) CHANNEL								
9 OVERPOWER DELTA-T — DELTA-T CHANNEL								
10 Tavg								
11 PRESSURIZER PRESSURE - LOW								
12 PRESSURIZER PRESSURE - HIGH								
13 PRESSURIZER WATER LEVEL - HIGH								
14 LOSS OF FLOW								
16 STEAM GENERATOR WATER LEVEL, LOW-LOW								
17 STEAM GENERATOR WATER LEVEL, LOW								
18 STEAM/FEED FLOW MISMATCH — STEAM FLOW								
19 STEAM PRESSURE								
20 FEED FLOW								
21 UNDERVOLTAGE 4.16KV BUS								
22 UNDERFREQUENCY								
23 TURBINE TRIP-AUTO STOP OIL PRESSURE								
24 CONTAINMENT PRESSURE - HIGH, SI								
25 PRESSURIZER PRESSURE - LOW, SAFETY INJECTION								
26 DIFF. PRESSURE BETWEEN STM HEADER & STM LINES-HIGH, SI								
27 Header								
28 HIGH STEAM LINE FLOW -SI, STEAM LINE ISOLATION — STEAM FLOW								
29 TURBINE PRESSURE								
30 STEAM LINE PRESSURE - LOW-SI, STEAM LINE ISOLATION								
31 CONTAINMENT PRESSURE - HIGH-HIGH, SPRAY								
32 CONTAINMENT RADIOACTIVITY - HIGH PARTICULATE CONT. ISOLATION								
33 Tavg - LOW-LOW,SI, STEAM LINE ISOLATION								
34 CONTAINMENT RADIOACTIVITY - HIGH GASEOUS, CONT. ISOLATION								
35 DEGRADED VOLTAGE AND INVERSE TIME DEGRADED VOLTAGE FOR ALL 480VAC LOAD CENTERS								

WE...

TABLE 3-23

...NEERED SAFETY FEATURES ACTUATION SYSTEM CHANNEL ERROR ALLOWANCES

...POWER AND LIGHT COMPANY TURKEY POINT UNITS 3 & 4

...>|<-------- INSTRUMENT RACK					-------->|							
8	9	10	11	12	13	14	15	16	17	18	19	
...MENTAL ...ANCE (...)	CALIBRATION ACCURACY (1)	MEASUREMENT & TEST EQUIP ACCURACY (1)	COMPARATOR SETTING ACCURACY (1)	TEMPERATURE EFFECTS (1) +a,c	DRIFT (1)	SAFETY ANALYSIS LIMIT (2)	STS ALLOWABLE VALUE (3)	STS TRIP SETPOINT (3)	TOTAL ALLOWANCE (1)	CHANNEL STATISTICAL ALLOWANCE (1)	MARGIN (1) +a,c	
					1.0	118% RTP	112.0% RTP	109% RTP	7.5			1
					1.0	35% RTP	28.0% RTP	25% RTP	8.3			2
					4.2	(5)	31% RTP	25% RTP	13.5			3
					3.0	(5)	1.4 E+5 CPS	1 E+5 CPS	13.9			4
					0.5							5
					---	FUNCTION (1)	FUNCTION (6)	FUNCTION (6)	7.2			6
					0.3		+ 1.5% DT SPAN					7
					0.3							8
					0.5	FUNCTION (1)	FUNCTION (7)	FUNCTION (7)	5.3			9
					---		+ 1.4% DT SPAN					10
					1.0	1790 PSIG	1817 PSIG	1835 PSIG	4.5			11
					1.0	2440 PSIG	2403 PSIG	2385 PSIG	5.5			12
					0.3	100% SPAN	92.2% SPAN	92% SPAN	8.0			13
					0.6	84.5% SPAN	88.7% SPAN	90% SPAN	4.6			14
					1.0	10% SPAN	13.2% SPAN	15% SPAN	5.0			16
					1.0	(5)	13.2% SPAN	15% SPAN	5.0			17
					1.0							18
					1.2	(5)	23.9% FLOW	20% FLOW	20.0			19
					1.0							20
					2.0	(5)	69% BUS VAC	70% BUS VAC	20.0			21
					2.0	55 HZ	55.9 HZ	56.1 HZ	16.4			22
					2.6	(5)	43 PSIG	45 PSIG	8.6			23
					1.0	6 PSIG	5.5 PSIG	4 PSIG	2.0			24
					1.0	1600 PSIG	1712 PSIG	1730 PSIG	13.0			25
					1.0	165 PSIG	114 PSIG	100 PSIG	4.7			26
					1.0							27
					0.6	(8)	42.6% FLOW	40% FLOW	16.7			28
					1.0							29
					[illegible].0	432 PSIG	588 PSIG	614 PSIG	13.0			30
					0.9	30 PSIG	21.4 PSIG	20 PSIG	10.0			31
					2.0	7.4 E+5 CPM	6.8 E+5 CPM	6.1 E+5 CPM	13.0			32
					0.5	540°F	542.5°F	543°F	4.0			33
					2.0	3.6 E+4 CPM	3.5 E+4 CPM	3.2 E+4 CPM	8.0			34
					(11)	(5)	(12)	(12)	(11)			35

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NOTES FOR TABLE 3-23

1. All values in percent span.
2. As noted in FSAR.
3. As noted in Tables 2.2-1 and 3.3-3 of Plant Technical Specifications.
4. Included in [ ]$^{+a,c}$
5. Not specifically used in the Safety Analysis.
6. As noted in Table 2.2-1 Note 1 of Plant Technical Specifications shown below.

TABLE 2.2-1 TABLE NOTATION
REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

NOTE 1: OVERTEMPERATURE ΔT

$$\Delta T\left(\frac{(1+\tau_1 S)}{(1+\tau_2 S)}\right)\left[\frac{1}{(1+\tau_3 S)}\right] \le \Delta T_o \left\{K_1 - K_2\left(\frac{(1+\tau_4 S)}{(1+\tau_5 S)}\right)\left[T\left[\frac{1}{(1+\tau_6 S)}\right] - T'\right] + K_3(P - P') - f_1(\Delta I)\right\}$$

Where: ΔT = Measured ΔT by RTD Instrumentation;

$\frac{1+\tau_1 S}{1+\tau_2 S}$ = Lead/Lag compensator on measured ΔT;

τ_1, τ_2 = Time constants utilized in the lag compensator for ΔT; τ_1 = 8 secs., τ_2 = 3 secs.;

$\frac{1}{(1+\tau_3 S)}$ = The function generated by the rate-lag controller for Tavg dynamic compensation;

ΔT_o ≤ Indicated Delta-T at RATED THERMAL POWER;

K_1 ≤ 1.095;

K_2 ≥ 0.0107/°F;

$\frac{1+\tau_4 S}{1+\tau_5 S}$ = The function generated by the lead-lag controller for Tavg dynamic compensation;

τ_4, τ_5 = Time constants utilized in the lead-lag controller for Tavg, τ_4 = 25 secs., τ_5 = 3 secs.;

T = Average temperature °F;

$\frac{1}{1+\tau_6 S}$ = Lag compensator on measured T_{avg};

T' ≤ 574.2 °F (Nominal T_{avg} at RATED THERMAL POWER)

TABLE 2.2-1 (continued)

NOTE 1: OVERTEMPERATURE ΔT (continued)

K_3	$\geq$ 0.000453/psig;
τ_3	= Time constant utilized in the lag compensator for ΔT, τ_3 = 0 secs.;
τ_6	= Time constant utilized in the T_{avg} lag compensator for ΔT, τ_6 = 0 secs.;
P	= Pressurizer pressure (psig);
P'	$\geq$ 2235 psig, (Nominal RCS operating pressure);
S	= Laplace transform operator, sec^{-1};

and $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power range nuclear ion chambers; with gains to be selected based on measured instrument response during plant start-up tests such that:

(1) for $q_t - q_b$ between - 14% and + 10%, $f_1(\Delta I)$ = 0 where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is the total THERMAL POWER in percent of RATED THERMAL POWER;

(2) for each percent that the magnitude of $q_t - q_b$ exceeds - 14%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

(3) for each percent that the magnitude of $q_t - q_b$ exceeds + 10%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

NOTE 2: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.5% of instrument span.

NOTE 3: OVERPOWER ΔT

$$\Delta T[\frac{(1 + \tau_1 S)}{(1 + \tau_2 S)}][\frac{1}{(1 + \tau_3 S)}] \leq \Delta T_o \{K_4 - K_5([\frac{\tau_7 S}{(1 + \tau_7 S)}][\frac{1}{(1 + \tau_6 S)}])T - K_6[T[\frac{1}{(1 + \tau_6 S)}] - T''] - f_2(\Delta I)\}$$

Where: ΔT	= As defined in Note 1:
ΔT_o	= As defined in Note 1;

NOTES FOR TABLE 3-23 (Continued)

TABLE 2.2-1 (continued)

NOTE 3: OVERPOWER ΔT (continued)

$\frac{1 + \tau_1 S}{1 + \tau_2 S}$	= As defined in Note 1;
$\frac{(\tau_7 S)}{(1 + \tau_7 S)}$	= The function generated by the rate-lag controller for T_{avg} dynamic compensation;
τ_7	= Time constant utilized in the rate-lag controller for T_{avg}, $\tau_7 \geq 10$ secs.;
K_4	$\leq$ 1.09;
K_5	$\geq$ 0.02/^{O}F for increasing average temperature and 0.0 for decreasing average temperature;
$\frac{1}{(1 + \tau_3 S)}$	= As defined in Note 1;
$\frac{1}{(1 + \tau_6 S)}$	= As defined in Note 1;
K_6	$\geq$ 0.00068/^{O}F for T > T" and 0.0 for T $\leq$ T";
T	= as defined in Note 1;
T"	$\leq$ Indicated Tavg at RATED THERMAL POWER (Calibration temperature for ΔT instrumentation, $\leq$ 574.2^{O}F);
S	= as defined in Note 1;
f_2	= 0 for all ΔI;

NOTE 4: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.4% Delta-T span.

7. As noted in Table 2.2-1 Note 3 of Plant Technical Specifications, see above.
8. As noted in Table 3.3-3 Item 1 of Plant Technical Specifications item f;

Trip Setpoint	$\leq$ A function defined as follows: a Delta-P corresponding to 40% Steam Flow at 0% Load increasing linearly from 20% load to a value corresponding to 120% Steam Flow at full load.
Allowable Value	$\leq$ A function defined as follows: a Delta-P corre ponding to 42.6% Steam Flow at 0% Load increasing linearly from 20% load to a value corresponding to 122.6% Steam Flow at full load.

9. [$]^{+a,c}$
10. Included in [$]^{+a,c}$
11. Not in Westinghouse Scope.
12. As noted in Item 7b & c of Table 3.3-3 of the Turkey Point Technical Specifications.
13. [$]^{+a,c}$

TABLE 3-24

OVERTEMPERATURE ΔT CALCULATIONS

The equation for [illegible]mperature ΔT is:

$$\Delta T\left[\frac{(1+\tau_1 S)}{(1+\tau_2 S)}\right]\left[\frac{1}{(1+\tau_3 S)}\right] \le \Delta T_0 \left\{K_1 - K_2\frac{(1+\tau_4 S)}{(1+\tau_5 S)}\left[T\left[\frac{1}{(1+\tau_6 S)}\right] - T'\right] + K_3(P - P') - f_1(\Delta I)\right\}$$

K_1 (nominal)	=	1.0950 Technical Specification value
K_1 (m[illegible])	=	[ ]+a,c
K_2	=	0.0107/°F
K_3	=	0.000453/psi
ΔT_0 = vessel ΔT	=	56.1°F
ΔI gain	=	1.5 FP ΔI/%ΔI

Reference notes to Table 3-23 for a complete listing of terms.

Delta-T = [ ]+a,c

Delta-T span = [ ]+a,c

Process Measurement Accuracy

Delta-T

[ ]+a,c

Delta-I

PMA-1

[ ]+a,c

PMA-2

[ ]+a,c

Tavg [ ]+a,c

Pressure Channel Uncertainties

Pressure Gain = [

Pressure SCA =

Pressure SMTE =

Pressure STE =

Pressure SD =]+a,c

TABLE 3-24

OVERTEMPERATURE ΔT CALCULATIONS (Continued)

Total Allowance =

[ ]+a,c

= 7.2% ΔT span

TABLE 3-25

OVERPOWER ΔT CALCULATIONS

The equation for [illegible] ΔT is:

$$\Delta T \left[\frac{(1 + \tau_1 S)}{(1 + \tau_2 S)}\right]\left[\frac{1}{(1 + \tau_3 S)}\right] \leq \Delta T_0 \left\{K_4 - K_5\left(\left[\frac{\tau_7 S}{(1 + \tau_7 S)}\right]\left[\frac{1}{(1 + \tau_6 S)}\right]\right)T - K_6\left[T\left[\frac{1}{(1 + \tau_6 S)}\right] - T''\right] - f_2(\Delta I)\right\}$$

K_4 (nominal) = 1.09 Technical Specification value

K_4 (max) = [ ]$^{+a,c}$

K_5 = 0.02/^oF

K_6 = 0.00068/^oF

ΔT_0 = vessel ΔT = 56.1^oF

f_2 = 0 for all ΔI

Reference notes to Table 3-23 for a complete listing of terms.

Process Measurement Accuracy

Tavg - [ ]$^{+a,c}$

Total Allowance =

[ ]$^{+a,c}$

= 5.3% span

TABLE 3-26

STEAM GENERATOR LEVEL DENSITY VARIATIONS

Because of density variations with load, it is impossible without some form of compensation to have the same accuracy under all load conditions. The recommended calibration point is at 50% power conditions. Approximate errors at 0% and 100% water level readings and also for nominal trip points of 10% and 70% level are listed below for a typical 50% power condition calibration. This is a general case and will change somewhat from plant to plant. These errors are only from density changes and do not reflect channel accuracies, trip accuracies or indicated accuracies which have been defined as ΔP measurements only.[1]

INDICATED LEVEL (50% Power Calibration)

	0%	10%	70%	100%
Actual Level 0% Power				
Actual Level 100% Power				

+a,c

(1) Miller, R. B., "Accuracy Analysis for Protection/Safeguards and Selected Control Channels", WCAP-8108 (Proprietary), March 1973.

TABLE 3-27

ΔP MEASUREMENTS EXPRESSED IN FLOW UNITS

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

$F_N{}^2 = \Delta P_N$ where N = nominal flow

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

$$\text{thus } \partial F_N = \frac{\partial \Delta P_N}{2F_N} \qquad \text{Eq. 3-28.1}$$

Error at a point (not in percent) is:

$$\frac{\partial F_N}{F_N} = \frac{\partial \Delta P_N}{2(F_N)^2} = \frac{\partial \Delta P_N}{2\Delta P_N} \qquad \text{Eq. 3-28.2}$$

and

$$\frac{\Delta P_N}{\Delta P_{max}} = \frac{(F_N)^2}{(F_{max})^2} \qquad \text{where max = maximum flow} \qquad \text{Eq. 3-28.3}$$

and the transmitter ΔP error is:

$$\left(\frac{\partial \Delta P_N}{\Delta P_{max}}\right)(100) = \text{\% error in Full Scale } \Delta P \text{ (\% FS } \Delta P) \qquad \text{Eq. 3-28.4}$$

therefore:

$$\frac{\partial F_N}{F_N} = \frac{(\Delta P_{max})\left(\frac{\text{percent error (FS } \Delta P)}{100}\right)}{2(\Delta P_{max}) \left[\frac{F_N}{F_{max}}\right]^2} = \left(\frac{\text{percent error (FS } \Delta P)}{(2)\ (100)}\right) \left(\frac{F_{max}}{F_N}\right)^2$$

Error in flow units is: Eq. 3-28.5

$$\partial F_N = (F_N)\left(\frac{\text{percent (FS } \Delta P)}{(2)\ (100)}\right)\left[\frac{F_{max}}{F_N}\right]^2 \quad \text{Eq. 3-28.6}$$

Error in percent nominal flow is:

$$\left(\frac{\partial F_N}{F_N}\right)(100) = \frac{\text{percent error (FS } \Delta P)}{2} \left[\frac{F_{max}}{F_N}\right]^2 \quad \text{Eq. 3-28.7}$$

Error in percent full span is:

$$\left(\frac{\partial F_N}{F_{max}}\right)(100) = \frac{(F_N)(\text{percent error (FS } \Delta P))}{(F_{max})\ (2)\ (100)} \left[\frac{F_{max}}{F_N}\right]^2$$

$$= \left(\frac{\text{percent error (FS } \Delta P)}{2}\right)\left(\frac{F_{max}}{F_N}\right)$$

Eq. 3-28.8

Equation 3-28.8 is used to express errors in percent full span in this document.

4.0 TECHNICAL SPECIFICATION USAGE

4.1 CURRENT USE

The Standard Technical Specifications (STS) as used for Westinghouse type plant designs (see NUREG-0452, Revision 4) utilizes a two column format for the RPS and ESF system. This format recognizes that the setpoint channel breakdown, as presented in Figure 4-1, allows for a certain amount of rack drift. The original intent was to reduce the number of reporting events in the area of instrumentation setpoint drift. It appears that this goal was achieved. However, it does not recognize how setpoint calibrations and verifications are performed in the plant. In fact, this two column approach forces the plant to take a double penalty in the area of calibration error. As noted in Figure 4-1, the plant must allow for calibration error below the STS Trip Setpoint, in addition to the allowance assumed in the various accident analyses, if full utilization of the rack drift is wanted. This is due, as noted in 2.2, to the fact that calibration error cannot be distinguished from rack drift after an initial calibration. Thus, the plant is left with two choices; 1) to assume a rack drift value less than that allowed for in the analyses (actual RD = assumed RD - RCA) or, 2) penalize the operation of the plant (and increasing the possibility of a spurious trip) by lowering the nominal trip setpoint into the operating margin.

The use of the summation technique described in Section 2 of this report allows for a natural extension of the two column approach. This extension recognizes the calibration/verification techniques used in the plants and allows for a more flexible approach in determining reportability. Also of significant benefit to the plant is the incorporation of sensor drift parameters on an 18 month basis (or more often if necessary).

4.2 WESTINGHOUSE SETPOINT METHODOLOGY FOR STS SETPOINTS

Recognizing that the plant experiences both rack and sensor drift, a different approach to Technical Specification setpoints may be used. This revised methodology accounts for two additional factors seen in the plant during periodic surveillance, 1) interactive effects for both sensors and rack and, 2) sensor drift effects.

4.2.1 RACK ALLOWANCE

Interactive effects will be covered first. When an instrument technician looks for rack drift, more than that is seen if "as left/as found" data is not used. This interaction has been noted several times and is treated in Equations 2.1 and 3.1 by the arithmetic summation of the rack effects, RD, RMTE, RCSA, and RCA; and the sensor effects, SD, SMTE and SCA. To provide a conservative "trigger value", the difference between the STS trip setpoint and the STS allowable value is determined by two methods. The first is simply the values used in the CSA calculation,

$$T_1 = (RCA + RMTE + RCSA + RD) \qquad \text{(Eq. 4.1)}$$

The second extracts these values from the calculations and compares the remaining values against the total allowance:

$$T_2 = TA - ((A) + (S)^2)^{1/2} - EA \qquad \text{(Eq. 4.2)}$$

where:

T_2 = Rack trigger value

$A = (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2$

$S = (SCA + SMTE + SD)$

EA, TA and all other parameters are as defined for Equation 2.1.

The smaller of the trigger values should be used for comparison with the "as measured" (RCA + RMTE + RCSA + RD) value. As long as the "as measured" value is smaller, the channel is within the accuracy allowance. If the "as measured" value exceeds the "trigger value", the actual number should be used in the calculation described in Section 4.2.3. This means that all the instrument technician has to do during the periodic surveillance is determine the value of the bistable trip setpoint, verify that it is less than the STS Allowable Value, and does not have to account for any additional effects. The same approach is used for the sensor, i.e., the "as measured" value is used when required. Tables 4-1 and 4-2 show the current STS setpoint philosophy (NUREG-0452, Revision 4) and the Westinghouse rack allowance for Turkey Point Units 3 & 4 (31 day surveillance for analog and 92 day surveillance for digital). A comparison of the differences between the Safety Analysis Limits and Allowable Values will show the relative gain of the Westinghouse version.

4.2.2 INCLUSION OF "AS MEASURED" SENSOR ALLOWANCE

If the approach used was a straight arithmetic sum, sensor allowances for drift would also be straight forward, i.e., a three column setpoint methodology. However, the use of the Westinghouse methodology requires a somewhat more complicated approach. The methodology is based on the use of Equation 4.3, and demonstrated in Section 4.2.3, Implementation.

$$TA \geq (A)^{1/2} + R + S + EA \qquad \text{(Eq. 4.3)}$$

where:

R = the "as measured rack value" (RCA + RMTE + RCSA + RD)
S = the "as measured sensor value" (SCA + SMTE + SD)
all other parameters are as defined in Equation 4.2.

Equation 4.3 can be reduced further, for use in the STS to:

$$TA \geq Z + R + S \qquad \text{(Eq. 4.4)}$$

where:

$$Z = (A)^{1/2} + EA$$

Equation 4.3 would be used in two instances, 1) when the "as measured" rack setpoint value exceeds the rack "trigger value" as defined by the STS Allowable Value, and, 2) when determining that the "as measured" sensor value is within acceptable values as utilized in the various Safety Analyses and verified every 18 months.

4.2.3 IMPLEMENTATION OF THE WESTINGHOUSE SETPOINT METHODOLOGY

Implementation of this methodology is reasonably straight forward, Appendix A provides the text and tables for use at Turkey Point. An example of how the specification would be used for the Pressurizer Pressure - Low reactor trip is as follows.

For the periodic surveillance, as required by Table 4.3-1 of NUREG-0452, Revision 4, a functional test would be performed on the channels of this trip function. During this test the bistable trip setpoint would be determined for each channel. If the "as measured" bistable trip setpoint error was found to be less than or equal to that required by the Allowable Value, no action would be necessary by the plant staff. The Allowable Value is determined by Equation 4.2 as follows:

$$T_2 = TA - ((A) + (S)^2)^{1/2} - EA$$

where:

TA = 4.5%

A =
S =
EA =
T_2 =
=
=
=

$[\quad]^{+a,c}$

However, since only $T_1 = [\quad]^{+a,c}$ is assumed for T in the various analyses, that value will be used as the "trigger value". The lowest of two values is used for the "trigger value"; either the value for T assumed in the analyses or the value calculated by Equation 4.2.

Now assume that one bistable has "drifted" more than that allowed by the STS for periodic surveillance. According to ACTION statement b.1, the plant staff must verify that Equation 2.2-1 is met. Going to Table 2.2-1, the following values are noted: Z = 1.12 and the Total Allowance is (TA) = 4.5. Assume that the "as measured" rack setpoint value is 2.75% low and the "as measured" sensor value is 1.3%. Equation 2.2-1 looks like:

$$TA \geq Z + R + S$$

$$1.12 + 2.75 + 1.3 \leq 4.5$$

$$5.2 > 4.5$$

As can be seen, 5.2% is not less than 4.5% thus, the plant staff must follow ACTION statement b.2 (declare channel inoperable and place in the "tripped" condition). It should be noted that if the plant staff had not measured the sensor drift, but instead used the value of S in Table 2.2-1 then the sum of Z + R + S would also be greater than 4.5%. In fact, anytime the "as measured" value for rack drift is

greater than T (the "trigger value") and there is less than 1.0% margin, use of S in Table 2.2-1 will result in the sum of Z + R + S being greater than TA and result in the determination that the channel is inoperable.

If the sum of R + S was about 0.75% less, e.g., R = 2.0%, S = 1.3% thus, R + S = 3.3%, then the sum of Z + R + S would be less than 4.5%. Under this condition, the plant staff would recalibrate the instrumentation, as good engineering practice suggests, but the channel is considered operable, even though the "trigger value" is exceeded, because Equation 2.2-1 was satisfied.

In the determination of T for a function with multiple channel inputs there is a slight disagreement between Westinghouse proposed methodology and NRC approved methodology. Westinghouse believes that T should be either:

$$T_1 = (RCA_1 + RMTE_1 + RCSA_1 + RD_1) + (RCA_2 + RMTE_2 + RCSA_2 + RD_2) \quad \text{(Eq. 4.5)}$$

or

$$T_2 = TA - (A + (S_1)^2 + (S_2)^2)^{1/2} - EA \quad \text{(Eq. 4.6)}$$

where the subscript 1 and 2 denote channels 1 and 2, and the value of T used is whichever is smaller.

The NRC in turn has approved a method of determining T for a multiple channel input function as follows, either:

$$T_3 = ((RCA_1 + RMTE_1 + RCSA_1 + RD_1)^2 + (RCA_2 + RMTE_2 + RCSA_2 + RD_2)^2)^{1/2} \quad \text{(Eq. 4.7)}$$

or

Equation 4.6 as described above.

Again the value of T used is whichever is smaller. This method is described in NUREG-0717 Supplement 4, dated August 1982.

The complete set of calculations follows for High Steam Flow to demonstrate this aspect (values noted are from Table 3-17).

TA = [ ]+a,c
A =
=
S_1 =
S_2 =

T_2 = TA - BIAS - $(A + (S)^2)^{1/2}$

T_2 = [ ] +a,c

$T_3 = ((RCA_S + RMTE_S + RCSA_S + RD_S)^2 + (RCA_T + RMTE_T + RCSA_T + RD_T)^2)^{1/2}$

T_3 =[ ]+a,c

The value of T used is based on Equation 4.7 (T_3). In this document Equations 4.6 and 4.7, whichever results in the smaller value, is used for multiple channel input functions to remain consistent with current NRC approved methodologies. Table 4-1 notes the values of TA, A, S, T, and Z for all protection functions and is utilized in the determination of the Allowable Values noted in Appendix A.

Table 4.3-1 also requires that a calibration be performed every refueling (approximately 18 months). To satisfy this requirement, the plant staff would determine the bistable trip setpoint (thus, determining the "as measured" rack value at that time) and the sensor "as measured" value. Taking these two "as measured" values and using Equation 2.2-1 again the plant staff can determine that the tested channel is in fact within the Safety Analysis allowance.

4.3 CONCLUSION

Using the above methodology, the plant gains added operational flexibility and yet remains within the allowances accounted for in the various accident analyses. In addition, the methodology allows for a sensor drift factor and an increased rack drift factor. These two gains should significantly reduce the problems associated with channel drift and thus, decrease the number of instances a channel is determined to be inoperable while allowing plant operation in a safe manner.

TABLE 4-1

EXAMPLES OF CURRENT STS SETPOINT PHILOSOPHY

	Power Range Neutron Flux - High	Pressurizer Pressure - Low
Safety Analysis Limit	118% RTP	1790 psig
STS Allowable Value	110% RTP	1825 psig
STS Trip Setpoint	109% RTP	1835 psig

TABLE 4-2

EXAMPLES OF WESTINGHOUSE STS RACK ALLOWANCE

	Power Range Neutron Flux - High	Pressurizer Pressure - Low
Safety Analysis Limit	118% RTP	1790 psig
STS Allowable Value (Trigger Value)	112% RTP	1817 psig
STS Trip Setpoint	109% RTP	1835 psig

```
Safety Analysis Limit
                                    |----------
                                    (   Process Measurement Accuracy
                                    |----------
                                    (   Primary Element Accuracy
                                    |----------
                                    (   Sensor Calibration Accuracy
                                    |----------
                                    (   Sensor Measurement & Test Equipment
                                    |----------
                                    (   Sensor Pressure Effects
                                    |----------
                                    (   Sensor Temperature Effects
                                    |----------
                                    (   Sensor Drift
                                    |----------
                                    (   Environmental Allowance
                                    |----------
                                    (   Rack Temperature Effects
                                    |----------
                                    (   Rack Comparator Setting Accuracy
                                    |----------
                                    (   Rack Calibration Accuracy
                                    |----------
                                    (   Rack Measurement & Test Equipment
STS Allowable Value                 |---------
                                    (   Rack Drift
STS Trip Setpoint

Actual Calibration Setpoint
```

Figure 4-1 NUREG-0452 Rev. 4 Setpoint Error Breakdown (Analog Process Racks)

```
Safety Analysis Limit
                                      |----------
                                      {   Process Measurement Accuracy
                                      |----------
                                      {   Primary Element Accuracy
                                      |-------
                                      {   Sensor Calibration Accuracy
                                      |----------
                                      {   Sensor Measurement & Test Equipment
                                      |----------
                                      {   Sensor Pressure Effects
                                      |----------
                                      {   Sensor Temperature Effects
                                      |----------
                                      {   Sensor Drift
                                      |----------
                                      {   Environmental Allowance
                                      |-----------
                                      {   Rack Temperature Effects
STS Allowable Value                   |----------
                                      {   Rack Comparator Setting Accuracy
                                      |-----------
                                      {   Rack Calibration Accuracy
                                      |----------
                                      {   Rack Measurement & Test Equipment
                                      |---------
                                      {   Rack Drift
STS Trip Setpoint
```

Figure 4-2 Westinghouse STS Setpoint Error Breakdown
(Analog Process Racks)

TABLE 4-3

WESTINGHOUSE PROTECTION SYSTEM STS SETPOIN

TURKEY POINT UNITS 3 & 4

PROTECTION CHANNEL	TOTAL ALLOWANCE (TA) (7)	(A)	(7) (1) +a,c	(S)	(7) (2)	(T)	(7) (3)	(Z)	(7) (4)	INSTRUM SPAN
POWER RANGE, NEUTRON FLUX - HIGH SETPOINT	7.5			0.0		2.5		4.56		120% RTP
POWER RANGE, NEUTRON FLUX - LOW SETPOINT	8.3			0.0		2.5		4.56		120% RTP
INTERMEDIATE RANGE, NEUTRON FLUX	13.5			0.0		5.0		8.41		120% RTP
SOURCE RANGE, NEUTRON FLUX	13.9			0.0		3.9		10.01		1 E+6 CPS
OVERTEMPERATURE DELTA-T	7.2			2.5		1.5		4.82		(5)
OVERPOWER DELTA-T	5.3			2.0		1.4		3.09		(6)
PRESSURIZER PRESSURE - LOW	4.5			1.4		1.9		1.12		1000 PSIG
PRESSURIZER PRESSURE - HIGH	5.5			1.4		1.9		1.12		1000 PSIG
PRESSURIZER WATER LEVEL - HIGH	8.0			4.0		0.2		6.76		100% SPAN
LOSS OF FLOW	4.6			0.8		1.1		2.65		120% FLOW
STEAM GENERATOR WATER LEVEL - LOW-LOW	5.0			1.9		1.9		2.33		100% SPAN
STEAM GENERATOR WATER LEVEL - LOW	5.0			1.9		1.9		2.33		100% SPAN
STEAM/FEED FLOW MISMATCH	20.0			1.7+2.9+2.8		3.[illegible]		3.67		120% FLOW
UNDERVOLTAGE 4.16KV BUS	20.0			0.0		3.1		1.12		1040 VAC
UNDERFREQUENCY	16.4			0.0		2.5		0.50		7 HZ
TURBINE TRIP-AUTO STOP OIL PRESSURE	8.6			0.0		3.8		1.0		58 PSIG
CONTAINMENT PRESSURE - HIGH, SI	2.0			0.0		1.5		0.2		100 PSIG
PRESSURIZER PRESSURE - LOW, SAFETY INJECTION	13.0			1.4		1.9		8.42		1000 PSIG
DIFF. PRESSURE BETWEEN STM HEADER & STM LINES-HIGH	4.7			4.6		1.0		1.57		1400 PSIG
HIGH STEAM LINE FLOW-SI, STEAM LINE ISOLATION	16.7			1.7+2.2		2.2		2.86		120% FLOW
STEAM LINE PRESSURE - LOW-SI, STEAM LINE ISOLATION	13.0			2.3		1.9		1.16		1400 PSIG
CONTAINMENT PRESSURE HIGH-HIGH, SPRAY	10.0			0.0		1.4		1.60		100 PSIG
CONTAINMENT RADIOACTIVITY-HIGH PARTICULATE CTM ISL	13.0			0.0		7.3		0.50		999990 C
Tavg - LOW-LOW, SI, STEAM LINE ISOLATION	4.0			1.0		0.7		2.00		$75^{o}F$
CONTAINMENT RADIOACTIVITY-HIGH GASEOUS, CTM ISL	8.0			0.0		7.3		0.50		49990 CP
DEGRADED VOLTAGE AND INVERSE TIME DEGRADED VOLTAGE FOR ALL 480VAC LOAD CENTERS	(12)			(12)		(12)		(12)		(12)

T INPUTS

ENT	STS TRIP SETPOINT	STS ALLOWABLE VALUE	MAXIMUM VALUE (9)
	109% RTP	112.0% RTP	+a,c
	25% RTP	28.0% RTP	
	25% RTP	31% RTP	
	1 E+5 CPS	1.4 E+5 CPS	
	FUNCTION (8)	FUNCTION (8) ±1.5% DT SPAN	
	FUNCTION (8)	FUNCTION (8) ± 1.4% DT SPAN	
	1835 PSIG	1817 PSIG	
	2385 PSIG	2403 PSIG	
	92% SPAN	92.2% SPAN	
	90% SPAN	88.7% SPAN	
	15% SPAN	13.2% SPAN	
	15% SPAN	13.2% SPAN	
)	20% FLOW (10)	23.9% FLOW (10)	
	70% BUS VAC	69% BUS VAC	
	56.1 HZ	55.9 HZ	
	45 PSIG	43 PSIG	
	4 PSIG	5.5 PSIG	
G	1730 PSIG	1712 PSIG	
G	100 PSIG	114 PSIG	
W	40% FLOW (11)	42.6% FLOW (11)	
G	614 PSIG	588 PSIG	
	20 PSIG	21.4 PSIG	
PM	6.1 E+5 CPM	6.8 E+5 CPM	
	543°F	542.5°F	
M	3.2 E+4 CPM	3.5 E+4 CPM	
	(12)	(12)	

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NOTES FOR TABLE 4-3

(1) $A = (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2$

(2) $S = SCA + SMTE + SD$

(3) $T_1 = RCA + RMTE + RCSA + RD$

$T_2 = TA - (A + (S_1)^2 + (S_2)^2)^{1/2} - EA$

$T_3 = ((RCA_1 + RMTE_1 + RCSA_1 + RD_1)^2 +$

$(RCA_2 + RMTE_2 + RCSA_2 + RD_2)^2)^{1/2}$

T = minimum of T_1, T_2 or T_3

(4) $Z = (A)^{1/2} + EA$

(5)

Parameter	Span
Tavg	75°F
Pressure	1000 PSIG
Flux	120% RTP
ΔT	75°F
ΔI	± 100% ΔI

(6)

Parameter	Span
Tavg	75°F
ΔT	75°F

(7) All values in percent Span

NOTES FOR TABLE 4-3 (Continued)

(8) As noted in Notes 1, 2, 3 and 4 of Table 2.2-1 of the Turkey Point Technical Specifications shown below

TABLE 2.2-1 TABLE NOTATION
REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

NOTE 1: OVERTEMPERATURE ΔT

$$\Delta T\left(\frac{(1+\tau_1 S)}{(1+\tau_2 S)}\right)\left[\frac{1}{(1+\tau_3 S)}\right] \le \Delta T_0 \left\{K_1 - K_2\left(\frac{(1+\tau_4 S)}{(1+\tau_5 S)}\right)\left[T\left[\frac{1}{(1+\tau_6 S)}\right] - T'\right] + K_3(P - P') - f_1(\Delta I)\right\}$$

Where: ΔT	= Measured ΔT by RTD Instrumentation;
$\frac{1+\tau_1 S}{1+\tau_2 S}$	= Lead/Lag compensator on measured ΔT;
τ_1, τ_2	= Time constants utilized in the lag compensator for ΔT; τ_1 = 8 secs., τ_2 = 3 secs.;
$\frac{1}{(1+\tau_3 S)}$	= The function generated by the rate-lag controller for Tavg dynamic compensation;
ΔT_0	≤ Indicated Delta-T at RATED THERMAL POWER;
K_1	≤ 1.095;
K_2	≥ 0.0107/°F;
$\frac{1+\tau_4 S}{1+\tau_5 S}$	= The function generated by the lead-lag controller for Tavg dynamic compensation;
τ_4, τ_5	= Time constants utilized in the lead-lag controller for Tavg, τ_4 = 25 secs., τ_5 = 3 secs.;
T	= Average temperature °F;
$\frac{1}{1+\tau_6 S}$	= Lag compensator on measured T_{avg};
T'	≤ 574.2 °F (Nominal T_{avg} at RATED THERMAL POWER)
K_3	≥ 0.000453/psig;
τ_3	= Time constant utilized in the lag compensator for ΔT, τ_3 = 0 secs.;
τ_6	= Time constant utilized in the T_{avg} lag compensator for ΔT, τ_6 = 0 secs.;

NOTES FOR TABLE 4-3 (Continued)

TABLE 2.2-1 (continued)

NOTE 1: OVERTEMPERATURE ΔT (continued)

P	= Pressurizer pressure (psig);
P'	$\geq$ 2235 psig, (Nominal RCS operating pressure);
S	= Laplace transform operator, sec^{-1};

and $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power range nuclear ion chambers; with gains to be selected based on measured instrument response during plant start-up tests such that:

(1) for $q_t - q_b$ between - 14% and + 10%, $f_1(\Delta I) = 0$ where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is the total THERMAL POWER in percent of RATED THERMAL POWER;

(2) for each percent that the magnitude of $q_t - q_b$ exceeds - 14%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

(3) for each percent that the magnitude of $q_t - q_b$ exceeds + 10%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

NOTE 2: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.5% of instrument span.

NOTE 3: OVERPOWER DELTA-T

$$\Delta T\left[\frac{(1 + \tau_1 S)}{(1 + \tau_2 S)}\right]\left[\frac{1}{(1 + \tau_3 S)}\right] \leq \Delta T_o \left\{K_4 - K_5\left(\left[\frac{\tau_7 S}{(1 + \tau_7 S)}\right]\left[\frac{1}{(1 + \tau_6 S)}\right]\right)T - K_6\left[T\left[\frac{1}{(1 + \tau_6 S)}\right] - T''\right] - f_2(\Delta I)\right\}$$

Where: ΔT	= As defined in Note 1;
ΔT_o	= As defined in Note 1;
$\frac{1 + \tau_1 S}{1 + \tau_2 S}$	= As defined in Note 1;

NOTES FOR TABLE 4-3 (Continued)

TABLE 2.2-1 (continued)

$\frac{\tau_7 S}{(1 + \tau_7 S)}$	= The function generated by the rate-lag controller for T_{avg} dynamic compensation;
τ_7	= Time constant utilized in the rate-lag controller for T_{avg}, $\tau_7 \geq 10$ secs.;
K_4	≤ 1.09;
K_5	$\geq 0.02/^{o}F$ for increasing average temperature and 0.0 for decreasing average temperature;
$\frac{1}{(1 + \tau_3 S)}$	= As defined in Note 1;
$\frac{1}{(1 + \tau_6 S)}$	= As defined in Note 1;
K_6	$\geq 0.00068/^{o}F$ for $T > T''$ and 0.0 for $T \leq T''$;
T	= As defined in Note 1;
T"	= Indicated T_{avg} at RATED THERMAL POWER (Calibration temperature for ΔT instrumentation, $\leq 574.2^{o}F$);
S	= As defined in Note 1;
f_2	= 0 for all ΔI;

NOTE 4: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.4% Delta-T span.

(9) This column provides the maximum value for a bistable assuming that the transmitter is not evaluated and the values for S, Z and TA from this table are used in the following equation: R = TA - Z - S. This implies that the transmitter is assumed to be at it's maximum allowed calibration and drift deviation in the non-conservative direction. With a bistable's Trip Setpoint found in excess of the value noted in this column, it is possible (but not known absolutely) that a channel would be considered inoperable. This must be tempered by the transmitter assumption noted above, i.e., the transmitter is assumed to be at it's worst acceptable condition.

NOTES FOR TABLE 4-3 (Continued)

(10) As noted in Item 12 of Table 2.2-1 of the Turkey Point Technical Specifications;

Trip Setpoint	Feed Flow ≤ 20% below Steam Flow
Allowable Value	Feed Flow ≤ 23.9% below Steam Flow

(11) As noted in Item 1 of Table 3.3-3 item f, of the Turkey Point Technical Specifications

Trip Setpoint	≤ A function defined as follows: A Delta-P corresponding to 40% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 120% Steam Flow at full load.
Allowable Value	≤ A function defined as follows: A Delta-P corresponding to 42.6% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 122.6% Steam Flow at full load.

(12) As noted in Item 7b & c of Table 3.3-3 of the Turkey Point Technical Specifications.

APPENDIX A

TURKEY POINT UNITS 3 & 4

SETPOINT TECHNICAL SPECIFICATIONS

SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

2.2 LIMITING SAFETY SYSTEM SETTINGS

REACTOR TRIP SYSTEM INSTRUMENTATION SETPOINTS

2.2.1 The Reactor Trip System Instrumentation and Interlock Setpoints shall be set consistent with the Trip Setpoint values shown in Table 2.2-1.

APPLICABILITY: As shown for each channel in Table 3.3-1.

ACTION:

a. With a Reactor Trip System Instrumentation or Interlock Setpoint less conservative than the value shown in the Trip Setpoint column but more conservative than the value shown in the Allowable Value column of Table 2.2-1, adjust the setpoint consistent with the Trip setpoint value within permissible calibration tolerance.

b. With the Reactor Trip System Instrumentation or Interlock Setpoint less conservative than the value shown in the Allowable Value column of Table 2.2-1, either:

   1. Adjust the Setpoint consistent with the Trip Setpoint value of Table 2.2-1 and determine within 12 hours that Equation 2.2-1 was satisfied for the affected channel or

   2. Declare the channel inoperable and apply the applicable ACTION statement requirement of Specification 3.3-1 until the channel is restored to OPERABLE status with its setpoint adjusted consistent with the Trip Setpoint value.

EQUATION 2.2-1 $$Z + R + S \leq TA$$

where:

Z = The value for column Z of Table 2.2-1 for the affected channel,

R = The "as measured" value (in percent span) of rack error for the affected channel,

S = Either the "as measured" value (in percent span) of the sensor error, or the value of Column S (Sensor Error) of Table 2.2-1 for the affected channel, and

TA = The value for Column TA (Total Allowance in percent of span) of Table 2.2-1 for the affected channel.

APPENDIX A

TABLE 2.2-1

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
1. Manual Reactor Trip	NA	NA	NA	NA	NA
2. Power Range, Neutron Flux,					
a. High Setpoint	7.5	4.56	0.0	≤ 109% RTP **	≤ 112.0% RTP **
b. Low Setpoint	8.3	4.56	0.0	≤ 25% RTP **	≤ 28.0% RTP **
3. Intermediate Range, Neutron Flux	13.5	8.41	0.0	≤ 25% RTP **	≤ 31% RTP **
4. Source Range, Neutron Flux	13.9	10.01	0.0	≤ 10^5 CPS	≤ 1.4 x 10^5 CPS
5. Overtemperature Delta-T	7.2	4.82	2.5 #	See Note 1	See Note 2
6. Overpower Delta-T	5.3	3.09	2.0	See Note 3	See Note 4
7. Pressurizer Pressure - Low	4.5	1.12	1.4	≥ 1835 PSIG	≥ 1817 PSIG
8. Pressurizer Pressure - High	5.5	1.12	1.4	≤ 2385 PSIG	≤ 2403 PSIG
9. Pressurizer Water Level High	8.0	6.76	4.0	≤ 92% of instrument Span	≤ 92.2% of instrument Span.
10. Reactor Coolant Flow - Low	4.6	2.65	0.8	≥ 90% of Loop Design Flow *	≥ 88.7% of Loop Design Flow *
11. Steam Generator Water Level Low-Low	5.0	2.33	1.9	≥ 15% of narrow range instrument span	≥ 13.2% of narrow range instrument span

* Loop Design Flow = 89,500 gpm

** RTP = RATED THERMAL POWER

\# 2.0% Span for Delta-T (RTDs) and 0.5% for Pressurizer Pressure

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
12. Steam/Feedwater Flow Mismatch Coincident with	20.0	3.67	7.3 ##	Feed Flow ≤ 20% below Steam Flow	Feed Flow ≤ 23.9% below Steam Flow
Steam Generator Water Level Low	5.0	2.33	1.9	≥ 15% of narrow range instrument span	≥ 13.2% of narrow range instrument span
13. Undervoltage RCP	20.0	1.12	0.0	≥ 70% bus voltage	≥ 69% bus voltage
14. Underfrequency RCP	16.4	0.50	0.0	≥ 56.1 Hz	≥ 55.9 Hz
15. Turbine Trip					
Auto Stop Oil Pressure	8.6	1.0	0.0	≥ 45 PSIG	≥ 43 PSIG
Turbine Stop Valve Closure	NA	NA	NA	Fully Closed ***	Fully Closed ***
16. Safety Injection Input from ESF	NA	NA	NA	NA	NA
17. Reactor Trip System Interlocks					
a. Intermediate Range Neutron Flux, P-6	NA	NA	NA	Nominal 1×10^{-10} amps	≥ 6.0×10^{-11} amps

*** Limit switch is set when Turbine Stop Valves are fully closed.

1.7% Span for Steam Line Flow, 2.9% Span for Feedwater Flow and 2.8% Span for Steam Line Pressure.

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
17. Reactor Trip System Interlocks (continued)					
b. Low Power Reactor Trips Block, P-7					
1) P-10 Input	NA	NA	NA	Nominal 10% RTP **	≤ 13.0% RTP **
2) Turbine First Stage Pressure	NA	NA	NA	Nominal 10% Turbine Power	≤ 13.0% Turbine Power
c. Power Range Neutron Flux, P-8	NA	NA	NA	Nominal 45% RTP **	≤ 48.0% RTP **
d. Power Range Neutron Flux, P-10	NA	NA	NA	Nominal 10% RTP **	≥ 7.0% RTP **
18. Reactor Coolant Pump Breaker Position Trip	NA	NA	NA	NA	NA
19. Reactor Trip Breakers	NA	NA	NA	NA	NA
20. Automatic Trip and Interlock Logic	NA	NA	NA	NA	NA

** RTP = RATED THERMAL POWER

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

<u>TABLE NOTATIONS</u>

NOTE 1: OVERTEMPERATURE ΔT

$$\Delta T\left[\frac{(1 + \tau_1 S)}{(1 + \tau_2 S)}\right]\left[\frac{1}{(1 + \tau_3 S)}\right] \leq \Delta T_o \left\{K_1 - K_2\left(\frac{(1 + \tau_4 S)}{(1 + \tau_5 S)}\right)\left[T\left[\frac{1}{(1 + \tau_6 S)}\right] - T'\right] + K_3(P - P') - f_1(\Delta I)\right\}$$

Where:	ΔT	= Measured ΔT by RTD Instrumentation;
	$\frac{1 + \tau_1 S}{1 + \tau_2 S}$	= Lead/Lag compensator on measured ΔT;
	τ_1, τ_2	= Time constants utilized in the lag compensator for ΔT; τ_1 = 8 secs., τ_2 = 3 secs.;
	$\frac{1}{(1 + \tau_3 S)}$	= The function generated by the rate-lag controller for T_{avg} dynamic compensation;
	ΔT_o	$\leq$ Indicated ΔT at RATED THERMAL POWER;
	K_1	$\leq$ [illegible].095;
	K_2	$>$ 0.0107/^oF;
	$\frac{1 + \tau_4 S}{1 + \tau_5 S}$	= The function generated by the lead-lag controller for T_{avg} dynamic compensation;
	τ_4, τ_5	= Time constants utilized in the lead-lag controller for T_{avg}, τ_4 = 25 secs., τ_5 = 3 secs.;
	T	= Average temperature ^oF;
	$\frac{1}{1 + \tau_6 S}$	= Lag compensator on measured T_{avg};
	T'	$\leq$ 574.2 ^oF (Nominal T_{avg} at RATED THERMAL POWER)
	K_3	$\geq$ 0.000453/psig;
	τ_3	= Time constant utilized in the lag compensator for ΔT, τ_3 = 0 secs.;

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

TABLE NOTATION

NOTE 1: OVERTEMPERATURE ΔT (continued)

τ_6	= Time constant utilized in the $_{avg}$ lag compensator for ΔT, τ_6 = 0 secs.;
P	= Pressurizer pressure (psig);
P'	≥ 2235 psig, (Nominal RCS operating pressure);
S	= Laplace transform operator, sec^{-1};

and $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power range nuclear ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

(1) for $q_t - q_b$ between - 14% and + 10%, $f_1(\Delta I) = 0$ where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is the total THERMAL POWER in percent of RATED THERMAL POWER;

(2) for each percent that the magnitude of $q_t - q_b$ exceeds - 14%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

(3) for each percent that the magnitude of $q_t - q_b$ exceeds + 10%, the Delta-T trip setpoint shall be automatically reduced by 1.5% of its value at RATED THERMAL POWER.

NOTE 2: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.5% of instrument span.

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

TABLE NOTATION

NOTE 3: OVERPOWER ΔT

$$\Delta T[\frac{(1+\tau_1 S)}{(1+\tau_2 S)}][\frac{1}{(1+\tau_3 S)}] \leq \Delta T_o\{K_4 - K_5[\frac{(\tau_7 S)}{(1+\tau_7 S)}](\frac{1}{(1+\tau_6 S)})T - K_6[T(\frac{1}{(1+\tau_6 S)}) - T''] - f_2(\Delta I)\}$$

Where: ΔT	= As defined in Note 1;
$\frac{1+\tau_1 S}{1+\tau_2 S}$	= As defined in Note 1;
$\frac{1}{1+\tau_3 S}$	= As defined in Note 1;
ΔT_o	= As defined in Note 1;
K_4	$\leq$ 1.09;
K_5	$\geq$ 0.02/°F for increasing average temperature and 0.0 for decreasing average temperature;
$\frac{(\tau_7 S)}{(1+\tau_7 S)}$	= The function generated by the rate-lag controller for T_{avg} dynamic compensation;
τ_7	= Time constant utilized in the rate-lag controller for T_{avg}, $\tau_7 \geq$ 10 secs.;
$\frac{1}{1+\tau_6 S}$	= As defined in Note 1;
τ_6	= As defined in Note 1;

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

TABLE NOTATION

NOTE 3: OVERPOWER ΔT (continued)

K_6	$\geq 0.00068/^{o}F$ for T > T" and 0.0 for T $\leq$ T";
T	= As defined in Note 1;
T"	= Indicated T_{avg} at RATED THERMAL POWER (Calibration temperature for ΔT instrumentation, $\leq 574.2^{o}F$);
S	= As defined in Note 1;
$f_2(\Delta I)$	= 0 for all ΔI.

NOTE 4: The channel's maximum trip setpoint shall not exceed its computed trip point by more than 1.4% ΔT span.

2.2 LIMITING SAFETY SYSTEM SETTINGS

BASES

2.2.1 REACTOR TRIP SYSTEM INSTRUMENTATION SETPOINTS

The Reactor Trip Setpoint Limits specified in Table 2.2-1 are the nominal values at which the Reactor trips are set for each functional unit. The Trip Setpoints have been selected to ensure that the reactor core and reactor coolant system are prevented from exceeding their safety limits during normal operation and design basis anticipated operational occurrences and to assist the Engineered Safety Features Actuation System in mitigating the consequences of accidents. The setpoint for a reactor trip system or interlock function is considered to be adjusted consistent with the nominal value when the "as measured" setpoint in within the band allowed for calibration accuracy.

To accommodate the instrument drift that may occur between operational tests and the accuracy to which setpoints can be measured and calibrated, Allowable Values for the Reactor Trip Setpoints have been specified in Table 2.2-1. Operation with setpoints less conservative than the Trip Setpoint but within the specified Allowable Value is acceptable since an allowance has been made in the safety analysis to accommodate this error. An optional provision has been included for determining the OPERABILITY of a channel when its trip setpoint is found to exceed the Allowable Value. The methodology of this option utilizes the "as measured" ("as found") deviation from the specified calibration point for rack and sensor components, in conjunction with a statistical combination of the other uncertainties of the instrumentation to measure the process variable, and the uncertainties in calibrating the instrumentation. In Equation 2.2-1, $Z + R + S \leq TA$, the interactive effects of the errors in the rack and the sensor, and the "as measured" ("as found" - nominal) values of the errors are considered. Z, as specified in Table 2.2-1, in percent span, is the statistical summation of errors assumed in the analysis excluding those associated with the sensor and rack drift and the accuracy of their measurement. TA or Total Allowance is the difference, in percent span, between the trip setpoint and the value used in the analysis for reactor trip. R or Rack Error is the "as measured" ("as found" - nominal) deviation, in percent span, for the affected channel from the specified trip setpoint. S or Sensor Drift is either the "as measured" ("as found" - nominal) deviation of the sensor from its calibration point or the value specified in Table 2.2-1, in percent span, from the analysis assumptions. Use of Equation 2.2-1 allows for a sensor drift factor, an increased rack drift factor, and provides a threshold value for determining reportability.

The methodology to derive the Trip Setpoints is based upon combining all of the uncertainties in the channels. Inherent to the determination of the Trip Setpoints are the magnitudes of these channel uncertainties.

2.2 LIMITING SAFETY SYSTEM SETTINGS

BASES

2.2.1 REACTOR TRIP SYSTEM INSTRUMENTATION SETPOINTS

Sensors and other instrumentation utilized in these channels are expected to be capable of operating within the allowances of these uncertainty magnitudes. Rack drift in excess of the Allowable Value exhibits the behavior that the rack has not met its allowance. Being that there is a small statistical chance that this will happen, an infrequent excessive drift is expected. Rack or sensor drift, in excess of the allowance that is more than occasional, may be indicative of more serious problems and should warrant further investigation.

LIMITING CONDITION FOR OPERATION

3.3.2 The Engineered Sa ty Feature Actuation System (ESFAS) instrumentation channels and interlocks shown in Table 3.3-2 shall be OPERABLE with their Trip Setpoints set consistent with the values shown in the Trip Setpoint column of Table 3.3-3

APPLICABILITY: As shown in Table 3.3-2.

ACTION:

a. With an ESFAS Instrumentation or Interlock Setpoint trip less conservative than the value shown in the Trip Setpoint column but more conservative than the value shown in the Allowable Value column of Table 3.3-3, adjust the setpoint consistent with the Trip setpoint value within permissible calibration tolerance.

b. With an ESFAS Instrumentation or Interlock Setpoint less conservative than the value shown in the Allowable Value column of Table 3.3-3, either:

   1. Adjust the Setpoint consistent with the Trip Setpoint value of Table 3.3-3 and determine within 12 hours that Equation 2.2-1 was satisfied for the affected channel, or

   2. Declare the channel inoperable and apply the applicable ACTION statement requirements of Table 3.3-2 until the channel is restored to OPERABLE status with its setpoint adjusted consistent with the Trip Setpoint value.

EQUATION 2.2-1 $Z + R + S \leq TA$

where:

Z = The value for column Z of Table 3.3-3 for the affected channel,

R = The "as measured" value (in percent span) of rack error for the affected channel,

S = Either the "as measured" value (in percent span) of the sensor error, or the value of Column S (Sensor Error) of Table 3.3-3 for the affected channel, and

TA = The value for Column TA (Total Allowance in percent of span) of Table 3.3-3 for the affected channel.

c. With an ESFAS instrumentation channel or interlock inoperable, take the ACTION shown in Table 3.3-2.

SURVEILLANCE REQUIREMENTS

4.3.2.1 Each ESFAS instrumentation channel and interlock and the automatic actuation logic and relays shall be demonstrated OPERABLE by performance of the ESFAS Instrumentation Surveillance Requirements specified in Table 4.3-2.

APPENDIX A
TABLE 3.3-3

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
1. Safety Injection, (Reactor Trip, Turbine Trip, Feedwater Isolation, Control Room Isolation, Start Die el Generators, Containment Phase A Isolation (except manual SI), Containment Cooling Fans, Containment Filter Fans, Start Sequencer, Component Cooling Water, Start Auxiliary Feedwater and Intake Cooling Water)					
a. Manual Initiation	NA	NA	NA	NA	NA
b. Automatic Actuation Logic	NA	NA	NA	NA	[illegible]
c. Containment Pressure High	2.0	0.2	0.0	≤ 4.0 PSIG	≤ 5.5 PSIG
d. Pressurizer Pressure - Low	13.0	8.4	1.4	[illegible] PSIG	≥ [illegible] PSIG
e. High Differential Pressure Between Steam Line Header and Steam Line.	4.7	1.57	4.60 *	≤ 100 PSIG	≤ 114 PSIG
f. Steam Line Flow - High	16.7	2.86	3.9	≤ A function defined as follows: A Delta-P corresponding to 40% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 120% Steam Flow at full load.	≤ A function defined as follows: A Delta-P corresponding to 42.6% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 122.6% Steam Flow at full load.
Coincident with: Steam Generator Pressure - Low	13.0	1.16	2.3	≥ 614 PSIG	≥ 588 PSIG
or					
Tavg - Low	4.0	2.00	1.00	≥ 543°F	≥ 542.5°F
2. Containment Spray					
a. Automatic Actuation Logic and Actuation Relays	NA	[illegible]	NA	NA	NA
b. Containment Pressure High - High Coincident with: Containment	10.0	1.6	0.0	≤ 20 PSIG	≤ 21.4 PSIG
Pressure High	2.0	0.2	0.0	≤ 4.0 PSIG	≤ 5.5 PSIG

* 2.3% Span for each sensor

APPENDIX A

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
3. CONTAINMENT ISOLATION					
a. Phase "A" Isolation					
1) Manual Initiation	NA	NA	NA	NA	NA
2) Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	NA
3) Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				
b. Phase "B" Isolation					
1) Manual Initiation	NA	NA	NA	NA	NA
2) Automatic Actuation Logic and Actuation Relays	NA	NA	NA		NA
3) Containment Pressure High - High Coincident	10.0	1.6	0.0	≤ 20 PSIG	≤ 21.4 PSIG
with:Containment Pressure High	2.0	0.2	0.0	≤ 4.0 PSIG	≤ 5.5 PSIG
c. Containment Ventilation Isolation					
1) Containment Isolation Manual Phase A or Manual Phase B	NA	NA	NA	NA	NA
2) Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	NA
3) Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				
4) Containment Radioactivity High	NA	NA	NA	Particulate (R-11) ≤ 6.1×10^5 CPM Gaseous (R-12) see (2)	Particulate (R-11) ≤ 6.8×10^5 CPM Gaseous (R-12) see (2)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
4. STEAM LINE ISOLATION					
a. Manual Initiation	NA	NA	NA	NA	
b. Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	
c. Containment Pressure High - High Coincident with:Containment	10.0	1.6	0.0	≤ 20 PSIG	≤ 21.4 PSIG
Pressure High	2.0	0.2	0.0	≤ 4.0 PSIG	≤ 5.5 PSIG
f. Steam Line Flow - High	16.7	2.86	3.9	≤ A function defined as follows: A Delta-P corresponding to 40% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 120% Steam Flow at full load.	≤ A function defined as follows: A Delta-P corresponding to 42.6% Steam Flow at 0% load increasing linearly from 20% load to a value corresponding to 122.6% Steam Flow at full load.
Coincident with: Steam Line Pressure - Low	13.0	1.16	2.3	≥ 614 PSIG	≥ 588 PSIG
or Tavg - Low	4.0	2.00	1.00	≥ 543°F	≥ 542.5°F
5. FEEDWATER ISOLATION					
a. Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	NA
b. Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				
6. Auxiliary Feedwater (3)					
a. Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	NA
b. Steam Generator Water Level Low-Low	5.0	2.33	1.9	≥ 15% of narrow range instrument span	≥ 13.2% of narrow range instrument span
c. Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
6. Auxiliary Feedwater (continued)					
d. Bus Stripping	See Item 7. below for all Bus Stripping Setpoints and Allowable Values				
e. Trip of All Main Feedwater Pump Breakers	NA	NA	NA	NA	NA
7. Loss of Power					
a. 4.16 kV Busses A and B (Loss of Voltage)	NA	NA	NA	NA	NA
b. 480V Load Centers (Instantaneous Relays) Degraded Voltage					
Load Center					
3A				436V±5V (10 sec ± 1 sec delay)	[ ]
3B				416V±5V (10 sec ± 1 sec delay)	[ ]
3C				417V±5V (10 sec ± 1 sec delay)	[ ]
3D				428V±5V (10 sec ± 1 sec delay)	[ ]
4A				415V±5V (10 sec ± 1 sec delay)	[ ]
4B				414V±5V (10 sec ± 1 sec delay)	[ ]
4C				401V±5V (10 sec ± 1 sec delay)	[ ]
4D				403V±5V (10 sec ± 1 sec delay)	[ ]
Coincident with: Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				
Diesel Generator Breaker Open				NA	NA

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(Z)	Sensor Drift (S)	Trip Setpoint	Allowable Value
7. Loss of Power (continued)					
c. 480V Load Centers (Inverse Time Relays) Degraded Voltage					
Load Center					
3A				419V±5V (60 sec ± 30 sec delay)	[ ]
3B				426V±5V (60 sec ± 30 sec delay)	[ ]
3C				427V±5V (60 sec ± 30 sec delay)	[ ]
3D				436V±5V (60 sec ± 30 sec delay)	[ ]
4A				427V±5V (60 sec ± 30 sec delay)	[ ]
4B				424V±5V (60 sec ± 30 sec delay)	[ ]
4C				413V±5V (60 sec ± 30 sec delay)	[ ]
4D				412V±5V (60 sec ± 30 sec delay)	[ ]
Coincident with: Diesel Generator Breaker Open				NA	NA
8. Engineered Safety Features Actuation System Interlocks					
a. P-11 Pressurizer Pressure	NA	NA	NA	nominal 2000 PSIG	≤ 2018 PSIG
b. P-12 Tavg - Low	NA	NA	NA	nominal 543°F	≥ 542.5°F
9. Control Room Isolation					
a. Automatic Actuation Logic and Actuation Relays	NA	NA	NA	NA	NA
b. Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values				

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
INSTRUMENTATION TRIP SETPOINTS

Functional Unit	Total Allowance (TA)	(2)	Sensor Drift (S)	Trip Setpoint	Allowable Value
9. Control Room Isolation (Continued)					
c. Containment Radioactivity High (1)	NA	NA	NA	Particulate (R-11) $\leq 6.1 \times 10^5$ CPM Gaseous (R-12) see (2)	Particulate (R-11) $\leq 6.8 \times 10^5$ CPM Gaseous (R-12) see (2)
d. Containment Isolation Manual Phase A or Manual Phase B	NA	NA	NA	NA	NA
e. Air Intake Radiation Level	NA	NA	NA	$\leq$ 2mR/hr	$\leq$ 2.83mR/hr

TABLE NOTATIONS

(1) Either the particulate or gaseous channel in the OPERABLE status will satisfy this LCO.

(2) Containment Gaseous Monitor Setpoint = $\frac{(3.2 \times 10^4)}{(F)}$ CPM,

Containment Gaseous Monitor Allowable Value = $\frac{(3.5 \times 10^4)}{(F)}$ CPM,

Where $F = \frac{\text{Actual Purge Flow}}{\text{Design Purge Flow (35,000 CFM)}}$

Setpoint may vary according to current plant conditions provided that the release rate does not exceed allowable limits provided in Specification 3.11.2.1.

(3) Auxiliary feedwater manual initiation is included in Specification 3.7.1.2.

If no allowable value is specified so indicated by [ ], the trip setpoint shall also be the allowable value.

3/4.3 INSTRUMENTATION

BASES

3/4.3.1 and 3/4.3.2 REACTOR TRIP SYSTEM and ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION

The OPERABILITY of the Reactor Trip System and the Engineered Safety Features Actuation System instrumentation and interlocks ensures that: (1) the associated ACTION and/or Reactor trip will be initiated when the parameter monitored by each channel or combination thereof reaches its Setpoint (2) the specified coincidence logic is maintained, (3) sufficient redundance is maintained to permit a channel to be out-of-service for testing or maintenance (due to plant specific design, pulling fuses and using jumpers may be used to place channels in trip), and (4) sufficient system functional capability is available from diverse parameters.

The OPERABILITY of these systems is required to provide the overall reliability, redundancy, and diversity assumed available in the facility design for the protection and mitigation of accident and transient conditions. The integrated operation of each of these systems is consistent with the assumptions used in the safety analyses. The Surveillance Requirements specified for these systems ensure that the overall system functional capability is maintained comparable to the original design standards. The periodic surveillance tests performed at the minimum frequencies are sufficient to demonstrate this capability.

The Engineered Safety Features Actuation System Instrumentation Trip Setpoints specified in Table 3.3-3 are the nominal values at which the bistables are set for each functional unit. The setpoint is considered to be adjusted consistent with the nominal value when the "as measured" setpoint is within the band allowed for calibration accuracy.

To accommodate the instrument drift that may occur between operational tests and the accuracy to which Setpoints can be measured and calibrated, Allowable Values for the Setpoints have been specified in Table 3.3-3. Operation with Setpoints less conservative than the Trip Setpoint but within the Allowable Value is acceptable since an allowance has been made in the safety analysis to accommodate this error. An optional provision has been included for determining the OPERABILITY of a channel when its trip setpoint is found to exceed the Allowable Value. The methodology of this option utilizes the "as measured" ("as found" deviation from the specified calibration point for rack and sensor components in conjunction with a statistical combination of the other uncertainties of the instrumentation to measure the process variable and the uncertainties in calibrating the instrumentation. In Equation 2.2-1, $Z + R + S \leq TA$, the interactive effects of the errors in the rack and the sensor, and the "as measured" values of the errors are considered. Z, as specified in Table 3.3-3, [illegible] percent span, is the statistical summation of errors assumed

3/4 INSTRUMENTATION

BASES

3/4.3.1 and 3/4.3.2 REACTOR TRIP SYSTEM and ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION (Continued)

in the analysis excluding those associated with the sensor and rack drift and the accuracy of their measurement. TA or Total Allowance is the difference, in percent span, between the trip setpoint and the value used in the analysis for actuation. R or Rack Error is the "as measured" ("as found" - nominal) deviation, in percent span, for the affected channel from the specified trip setpoint. S or Sensor Drift is either the "as measured" ("as found" - nominal) deviation of the sensor from its calibration point or the value specified in Table 3.3-3, in percent span, from the analysis assumptions. Use of Equation 2.2-1 allows for a sensor drift factor, an increased rack drift factor, and provides a threshold value for determining reportability.

The methodology to derive the Trip Setpoints includes an allowance for instrument uncertainties. Inherent to the determination of the Trip Setpoints are the magnitudes of these channel uncertainties. Sensor and rack instrumentation utilized in these channels are expected to be capable of operating within the allowances of these uncertainty magnitudes. Rack drift in excess of the Allowable Value exhibits the behavior that the rack has not met its allowance. Being that there is a small statistical chance that this will happen, an infrequent excessive drift is expected. Rack or sensor drift, in excess of the allowance that is more than occasional, may be indicative of more serious problems and should warrant further investigation.