ATTACHMENT 1

RAI RESPONSE

NRC REQUEST FOR ADDITIONAL INFORMATION (RAI)
ON LDCN 12-0015 (TAC NO. MF0378)

Question:

The NRC Staff has a question on the setpoint calculation submitted via Reference 3 and the initial performance Frequency of new SR 3.7.9.4.

The licensee calculated the loop uncertainty with a 6-month drift, but has asked for an initial surveillance interval of 18 months. Risk informing the initial frequency is unacceptable.

The licensee could provide further justification for the 18 month interval or change it to an *initial* interval of 6 months. Since SR 3.7.9.4 is a new Surveillance Requirement the licensee may not have the performance data under the Surveillance Frequency Control Program (SFCP) to justify an 18 month interval. Since new SR 3.7.9.4 will be under the SFCP, the licensee could extend the interval after test data exists to justify an extension.

With respect to new SR 3.7.9.4 the licensee cited Callaway License Amendment 202 which implements TSTF-425. The TSTF relies on RG 1.175 and NEI 04-10 for guidance on risk informing surveillance frequencies. Section 3 of 04-10 sites the 5 key principles in the RG. Principle 3 states:

> **3. The proposed change maintains sufficient safety margins.**
>
> Conformance with this principle is assured with proposed changes to Surveillance Frequencies since the SSC design, operation, testing methods, and acceptance criteria specified in applicable Codes and Standards, or alternatives approved for use by the NRC, will continue to be met as described in the plant licensing basis (e.g., FSAR, or Technical Specifications Bases). Also, the safety analysis acceptance criteria in the plant licensing basis (e.g., FSAR, supporting analyses) will continue to be met with the proposed changes to Surveillance Frequencies.

It doesn’t appear to the NRC Staff that the licensee can demonstrate the requisite safety margin.

Response:

Reference 3 (ULNRC-06070) submitted setpoint calculation J-UEF03 Revision 1 which used an input assumption for temperature element drift (Table 7 on calculation page 10 of 21) of 0.15°F/year multiplied by a test interval of six months (0.5 year) which gave rise to this RAI. Attachment 2 herewith provides setpoint calculation J-UEF03 Revision 2 which increases the temperature element drift uncertainty to account for a test interval of

22.5 months (Table 7 on calculation page 10 of 21). This input is the only value changed from Revision 1 of the calculation. The overall Channel Uncertainty (CU) increased from 2.475°F to 2.489°F, an increase of 0.014°F. However, the CU had already been rounded up to 2.5°F in Revision 1 of the calculation. Therefore, the change included in Revision 2 of the calculation has no impact on the Safety Analysis Limits, actuation setpoints, or reset values for the UHS cooling tower bypass valves and fans.

In the context of setpoint calculations, sufficient safety margin is maintained by providing field settings that differ from the Safety Analysis Limits by the value expressed as the CU. This relationship is depicted by Figure 5 and Equation 7.1 of ISA-RP67.04, Part II, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," September 1994. The "margin" term in Equation 7.1 is an additional amount chosen, *if desired*, by the user for extra conservatism and can be set aside for future allocation if needed. It is not a required element in the methodology. In addition to the calculation margins discussed in Section 7.1 of J-UEF03 Revision 2, further margin is contained in the temperature element drift allowance determined for a 22.5 month test interval. The 25% allowance provided by SR 3.0.2 is not typically included in setpoint calculations for a nominal 18-month test interval and the application of SR 3.0.2 is not systematically used as an operational convenience.

ATTACHMENT 2

SETPOINT CALCULATION J-UEF03 REVISION 2

Calculation J-UEF03

Rev. 002

Instrument Loop Uncertainty Estimate: UHS Cooling Tower Fan Speed and Bypass Valve Control

Temperature loops EFT-0061/62 (ESW Supply Line) and EFT-0067A/68A (ESW Return Line) setpoint uncertainty calculation for the Ultimate Heat Sink (UHS) Cooling Tower fan speed control and ESW to UHS Cooling Tower bypass valve control.

Responsible Engineer: Scott Taylor Date: (See Elect. Sign.)

Qualified Reviewer: Ed Goss Date: (See Elect. Sign.)

Approver: Jesse Hutchison Date: (See Elect. Sign.)

Approx. Date: 08/2012

Director W.O.: CALC00002262

1.0 Purpose & Scope

This calculation determines the UHS Cooling Tower fan speed control and ESW to UHS Cooling Tower bypass valve control setpoints considering instrument uncertainties.

Temperature loops EFT-0061/62 (ESW supply line) and EFT-0067A/68A (ESW return line) actuate the UHS Cooling Tower fans (CEF01A/B/C/D); first in slow speed then into high speed as the temperature rises. The fans are normally controlled via the return line and switched to the supply line post Design Basis Accident (DBA) initiation. Fan control is used to protect two design basis parameters. In the initial hours of a DBA these loops protect the maximum UHS temperature limit (FSAR SP Chapter 9.2, Calc. EF-123). The fans are then used to ensure an adequate UHS inventory is maintained throughout the UHS's 30 day action statement (FSAR SA Chapter 9.2, Calc. EF-123).

These temperature loops also actuate the ESW to UHS Cooling Tower bypass valves (EFHV0065/66). Bypass valve control is set up to ensure freeze protection (FSAR SA Chapter 9.2, RFR 200802059). This valve also aids the above mentioned fan operation in that cooling is only achieved when the valve is closed, allowing return water over the UHS Cooling Tower fill.

Configuration A below details temperature instrumentation loops EFT-0061/62 (ESW supply line) and EFT-0067A/68A (ESW return line) for UHS Cooling Tower fan and bypass valve control. Each output isolation card feeds a selector switch (no signal impact/uncertainty) to allow selection between the supply and return lines. (EFT-0067A to EFT-0061 & EFT-0068A to EFT-0062)

Configuration A: UHS fan speed and bypass valve control loop

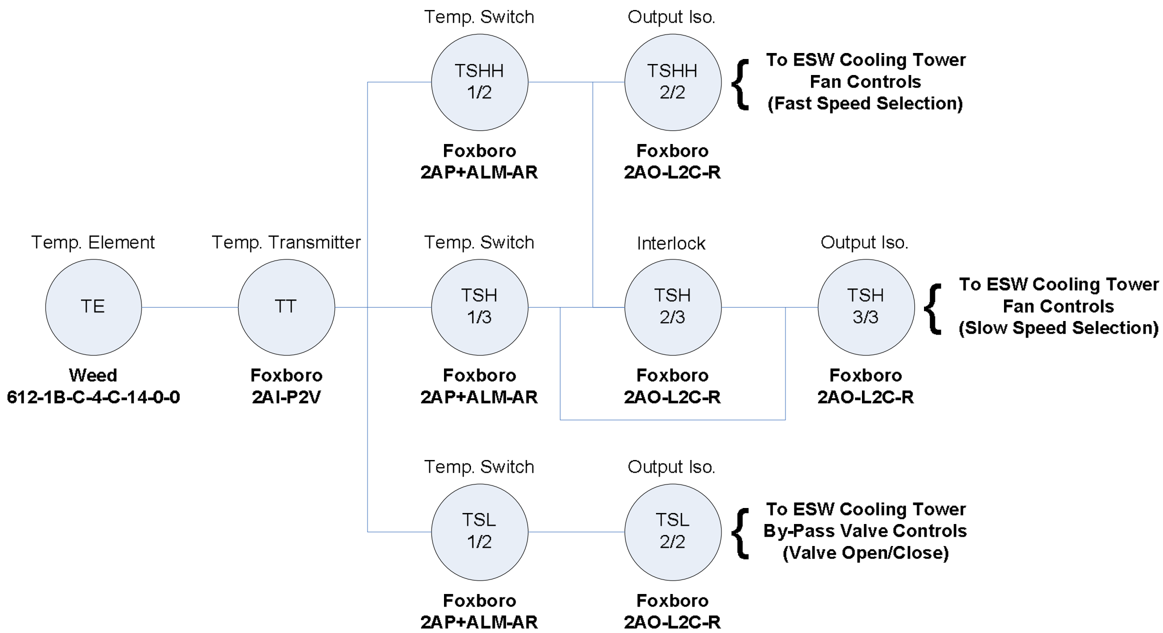


Table 1: Configuration A Director Location IDs

Train			TSHH 1/2*	TSHH 2/2*	
Supply					
A			EFTSHH006112	EFTSHH006122	
B			EFTSHH006212	EFTSHH006222	
Return					
A			EFTSHH0067A12	EFTSHH0067A22	
B			EFTSHH0068A12	EFTSHH0068A22	
	TE	**TT**	**TSH 1/3***	**TSH 2/3***	**TSH 3/3***
Supply					
A	EFTE0061	EFTT0061	EFTSH006113	EFTSH006123	EFTSH006133
B	EFTE0062	EFTT0062	EFTSH006213	EFTSH006223	EFTSH006233
Return					
A	EFTE0067A	EFTT0067A	EFTSH0067A13	EFTSH0067A23	EFTSH0067A33
B	EFTE0068A	EFTT0068A	EFTSH0068A13	EFTSH0068A23	EFTSH0068A33
			TSL 1/2*	**TSL 2/2***	
Supply					
A			EFTSL006112	EFTSL006122	
B			EFTSL006212	EFTSL006222	
Return					
A			EFTSL0067A12	EFTSL0067A22	
B			EFTSL0068A12	EFTSL0068A22	

Table 2: Director Switch Location IDs

Train	TSHH*	TSH*	TSL*
Supply			
A	EFTSHH0061	EFTSH0061	EFTSL0061
B	EFTSHH0062	EFTSH0062	EFTSL0062
Return			
A	EFTSHH0067A	EFTSH0067A	EFTSL0067A
B	EFTSHH0068A	EFTSH0068A	EFTSL0068A

* Callaway has given each circuit card (1/3, 2/3, 3/3, etc) a singular location ID for tracking purposes. The setpoint and tolerance data is maintained on a generic switch ID shown on Table 2 above.
** Hand switches EFHS0067 and EFHS0068 are used after each switch to select between the supply and return line for each control function (Low, High, and High-High Setpoints)

1.1 Calculation History

1.1.1 J-UEF03, Revision 000, INSTRUMENT LOOP UNCERTAINTY ESTIMATE: SYSTEM EF LOOPS 67A AND 68A. DETERMINE THE DEGREE OF UNCERTAINTY IN THE CALIBRATION AND MEASUREMENT OF THE SUBJECT INSTRUMENT LOOPS. – This Calculation determined the instrument loop uncertainty of EF Loops 67A and 68A when they exclusively controlled the UHS Cooling Tower fans/bypass valve.

1.1.2 J-1EF03, Revision 000, INSTRUMENT LOOP UNCERTAINTY ESTIMATE: SYSTEM EF LOOPS 67A & 68A DETERMINE THE DEGREE OF UNCERTAINTY IN THE SUBJECT INSTRUMENTATION LOOPS – This calculation is identical to J-UEF03, Revision 000. It shows one revision performed prior to the creation of J-UEF03, but is otherwise identical. The ‘1’ in the title implies a link to the Wolf Creek Power Plant, but there is no UHS at Wolf Creek. J-UEF03, Revision 001 has superseded J-UEF03, Revision 000; it has also superseded J-1EF03, Revision 000.

1.1.3 J-UEF03A, Revision 000, MIN ALLOW SETPT LIMIT RACK TRIP VAL & LIMIT SYS TRIP VAL: LPS 67A & 68A. DETERMINE THE SAFETY RELATED SETPOINT RACK ALLOWABLE VALUE AND SYSTEM ALLOWABLE VALUE OF THE EF-TSL-67A & 68A, EF-TSH-67A & 68A AND EF-TSHH-67A & 68A BISTABLES. – This Calculation used the uncertainty determined via J-UEF03/J-1EF03 to determine the UHS Cooling Tower Fan and Bypass Valve setpoints. This calculation determined the setpoints when they were controlled via EF Loops EFT-0067A and EFT-0068A exclusively. This document was superseded by J-UEF03, Revision 001.

1.1.4 J-UEF03, Revision 001, Instrument Loop Uncertainty Estimate: UHS Cooling Tower Fan Speed and Bypass Valve Control – This revision incorporates the changes done by MP 11-0004 to the UHS Cooling Tower Fan Speed and Bypass Valve Control. The MP added a hand switch to allow control off of the existing ESW return line temperature instrumentation loops EFT-0067A and EFT-0068A or the new ESW supply line temperature instrumentation loops EFT-0061 and EFT-0062.

1.1.5 J-UEF03, Revision 002 – This revision increased the calculated Temperature Element (TE) drift frequency to allow for extending the loop testing frequency.

2.0 Methodology

2.1 The methodology used to determine this uncertainty will be that of ISA-S67.04, Dated September 1994, Setpoints for Nuclear Safety-Related Instrumentation, and ISA-RP67.04, Dated September 1994, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation.

2.2 The general equation for channel uncertainty (CU) is:

$$CU = [PM^2 + PE^2 + e^2{}_1 + e^2{}_2 + \ldots + e^2{}_N]^{1/2} + B_T + |RB_T| \quad (2.2)$$

Where,
PM = Random component of the process measurement uncertainty
PE = Random component of the primary element uncertainty
e_n = Square Root Sum of the Squares of all random independent components of uncertainty associated with a module n
B_T = Algebraic sum of all bias estimates for all biases in a channel
RB_T = Sum of the absolute value of all random bias (and arbitrary distribution) estimates in a channel.

2.3 The general equation for a module uncertainty (e_n from equation 2.2) is:

$$e = [RA^2 + DR^2 + TE^2 + RE^2 + SE^2 + HE^2 + SP^2 + MTE^2]^{1/2} + B + |RB| \quad (2.3)$$

Where,
e = Module total uncertainty
RA = Module reference accuracy
DR = Module drift over a specified period
TE = Module temperature effect
RE = Module radiation effect
SE = Module seismic (vibration) effect
HE = Module humidity effect
SP = Module static pressure effect
MTE = Maintenance and test equipment used during module calibration
B = Bias uncertainty estimates associated with module

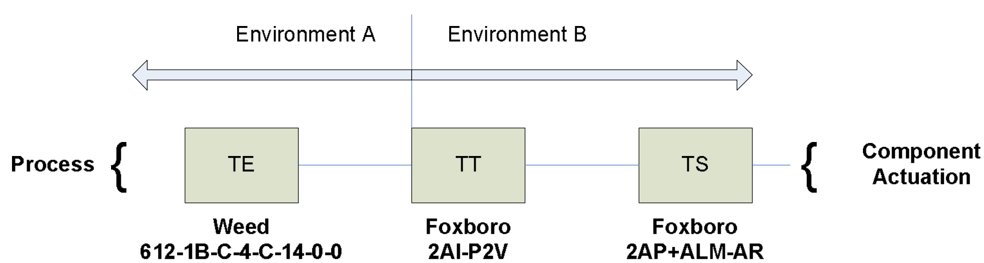
RB = Sum of absolute values of all random biases or abnormally distributed uncertainties for the module.

2.4 Bounding Uncertainty Loop

Configuration A, in section 1.0 above, shows all of the loop components necessary to actuate the UHS Cooling Tower fans and by-pass valves. This section breaks down Configuration A into a bounding set of loop modules that shows the loop uncertainty for any one component actuation.

The 2AO-L2C-R circuit cards have no impact on signal transmission. These cards are used for isolation and interlocking. For this reason they have been removed from the uncertainty. The supply/return line loop selector hand switch will also not be included as it also has no impact on signal transmission. The three Low, High, and High-High setpoint bistable (switch) circuit cards are identical and for any one component actuation only one switch will be used. Thus for any one component actuation the signal is impacted by the three modules shown below. The bounding uncertainty case is as follows:

Configuration B: Bounding Uncertainty Loop



2.5 Dependent uncertainties, shared amongst the separate modules, will be combined in such a way that independent variables will be combined using a square root sum of the square technique, (SRSS) while dependent variables will be combined by algebraic addition. Reference 8.3.2 describes how the dependence of the various effects is related. The variables described in section 2.3 are compared in Table 3, Variable Dependency, for each component in the loop.

Table 3: Variable Dependency

Effect	TE	TT	TS
PM -Process Measurement Accuracy	i	-	-
PE – Primary Element Accuracy	i	-	-
RA - Reference Accuracy	-	a	a
DR – Module Drift	i	a	a
TE – Temperature Effect	-	b	b
RE – Radiation Effect*	-*	-*	-*
SE – Seismic Effect	-	b	b
HE – Humidity Effect	-	b	b
SP – Static Pressure Effect*	-*	-*	-*
Power Supply	-	c	c
MTE**	-	a**	a**

a: The reference accuracy, or calibrated accuracy, and the module drift are both dependent with respect to M&TE and independent with respect to each other. This does not include the TE as it is not calibrated.

b: Since these components are all located in the same cabinet, they are all exposed to the same environment and seismic effect. Thus, the temperature, humidity, and seismic effects will be considered dependent between modules (circuit cards), but independent with respect to each other.

c: Since these components all use the same power supply, the power supply effects will be considered dependent.

i: This effect is considered independent of all other effects.

* Since all of the components are exposed to no more than atmospheric pressure and minimal radiation, the only environmental effects are temperature and humidity.

** Only one piece of M&TE will be considered for all of the rack mounted components.

2.6 Final Setpoint Determination

The final step in this calculation is to determine the setpoints for UHS Cooling Tower Fan and Bypass Valve control. Each setpoint is determined by combining the Safety Analysis Limits (SALs) found in the Design Inputs section, the setpoint uncertainties derived in this calculation, and margin.

The formula for a rising setpoint:

TS = SAL - CU - Margin

The formula for a falling setpoint:

TS = SAL + CU + Margin

Where,
TS = Trip Setpoint
SAL = Safety Analysis Limit
CU = Channel Uncertainty

3.0 Assumptions

3.1 Assumptions concerning the values of specific error terms for the loop components are included within the "Design Inputs" section for that component.

4.0 Design Inputs

4.1 *Environmental data for temperature loops (Configuration B, section 2.4)*

4.1.1 Environment A: Room 3101, Pipe Space & Tank Area, Elevation 1974

The following data has been taken from FSAR Table 3.11(B)-1 (Normal Environment) and FSAR Table 3.11(B)-2 (Design Basis Accident (DBA) Accident) for this room:

Table 5: Expected Environment A Values

	Pressure	**Temp (˚F)**	**Humidity (max/min)**	**Dose**	**Normal Dose**	**PH**
Normal	Atmospheric	104/60	70/30%	<0.0005	<200	7
DBA	Atmospheric	120	95%	<2.5	X	X

4.1.2 Environment B: Room 3605, Control Room Equipment Cabinet Area

The following data has been taken from FSAR Table 3.11(B)-1 (Normal Environment) and FSAR Table 3.11(B)-2 (Design Basis Accident (DBA) Accident) for this room:

Table 6: Expected Environment B Values

	Pressure	**Temp (˚F)**	**Humidity (max/min)**	**Dose**	**Normal Dose**	**PH**
Normal	Atmospheric	84/60	70/30%	<0.0005	<200	7
DBA	Atmospheric	84*	95%	<2.5	X	X

*Qualified to 104 ˚F

4.2 *Process Measurement Accuracy:*

The **Process Measurement Accuracy** is an error that is introduced due to possible fluctuations in the process medium that will impact the temperature measurement. Per calculation J-2B01, environmental effects are not considered. The temperature linearity is included in the basic accuracy. The humidity is assumed to have no effect as the RTD's are sealed devices that are also protected by a closed thermo-well and O-ring sealed connection head assembly. No Process Measurement Accuracy will be incorporated for this loop.

4.3 *Temperature Element Accuracy (TE, Primary Element Accuracy):*

Table 7: Temperature Element Accuracy Design Inputs

Effect/Value	Formula	Value	References
RA - Reference Accuracy	1/2˚F or 1/4% max temp, whichever is greater	0.5 ˚F	*
DR – Module Drift	0.15 ˚F/year * 1.875 years	0.281 ˚F	*, 4.3.1
TE – Temperature Effect	See section 4.2.2, 4.2.2.1	None	*, 4.3.2, 4.3.2.1
RE – Radiation Effect	See Section 4.2.2	None	*
SE – Seismic Effect	See section 4.2.3	1 ˚F	*, 4.3.3, J-558B-00018
HE – Humidity Effect	See section 4.2.2, 4.2.2.2	None	*, 4.3.2, 4.3.2.2
SP – Static Pressure Effect	Not applicable for RTD	None	
Power Supply	Not applicable for RTD	None	*, J2R03
MTE – Maint. & Test Equip.	RTD can not be calibrated	None	

* Calculation J-2B01 details the uncertainties associated with Weed Instruments Platinum RTD, model number 612-1B-C-4-C-14-0-0.

4.3.1 Calculated frequency duration is 22.5 months (1.875 years) to support an 18 month testing frequency with a 4.5 month grace period (late date).

4.3.2 No uncertainty will be given to the temperature elements for temperature, radiation, and humidity. FSAR 3.11(B).5.7 describes a mild environment as being ≤110 ˚F, < 10^3 rads, and ≤ 90% humidity while FSAR Table 3.11(B) shows this room reaching 120 ˚F and 95% humidity. However, this section also describes a mild environment as an environment that will not exceed its anticipated abnormal condition. NUREG0588 implementation has further determined the temperature elements to be rated category 'D' for HELB, LOCA, and MSLB design basis accidents (Ref. Director Database). Category D is defined as being located in a mild environment post-accident. Temperature and humidity uncertainties are not necessary for equipment rated for mild environments. The expected radiation levels are within mild environment requirements.

4.3.2.1 Temperature Effect: This component will not be impacted by temperature shifts as its primary function is to measure temperature. Per Table 5, Expected Environment A Values, the element could see a temperature shift of 16˚F (120-104˚F) which is inside the temperature elements expected range. Per calculation J-2B01, the normal environmental temperature effect for this component is included in the Reference Accuracy (RA).

4.3.2.2 Humidity Effect: Per calculation J-2B01, this component will not be impacted by humidity changes as the RTD's are sealed devices that are protected by a closed Thermo-well and O-ring sealed connection head assembly.

4.3.3 Seismic Effect = 1 ˚F. Qualification Report J-558B-00018, pages 95 & 106 provides the pre and post seismic response for the Weed Instruments, model 612-1B-C-4-C-14-0-0 temperature element (Table 8 Below). Comparing the post seismic functional test data to the baseline functional data shows a worst case drift of 0.205 Ω. Converting to degrees $\frac{X\ ^\circ F}{100\ ^\circ F} = \frac{0.205\ \Omega}{21.54\ \Omega}$ (Ref 4.2.3.1, 4.2.3.2) determines a worst case seismic response of 0.952˚F. This value will be rounded to 1 ˚F for conservatism.

Table 8: Seismic Response of Temperature Element

	VII (Baseline Test)	**XIII (Post Seismic Test)**	**Difference (Ω)**	**Difference (˚F)**
P1: G1-A ($R2_a$ – $R1_a$)	100.028	100.041	-0.013	
P1: G1-B ($R2_a$ – $R1_a$)	100.141	99.981	0.16	
P2: G1-A ($R2_a$ – $R1_a$)	99.997	99.964	0.033	
P2: G1-B ($R2_a$ – $R1_a$)	100.075	99.870	0.205	0.952

This qualification report provides an RTD qualification, considering a Design Basis Accident (DBA) effect for seismic uncertainty, which is over-conservative. This test was performed after radiation testing, thermal testing, vibration aging, humidity aging, and vibration aging again. The seismic tests follow IEEE standards IEEE-323 and 344.

4.3.3.1 Temperature Element Input Span: 100 ˚F. (30 – 130 ˚F per Director Database)

4.3.3.2 Temperature Element Output Span: Dependent on RTD specifications. EFTE0061: 21.54 Ω; EFTE0062 (Fitted Serial N1169): 21.54 Ω; EFTE0067A (Fitted Serial N4155): 21.577 Ω; EFTE0068A (Fitted Serial N2051): 21.586 Ω (See Director Database). The worst case span of 21.54 Ω was used for this calculation as it bounds the other loops.

4.4 *Temperature Transmitter (TT):*

Table 9: Temperature Transmitter Accuracy Design Inputs

Effect/Value	Formula	Value	References
RA - Reference Accuracy	0.5% output span (100 ˚F)	0.5 ˚F	*, 4.4.1
DR – Module Drift	0.5% output span (100 ˚F)	0.5 ˚F	*, 4.4.1
TE – Temperature Effect	0.686 % output span (100 ˚F)	0.686 ˚F	*, 4.4.2
RE – Radiation Effect	See Section 4.3.3	None	*, 4.4.3
SE – Seismic Effect	0.5% output span (100 ˚F)	0.5 ˚F	*
HE – Humidity Effect	0.67 % output span (100 ˚F)	0.67 ˚F	*, 4.4.2
SP – Static Pressure Effect	Not applicable for Circuit Card	None	
Power Supply Effect	0.150% output span (100 ˚F)	0.15 ˚F	*, 4.4.1
MTE – Maint. & Test Equip.	See Section 4.6	0.1123 ˚F	4.6

* Calculation J-2A03 details the uncertainties associated with the Foxboro, Resistance to Voltage Converter, model number 2AI-P2V.

4.4.1 Transmitter output span: 100 ˚F. (30 – 130 ˚F per Director Database)

4.4.2 Temperature and Humidity Effect: DBA effects are not considered for this component. The accident and normal environment are equivalent.

4.4.3 Radiation Effect: Radiation exposure within mild environment limits. No uncertainty will be considered for this effect.

4.5 *Temperature Bistable (TS):*

Table 10: Temperature Bistable Accuracy Design Inputs

Effect/Value	Formula	Value	References
RA - Reference Accuracy	0.5% input span (100 ˚F)	0.5 ˚F	*, 4.5.1
DR – Module Drift	0.5% input span (100 ˚F)	0.5 ˚F	*, 4.5.1
TE – Temperature Effect	0.44 % input span (100 ˚F)	0.44 ˚F	*, 4.5.1, 4.5.2
RE – Radiation Effect	See Section 4.3.3	None	*, 4.5.3
SE – Seismic Effect	0.3% input span (100 ˚F)	0.3 ˚F	*
HE – Humidity Effect	0.5 % input span (100 ˚F)	0.5 ˚F	*, 4.5.1, 4.5.2
SP – Static Pressure Effect	Not applicable for Circuit Card	None	
Power Supply Effect	0.15% input span (100 ˚F)	0.15 ˚F	*, 4.5.1
MTE – Maint. & Test Equip.	See Section 4.6	0.1125 ˚F	4.6

* Calculation J-2A02 details the uncertainties associated with the Foxboro, bistable circuit card, model number 2AP+ALM-AR.

4.5.1 Input span: 100 ˚F. (30 – 130 ˚F per Director Database)

4.5.2 Temperature and Humidity Effect: DBA effects are not considered for this component. The accident and normal environment are equivalent.

4.5.3 Radiation Effect: Radiation exposure within mild environment limits. No uncertainty will be considered for this effect.

4.6 *Maintenance & Testing Equipment (MTE)*

Typically a 1 to 1 accuracy (MTE to Component) is used for calculating MTE uncertainties. I&C craft is then held to a 2 to 1 accuracy for calibration. This is done for conservatism in setpoint uncertainty calculations. However, calculation EF-123, which determines the safety analysis limits (SALs) for these setpoints requires all conservatisms to be removed. In order to remove conservatism, the actual MTE accuracies will be used for this calculation.

The temperature element is not calibrated. The temperature curves are determined at the factory and provided to Callaway for scaling.

The rack components (TT, TS) are calibrated using a decade box (RTD simulator) and Digital Multimeter (DMM). The DMM used to calibrate these loops must be a Keithley 197 or equivalent. Per reference 8.2.10, the uncertainty of this DMM is 0.03% span (100 ˚F per 4.4.1) or 0.03 ˚F. The decade box used to calibrate these loops must be a Transcat 7010T decade box or equivalent. Per reference 8.2.10 the uncertainty of the decade box is 0.02% of the reading. The worst case reading (the highest possible ohms reading) is 121.150 per reference 8.2.1, giving an uncertainty of 0.02423Ω. Converting to degrees $\frac{X^{\circ}\mathrm{F}}{100^{\circ}\mathrm{F}} = \frac{0.02423\Omega}{21.54\Omega}$ (Ref 4.2.3.1, 4.2.3.2) determines a decade box uncertainty of 0.1125˚F.

4.7 *Safety Analysis Limits (SAL)*

4.7.1 Freeze Protection

The ESW to UHS Cooling Tower Bypass Valves open on a low temperature to prevent water going over the cooling tower fill and freezing. In addition, when the initial DBA temperature is below freezing, the water, although rising in temperature, cannot be allowed over the fill until a certain point to ensure large droplets don't freeze and impede tower performance.

Per RFR 200802059, the criteria for closing EFHV0065/66 requires either the ambient wet-bulb temperature to be greater than 32 F or the ESW return water temperature to be greater than or equal to 61 F. The fans may then be run at any temperature above this to provide cooling. The freeze protection function is necessary for both supply and return line setpoints. The Bypass valve fulfills a secondary role as being necessary for fan operation.

4.7.1.1 Freeze Protection SAL – 61 F. (RFR 200802059)

4.7.2 Return Line SALs

The UHS Cooling Tower Fan Speed and Bypass Valve Position is controlled off of the return line at the beginning of a DBA to protect the ESW system from reaching the max ESW temperature of 92.3 F (Ref. 8.2.4, 8.1.4) A discussion of the GOTHIC model anticipated max temperature and its acceptability can be found in Calculation EF-123 (Ref 8.1.4). With respect to setpoint determination the GOTHIC model requires the UHS Cooling Tower Fast Speed control (high-high setpoint) to actuate (set) between 102.5 and 107.5 F. The fast speed (high-high setpoint) reset values are of no consequence as the temperature is not anticipated to reach this limit prior to swap over to the supply line temperature loops. The slow speed (high setpoint) fan runs in this scenario are negligible as the temperature in the return line heats up quickly and doesn't reach normal levels until after swap over to the supply line. The bypass valve must be closed prior to reaching the fast speed setpoint to allow for proper cooling.

4.7.2.1 Fan Fast Speed Set – Between 102.5 and 107.5 ˚F (Calculation EF-123)

4.7.3 Supply Line SALs

After the ESW DBA temperature has reached a controllable state the UHS Cooling Tower Fan Speed and Bypass Valve Position will be controlled via the supply line temperature. At this point max temperature and UHS inventory is a concern for UHS operation. The GOTHIC model anticipated temperature values, as well as the inventory losses associated with using these setpoints are determined and can be found in calculation EF-123. With respect to setpoint determination the GOTHIC model fast and slow (high-high and high setpoints) set and reset values are used to ensure these two limits are maintained. The bypass valve is not expected to change state during the use of this control, but it must be closed to achieve proper cooling from the tower.

4.7.3.1 Fan Fast Speed Set – Between 87 and 92 ˚F (Calculation EF-123)

4.7.3.2 Fan Fast Speed Reset – Between 85 and 90 ˚F (Calculation EF-123)

4.7.3.1 Fan Slow Speed Set – Between 82 and 87 ˚F (Calculation EF-123)

4.7.3.2 Fan Slow Speed Reset – Between 80 and 85 ˚F (Calculation EF-123)

5.0 Calculation

Table 11 summarizes the design input values for each module in the loop.

Table 11: Complete Accuracy Design Inputs List

Effect	TE	TT	TS
PM – Process Measurement Ac.	-	-	-
PE – Primary Element Ac.	-	-	-
RA - Reference Accuracy	0.5 ˚F	0.5 ˚F	0.5 ˚F
DR – Module Drift	0.281 ˚F	0.5 ˚F	0.5 ˚F
TE – Temperature Effect	-	0.686 ˚F	0.44 ˚F
RE – Radiation Effect	-	-	-
SE – Seismic Effect	1 ˚F	0.5 ˚F	0.3 ˚F
HE – Humidity Effect	-	0.67 ˚F	0.5 ˚F
SP – Static Pressure Effect	-	-	-
PS - Power Supply Effect	-	0.15 ˚F	0.15 ˚F
MTE – Maint. & Test Equip.	-	0.1125 ˚F	0.1125 ˚F

5.1 The final equation for the Channel Uncertainty combines equation 2.2 and 2.3 for use with the values found in Table 11. Dependant variables between modules from table 4 are taken out of their module specific uncertainty and combined in the overall channel uncertainty. The resultant Channel Uncertainty Equation is calculated below:

<u>Equation 5.1</u>

$$CU = [PM^2 + PE^2 + ([DR_{TE}{}^2 + RA_{TE}{}^2 + SE_{TE}{}^2]^{1/2})^2 + ([(RA_{TT} + MTE_{TT})^2 + (DR_{TT} + MTE_{TT})^2]^{1/2})^2 + ([(RA_{TS} + MTE_{TS})^2 + (DR_{TS} + MTE_{TS})^2]^{1/2})^2 + (TE_{TT}+ TE_{TS})^2 + (SE_{TT}+ SE_{TS})^2 + (HE_{TT}+ HE_{TS})^2 + (PS_{TT}+ PS_{TS})^2]^{1/2}$$

5.2 Using equation 5.1 above with the numbers from Table 11 derives the following Channel Uncertainty:

$$CU = [0^2 + 0^2 + ([0.281\,^2 + 0.5\,^2 + 1.0^2]^{1/2})^2 + ([(0.5 + 0.1125)^2 + (0.5 + 0.1125)^2]^{1/2})^2 + ([(0.5 + 0.1125)^2 + (0.5 + 0.1125)^2]^{1/2})^2 + (0.686+ 0.44)^2 + (0.5+ 0.3)^2 + (0.67+ 0.5)^2 + (0.15+ 0.15)^2]^{1/2}$$

CU = 2.489 ˚F

The Setpoint Uncertainty associated with temperature instrumentation loops EFT-0067A, EFT-0068A, EFT-0061, and EFT-0062 is 2.489 ˚F. For ease of use and to add margin, the setpoint uncertainty (Channel Uncertainty CU) used in this calculation will be rounded up to **<u>2.5 ˚F</u>.**

5.3 Setpoint Determination

Per the methodology for deriving a Trip Setpoint (TS), found in section 2.6, TS is equal to the Safety Analysis Limit (SAL) +/- the Channel Uncertainty (CU) +/- Margin (M). The values are added or subtracted depending on whether the SAL is triggered rising or falling (directionality). The setpoints found in Tables 12 and 13 have been derived using this equation.

5.3.1 Example Calculation (Tables 12/13): Supply Line TSHH Set (Fan Fast speed actuation)

Required action point: 102.5 – 107.5.
Calculation Methodology (2.6): Rising: TS = SAL - CU - Margin
Calculation Methodology (2.6): Falling: TS = SAL + CU + Margin
If TS is known, margin is then: Rising: Margin = SAL - CU - TS
If TS is known, margin is then: Falling: Margin = SAL – (CU + TS)

Trip Setpoint Rising: TS = 107.5 ˚F – 2.5 ˚F – 0 ˚F = 105 ˚F
Trip Setpoint Falling: TS = 102.5 ˚F + 2.5 ˚F + 0 ˚F = 105 ˚F
Trip Setpoint = 105 ˚F
Margin Rising: 107.5 ˚F – 2.5 ˚F - 105 ˚F = 0 ˚F
Margin Falling: 107.5 ˚F – (2.5 ˚F + 105 ˚F) = 0 ˚F

Table 12: Return Line (EFT-0067A, EFT-0068A) Setpoint Determination

	Setpoint (˚F)	**Required Action Point (˚F)**	**Margin (˚F)**	**References**
TSHH Set (fast fan start)***	105.0	102.5 - 107.5 ***	0	EF-123, 4.7.2, 4.7.2.1
TSHH Reset (fast fan stop)	102.5	(Note 1)	(Note 1)	EF-123, 4.7.2
TSH Set (slow fan start)	95.0	(Note 1)	(Note 1)	EF-123, 4.7.2
TSH Reset (slow fan stop)	92.5	(Note 1)	(Note 1)	EF-123, 4.7.2
TSL Reset (close bypass valve)***	84.0	92.5 (Note 2) ***	6.0	EF-123, 4.7.1, 4.7.2, 4.7.3
TSL Set (open bypass valve)***	78.0	61.0 ***	14.5	EF-123, 4.7.1, 200802059

***Setpoint supports a Safety Analysis Limit (SAL). Other setpoints may be changed without impacting the analysis (EF-123).

Note 1: The values chosen for non-SAL setpoints support the values used in calculation EF-123. As their function does not impact the safety analysis results, they may be revised without recourse to the safety analysis. Thus the margin associated with these setpoints is not considered. These setpoints do operate in the proper order. With raising temperature the valve closes followed by the slow start of the fans and finishing with the fast start of the fans. With falling temperature when the fast fans kick off the slow fans will be running. The slow fans will then kick off followed by the valve opening. It is important to note that there is an interlock to ensure the fast fans will run if a set signal has been provided to the slow and fan start circuitry.

Note 2: The valve must be closed prior to the fast speed start signal to ensure the safety analysis is maintained. However, the valve should be closed prior to the slow speed start for proper cooling tower operation. For this reason the slow speed start setpoint was used to determine valve reset margin.

Table 13: Supply Line (EFT-0061, EFT-0062) Setpoint Determination

	Setpoint (˚F)	Required Action Point (˚F)	Margin (˚F)	References
TSHH Set (fast fan start)***	89.5	87.0 - 92.0 ***	0	EF-123, 4.7.3, 4.7.3.1
TSHH Reset (fast fan stop)***	87.5	85.0 – 90.0 ***	0	EF-123
TSH Set (slow fan start) ***	84.5	82.0 – 87.0 ***	0	EF-123
TSH Reset (slow fan stop)***	82.5	80.0 – 85.0 ***	0	EF-123
TSL Reset (close bypass valve)***	79.0	82.5 ***	1	EF-123, 4.7.1, 4.7.3
TSL Set (open bypass valve)***	73.0	61.0 ***	9.5	EF-123, 4.7.1, 200802059

***Setpoint supports a Safety Analysis Limit (SAL). Other setpoints may be changed without impacting the analysis (EF-123).

6.0 Impact Assessment

6.1 Upstream Calculations (reviewed, not impacted): J-2B01, J-2A02, J-2A03, & EF-123.

6.3 Downstream Calculations: None Identified.

6.4 Design Basis Documents (reviewed, not impacted): Setpoint data for EFTSL0061/62/67A/68A, EFTSH0061/62/67A/68A, and EFTSHH0061/62/67A/68A. MP 11-0004. FSAR SA 9.2.5.2.3 & FSAR SA 9.2.5.5.

6.5 50.59 Applicability

This calculation supports the changes identified in MP 11-0004 and calculation EF-123. The 50.59 review performed via MP 11-0004 covers all changes associated with this calculation.

7.0 Conclusion

This calculation determines the UHS Cooling Tower fan speed control and ESW to UHS Cooling Tower bypass valve control setpoints considering instrument uncertainties. A Channel Uncertainty for instrumentation temperature loops EFT-0061, EFT-0062, EFT-0067A, and EFT-0068A of **2.5 ˚F** has been determined via this calculation. The UHS Fan slow and fast speed control setpoints, as well as the UHS bypass valve control setpoints have additionally been determined. See Table 12, Supply Line (EFT-0067A, EFT-0068A) Setpoint Determination, and Table 13, Return Line (EFT-0061, EFT-0062) Setpoint Determination, for a breakdown of the new values.

Thus, for revision 002, the loop testing frequency can be extended to 22.5 months (18 months + 4.5 month grace period).

7.1 Margin Discussion

The margin associated with each setpoint is discussed in Table 12, Supply Line (EFT-0067A, EFT-0068A) Setpoint Determination, and Table 13, Return Line (EFT-0061, EFT-0062) Setpoint Determination. Per section 5.2, the Channel Uncertainty was rounded up to 2.5 ˚F, providing a relatively small amount of margin in the setpoint determination section. Per section 4.3.3, the seismic effect was rounded to 1 ˚F, providing a relatively small amount of margin to the temperature element uncertainty determination. Section 4.3.3 also discusses inherent margin associated with the testing of this equipment.

Revision 002 of this modification decreases margin in the uncertainty determination by 0.014 ˚F. This reduction in margin is inconsequential and does not impact the overall calculation results.

8.0 References

8.1 Calculation References

8.1.1 J-2A02, Rev 001 – Accuracy: Foxboro Bistable 2AP+ALM-AR
8.1.2 J-2A03, Rev 001 – Accuracy: Foxboro Res to Volt Conv Model 2AI-P2V
8.1.3 J-2B01, Rev 001 – Accuracy: Temperature Element (RTD) Weed Series 611 & 612
8.1.4 EF-123, Rev 000 – Callaway UHS Cooling Pond Performance using GOTHIC Model CN-CRA-10-21
8.1.5 J-1EF03, Rev 000 – Instrument Loop Uncertainty Estimate: EF Loops 67A & 68A
8.1.6 J-UEF03A, Rev 001 – Min Allow Setpt Rack Trip Val & Sys Trip Val: Lps 67A & 68A.
8.1.7 EF-54, Rev 003A – This Calculation Predicts the UHS performance for the meteorological conditions identified in FSAR SA TABLE 2.3-13 AND 2.3-15.

8.2 Design Basis Documentation References

8.2.1 Director Database (CEL, Callaway Equipment List)
8.2.2 RFR 200802059, Update OTN-EF-00001 Rev. 36 to reflect current UHS CT operating curves
8.2.3 MP 11-0004, Ultimate Heat Sink (UHS) Temperature Issue Solution
8.2.4 FSAR SP Chapter 9.2
8.2.5 FSAR SA Chapter 9.2
8.2.6 FSAR Table 3.11(B)-1, Normal Environment
8.2.7 FSAR Table 3.11(B)-2 Design Basis Accident (DBA) Accident
8.2.8 FSAR 3.11(B).5.7
8.2.9 J-558B-00018, Fast Response RTD/RTDT & Thermocouple Assemblies – Test Qual
8.2.10 AmerenUE letter NED080004, "Margin Recovery Program – Reactor Protection System Setpoint Uncertainty Calculations Information Request", 1/22/08.
8.2.11 AmerenUE letter NED080025, "Comments on Verified Draft Version of the Overtemperature and Overpower Delta T Uncertainty Calculations", 6/2/08
8.2.12 FSAR SA 9.2.5.2.3, System Operation

8.2.13 FSAR SA 9.2.5.5, Instrument Applications

8.3 Industry References

8.3.1 ISA-S67.04, Dated September 1994, Setpoints for Nuclear Safety-Related Instrumentation
8.3.2 ISA-RP67.04, Dated September 1994, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation
8.3.3 NUREG0588
8.3.4 IEEE-323
8.3.5 IEEE-344

8.4 Component References

8.4.1 EFT-0061 - ESW PMP (2PEF01A) DISCH TEMP
8.4.2 EFT-0062 - ESW PMP (2PFE01B) DISCH TEMP
8.4.3 EFT-0067A - ESW COOL TWR A (SEF01) INLET TEMP
8.4.4 EFT-0068A - ESW COOL TWR B (SEF01) INLET TEMP
8.4.5 EFTSL0061 - UHS COOLTWR Bypass VLV Temp SW Low ESW SPLY TRN A
8.4.6 EFTSL006112 - FOXBORO CIRCUIT CARD
8.4.7 EFTSL006122 - FOXBORO CIRCUIT CARD
8.4.8 EFTSL0062 - UHS COOLTWR Bypass VLV Temp SW Low ESW SPLY TRN B
8.4.9 EFTSL006212 - FOXBORO CIRCUIT CARD
8.4.10 EFTSL006222 - FOXBORO CIRCUIT CARD
8.4.11 EFTSL0067A - ESW TRN A TO UHS COOL TOWERS A & C LO TEMP SW
8.4.12 EFTSL0067A12 - FOXBORO CIRCUIT CARD
8.4.13 EFTSL0067A22 - FOXBORO CIRCUIT CARD
8.4.14 EFTSL0068A - ESW TRN B TO UHS COOL TOWERS B & D LO TEMP SW
8.4.15 EFTSL0068A12 - FOXBORO CIRCUIT CARD
8.4.16 EFTSL0068A22 - FOXBORO CIRCUIT CARD
8.4.17 EFTSH0061 - UHS COOLTWR FAN A & C TEMP SW HI ESW SPLY TRN A
8.4.18 EFTSH006113 – FOXBORO CIRCUIT CARD
8.4.19 EFTSH006123 - FOXBORO CIRCUIT CARD
8.4.20 EFTSH006133 - FOXBORO CIRCUIT CARD
8.4.21 EFTSH0062 - UHS COOLTWR FAN B & D TEMP SW HI ESW SPLY TRN B
8.4.22 EFTSH006213 - FOXBORO CIRCUIT CARD
8.4.23 EFTSH006223 - FOXBORO CIRCUIT CARD
8.4.24 EFTSH006233 - FOXBORO CIRCUIT CARD
8.4.25 EFTSH0067A - ESW TRN A TO UHS COOL TOWERS A & C HI TEMP SW
8.4.26 EFTSH0067A13 - ESW COOL TWR A (SEF01) INLET TEMP
8.4.27 EFTSH0067A23 - FOXBORO CIRCUIT CARD
8.4.27 EFTSH0067A33 - FOXBORO CIRCUIT CARD
8.4.28 EFTSH0068A - ESW PMP B TO UHS COOL TOWERS B & D HI TEMP SW
8.4.29 EFTSH0068A13 - ESW COOL TWR B (SEF01) INLET TEMP
8.4.30 EFTSH0068A23 - FOXBORO CIRCUIT CARD
8.4.31 EFTSH0068A33 - FOXBORO CIRCUIT CARD
8.4.32 EFTSHH0061 - UHS COOLTWR FAN A & C TEMP SW HIHI ESW SPLY TRN A
8.4.33 EFTSHH006112 – FOXBORO CIRCUIT CARD

8.4.34 EFTSHH006122 - FOXBORO CIRCUIT CARD
8.4.36 EFTSHH0062 - UHS COOLTWR FAN B & D TEMP SW HIHI ESW SPLY TRN B
8.4.37 EFTSHH006212 - FOXBORO CIRCUIT CARD
8.4.38 EFTSHH006222 - FOXBORO CIRCUIT CARD
8.4.39 EFTSHH0067A - ESW TRN A TO UHS COOL TOWERS A & C HI/HI TEMP SW
8.4.40 EFTSHH0067A12 - ESW COOL TWR A (SEF01) INLET TEMP
8.4.41 EFTSHH0067A22 - FOXBORO CIRCUIT CARD
8.4.42 EFTSHH0068A - ESW TRN B TO UHS COOL TOWERS B & D HI/HI TEMP SW
8.4.43 EFTSHH0068A12 - FOXBORO CIRCUIT CARD
8.4.44 EFTSHH0068A22 - FOXBORO CIRCUIT CARD
8.4.45 EFTE0061 - ESW PMP A DISCH TEMP ELEM
8.4.46 EFTE0062 - ESW PMP B DISCH TEMP ELEM
8.4.47 EFTE0067A - ESW TRN A TO UHS COOL TOWERS A & C TEMP ELEM
8.4.48 EFTE0068A - ESW TRN B TO UHS COOL TOWERS B & D TEMP ELEM
8.4.49 EFTT0061 - ESW A TEMP TO POWER BLOCK
8.4.50 EFTT0062 - ESW B TEMP TO POWER BLOCK
8.4.51 EFTT0067A - ESW COOL TWR A (SEF01) INLET TEMP
8.4.52 EFTT0068A - ESW COOL TWR B (SEF01) INLET TEMP
8.4.53 EFHS0067 - A Train ESW RTN/SPLY (Loops 67A/61) Line Temp Hand Switch
8.4.54 EFHS0068 - B Train ESW RTN/SPLY (Loops 68A/62) Line Temp Hand Switch
8.4.55 EFHV0065 - ESW UHS COOL-TWR TRN A BYP HV
8.4.56 EFHV0066 - ESW UHS COOL-TWR TRN B BYP HV
8.4.57 CEF01A - ESW ULTIMATE HEAT SINK COOLING TOWER FAN A
8.4.58 CEF01B - ESW ULTIMATE HEAT SINK COOLING TOWER FAN B
8.4.59 CEF01C - ESW ULTIMATE HEAT SINK COOLING TOWER FAN C
8.4.60 CEF01D - ESW ULTIMATE HEAT SINK COOLING TOWER FAN D