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February 27, 1998

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555-0001

Gentlemen:

ULNRC-03748
TAC No. MA0177

Ameren UE

DOCKET NUMBER 50-483
CALLAWAY PLANT
UNION ELECTRIC COMPANY
CHANGES TO RTS AND ESFAS
DELTA-T FUNCTIONAL UNITS

References: 1) ULNRC-3673 dated 10/31/97
2) B. C. Westreich letter to G. L. Randolph dated 1/29/98

Reference 1 transmitted a license amendment request to change several setpoint values contained in Callaway Technical Specification Tables 2.2-1 and 3.3-4. Reference 2 transmitted a request for additional information related to our amendment request.

Attached are responses to the request for information. Please contact us if you have additional questions.

Very truly yours,

Alan C Passwater

Alan C. Passwater
Manager-Licensing & Fuels

GGY/jdg

Attachments

A001 /1

STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

Alan C. Passwater, of lawful age, being first duly sworn upon oath says that he is Manager, Licensing and Fuels (Nuclear) for Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Alan C Passwater
Alan C. Passwater
Manager, Licensing and Fuels
Nuclear

SUBSCRIBED and sworn to before me this 27th day of February, 1998.

Patricia L. Reynolds

PATRICIA L. REYNOLDS
NOTARY SEAL
NOTARY PUBLIC
STATE OF MISSOURI

PATRICIA L. REYNOLDS
NOTARY PUBLIC—STATE OF MISSOURI
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MY COMMISSION EXPIRES DEC. 22, 2000

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1. **Question**:

Provide a copy of the setpoint calculation showing Total Allowance (TA), Channel Statistical Allowance (CSA) each for Functional Units OT Delta T (K1), OT Delta P[sic] (K4), and SG water Low-Low Vessel Delta T (Power-1 and Power-2) for reactor trips and for AFW start ESFAS functions.

Response:

A telecon was held on February 23, 1998 with NRC Staff to discuss our concerns with providing information held as proprietary to Westinghouse. As a result of that telecon, please find the attached Table 1 relating current vs. proposed values for the following parameters for the four affected trip functions:

a) Safety Analysis Limit (SAL, unchanged);

b) Nominal Trip Setpoint (NOM);

c) Total Allowance (TA);

d) Channel Statistical Allowance (CSA);

e) Allowable Value (AV); and

f) Margin (MAR).

Note when reviewing Table 1 that values presented there are in % RTP and that 100% ΔT span = 150% RTP.

In addition, a discussion of setpoint methodology was desired beyond the reference provided in SLNRC 84-50 dated 3/23/84. The setpoint methodology used is consistent with that represented by Equation 6.2 of ISA-RP67.04, Part II, Recommended Practice, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," September 1994.

The method discussed by that recommended practice is a combination of statistical and algebraic methods that use statistical square root sum of squares (SRSS) methods to combine random uncertainties and then algebraically combine the nonrandom terms with the result. The formulas and following discussion present the basic principles of this methodology.

The basic formula for our uncertainty calculations takes the form:

$$CSA = \pm [A^2+B^2+C^2)]^{1/2} \pm |F| + L - M$$

where

A,B,C = random and independent terms. The terms are zero-centered, approximately normally distributed, and are indicated by a ± sign.

F = abnormally distributed uncertainties and/or biases (unknown sign). The term is used to represent limits of error associated with uncertainties that are not normally distributed and do not have known direction. The magnitude of this term (absolute value) is assumed to contribute to the total uncertainty in a worst-case direction and is also indicated by a ± sign.

L & M = biases with known sign. The terms can impact an uncertainty in a specific direction and, therefore, have a specific + or - contribution to the total uncertainty.

CSA = resultant uncertainty. The resultant uncertainty combines the random uncertainty with the positive and negative components of the nonrandom terms separately to give a final uncertainty. The positive and negative nonrandom terms are not algebraically combined before combination with the random component. This calculated result is also called the Channel Statistical Allowance in our setpoint methodology.

The addition of the F, L, and M terms to the A, B, and C uncertainty terms allows the formula to account for influences on total uncertainty that are not random or independent. For biases with known direction, represented by L and M, the terms are combined with only the applicable portion (+ or -) of the random uncertainty. For the uncertainty represented by F, the terms are combined with both portions of the random uncertainty. Since these terms are uncertainties themselves, the positive and negative components of the terms cannot be algebraically combined into a single term. The positive terms of the nonrandom uncertainties should be summed separately, and the negative terms of the nonrandom uncertainties should be summed separately and then individually combined with the random uncertainty to yield a final value. Individual nonrandom uncertainties are independent probabilities and may not be present simultaneously. Therefore, the individual terms cannot be assumed to offset each other. The purpose of the setpoint calculation is to ensure that protective actions occur 95 percent of the time with a high degree of confidence before the analytical limits are reached. A conservative philosophy applies the SRSS technique only to those uncertainties that are characterized as independent, random, and approximately normally distributed. All other uncertainty components are combined using the maximum possible uncertainty treatment, i.e., algebraic summation of absolute values as necessary.

If R equals the resultant uncertainty $(A^2 + B^2 + C^2)^{1/2}$, the maximum positive uncertainty is

$$+CSA = +R + |F| + L$$

and the maximum negative uncertainty is

$$-CSA = -R - |F| - M.$$

SRSS combination for bias uncertainties is inappropriate since, by their nature, they do not satisfy the prerequisites for SRSS. Bias uncertainties are not random and are not characterized by a normal probability distribution. Since the number of known biases is typically small and they may or may not be present simultaneously, the recommended practice (RP67.04) conservatively endorses algebraic summation for bias uncertainties.

In the determination of the random portion of an uncertainty, situations may arise where two or more random terms are not totally independent of each other but are independent of the other random terms. This dependent relationship can be accommodated within the SRSS methodology by algebraically summing the dependent random terms prior to performing the SRSS determination. The formula takes the following form:

$$CSA = \pm [A^2+B^2+C + (D + E)^2]^{1/2} \pm |F| + L - M$$

where

D and E = random dependent uncertainty terms that are independent of terms A, B, and C.

The above methods are also discussed in Sections 4.4.1 and 4.4.2 of ISA-S67.04, Part I, Standard, "Setpoints for Nuclear Safety-Related Instrumentation", September 1994. The setpoint methodology used in this license amendment request has not changed since 1984 and follows the SRSS approach discussed above. A graphical breakdown of this approach is attached in Figure 7-1 from an internal 1994 I&C SSFA.

2. **Question**:

Provide a copy of the calculations used for ULNRC-2808 dated June 4, 1993, ULNRC-03198 dated April 17, 1995, and ULNRC-2196 dated April 12, 1990. Please note that these documents are included as References 2, 3 and 4 to the October 31, 1997 submittal.

Response:

Those other license amendments were referenced only inasmuch as they demonstrated the use of the setpoint methodology and provided a history of the Δ T and T_{avg} channel setpoint changes implemented since the RTD Bypass Modification (see Reference 4 of ULNRC-3673). They are not needed for the approval of ULNRC-3673 as they covered other, previously approved modifications. The information provided in response to Question 1 is similar to that contained in the above references.

3. **Question**:

In reference to the "Significant Hazards Evaluation" more information is needed as noted below.

a. Item 2, page 3 of the Attachment 1. It is stated that out of random and systematic portions of the Process Measurement Accuracy (PMA) error (due to hot leg streaming), the systematic component will be replaced with a bias considering the "burndown effect". Provide information as to how the bias-value was calculated or provide a copy of the calculation for this bias. Also, it is not clear how the random portion of the PMA could be eliminated from the OT Delta T setpoint calculation since this error-component will always be present (due to some streaming and due to other effects), although in some circumstances its value may be different. Explain how elimination of the random PMA error component is justified by moving the axial-flux-difference (AFD) penalty function deadband by 2 percent on both sides.

Response:

This question actually consists of three parts and will be addressed as such.

As discussed on pages 4 and 5 of the 50.92 evaluation, the treatment of the hot leg streaming portion of the OTΔT PMA term as a bias is justified by operating experience at Callaway demonstrating its unidirectional nature. It is not a random term that should be included with the square-root-sum-of-squares (SRSS) treatment of the other random, independent terms. The value of this bias was not calculated; it was determined from Callaway's operating experience during Cycle 8. The ΔT bias was observed to be bounded by 0.6°F, but a value of 1.0°F was used in the calculation for conservatism. Likewise, the T_{avg} bias was observed to be bounded by 0.3°F, but a value of 0.5°F was used in the calculation.

Not all portions of the OTΔT PMA term were eliminated; only those portions related to hot leg streaming (which has been demonstrated by operating experience to be unidirectional and more appropriately treated as a bias) and the ΔI incore/excore comparison term discussed below were eliminated. The treatment of the hot leg streaming PMA term and the scoop streaming bias discussed in the Reference 4 (ULNRC-2196, Attachment 6, page 10) spreadsheet for OTΔT is not only more appropriately handled as a bias, given its unidirectional nature, but it is more conservative to do so when considering these uncertainty terms and comparing the CSA calculated with a SRSS handling of the hot leg streaming PMA term and an algebraically added scoop streaming bias vs. algebraically added biases for both ΔT and T_{avg}.

The OTΔT AFD penalty function should only take away operating margin when the penalty deadband is exceeded on either side. Moving the OTΔT AFD penalty function deadband in 2% ΔI on both sides is the same as treating this function (listed as the 3% ΔI incore/excore comparison PMA term C in the same Reference 4 OTΔT spreadsheet mentioned above and later revised to a 2% ΔI PMA term in Reference 2 to ULNRC-3673) as a bias directly to the parameter of interest, rather than always taking away setpoint margin when no AFD penalty is warranted given operation within the penalty deadband.

<u>Question</u>:

b. Item 3, page 3 of the Attachment 1: It is stated that RTD sensor calibration accuracy and drift can be eliminated from the setpoint calculation because (a) periodic re-normalization of each loop's parameters performed during quarterly surveillance will compensate for the RTD uncertainty, (b) an additional error component which has been added for power calorimetric that will compensate for the RTD sensor calibration accuracy, and (c) addition of burndown effect bias will compensate for the RTD drift.

In this situation, if OT Delta T protection is required due to a transient during the period between the two successive surveillances (i.e., just before the loop being re-normalized), how will the loop respond without compromising safety since RTD accuracy and drift are eliminated from the setpoint calculation. Also, justify by a quantitative evaluation that the burndown effects bias will compensate for the RTD drift in addition to compensating the random component of PMA.

Response:

The RTD sensor drift and calibration accuracy terms from the Reference 4 spreadsheet aren't just eliminated, as suggested by the question. They are treated more appropriately. When the method used to calculate the CSA in Reference 4 (i.e., PMA term for hot leg streaming, hot leg scoop streaming bias, RTD drift sensor term, and RTD calibration accuracy sensor term) is compared against the proposed method of calculating the CSA:
(1) including a 2% RTP (1.33% ΔT span) power calorimetric PMA term to address the RTD calibration accuracy and M&TE sensor terms;
(2) handling the incore/excore mismatch as a direct, functional bias in the setting of the 7300 function generator cards, outside the OTΔT setpoint calculation itself, by moving the OTΔT penalty deadband in by 2% on both sides as discussed above; (3) and adding in biases of 1.0°F for ΔT burndown and 0.5°F for T_{avg} burndown to account for RTD drift and hot leg streaming effects, the proposed method is acceptable for addressing channel uncertainties. See also attached Table 1.

4. **Question**:

Provide more detailed discussions and justifications for the following changes. In addition provide a discussion of the effect of these changes on analyses and operating limits/assumptions. Provide a comparison of your new setpoints to the analytical limits.

a. The 2.41 percent RTP increase in the Nominal Trip Setpoints for the Vessel delta T Power-1 and Power-2 portions of the SG Water Level Low-Low RTS and ESFAS trip functions.

Response:

By virtue of the above discussions, the Vessel Delta-T Power-1 and Power-2 CSA values have decreased by 1.45% RTP. The Nominal Trip Setpoints were allowed to increase by 2.41% RTP span by using available setpoint margin. The Nominal Trip Setpoints of 12.41% RTP and 22.41% RTP are bounded by corresponding Safety Analysis Limits of 19% RTP and 29% RTP. There will be no effect on any safety analyses and only a minor effect on normal operations in that a trip time delay will be in effect up to 22.41% RTP to counteract inadvertent reactor trips due to SG level shrink/swell phenomena. See also attached Table 1.

<u>Question</u>:

b. The 2 percent reduction in the q(t) -q(b) values.

<u>Response</u>:

This response to this question on the OTΔT AFD penalty function deadband is discussed above in response to Questions 3a and 3b.

TABLE 1

	Old OTDT (%RTP)	New OTDT (%RTP)	Old OTDT (%RTP)	New OTDT (%RTP)	Old DTP1 (%RTP)	New DTP1 (%RTP)	Old DTP2 (%RTP)	New DTP2 (%RTP)
CSA	11.96	8.75	6.81	5.02	7.29	5.84	7.29	5.84
Margin	2.04	0.75	0.69	0.75	1.71	0.75	1.71	0.75
TA	14.00	9.50	7.50	5.77	9.00	6.59	9.00	6.59
SAL	129.00	129.00	116.50	116.50	19.00	19.00	29.00	29.00
NOM	115.00	119.50	109.00	110.73	10.00	12.41	20.00	22.41
AV	118.45	121.35	112.6	112.55	13.90	13.90	23.90	23.90

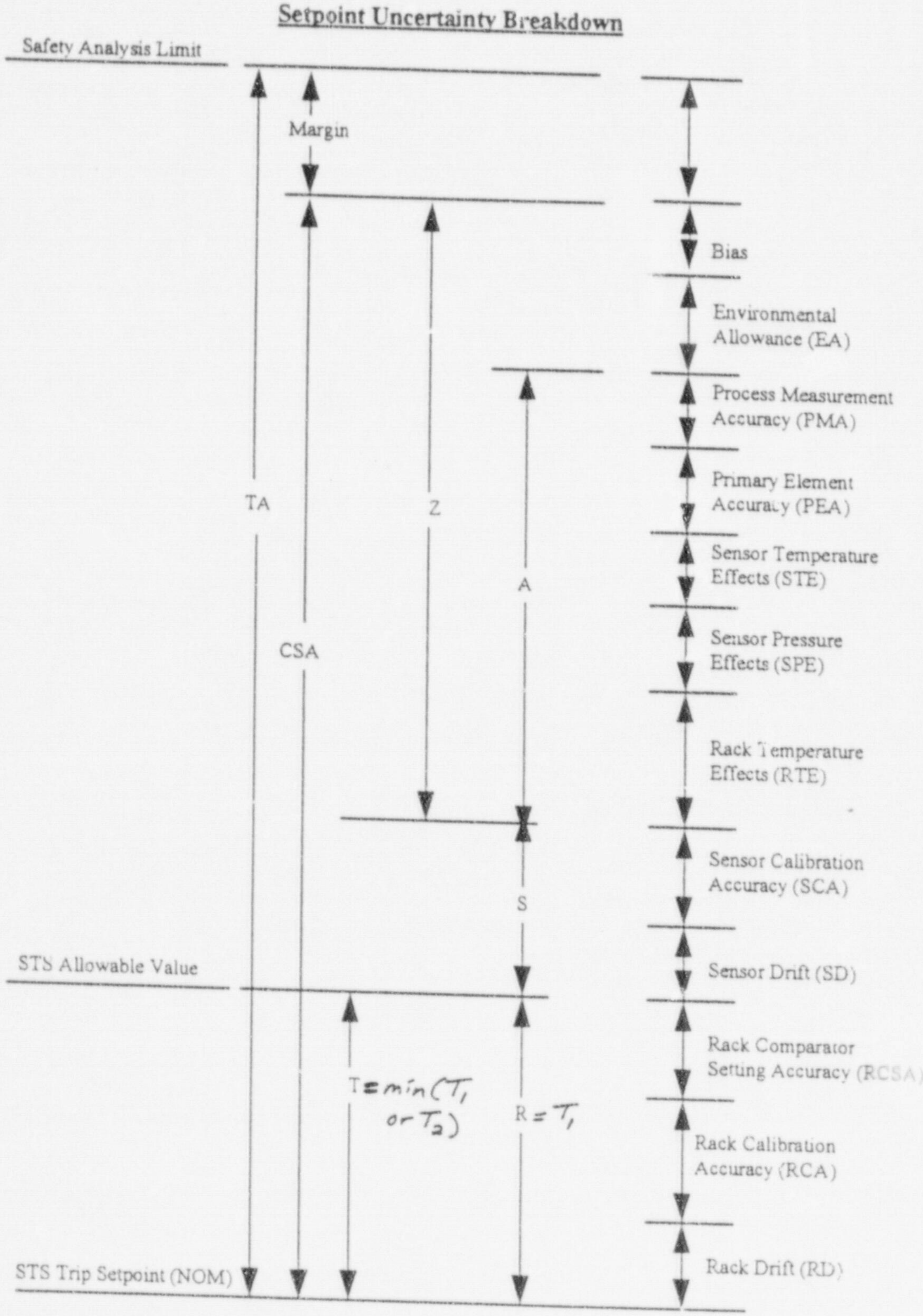
Setpoint Uncertainty Breakdown
Safety Analysis Limit
Margin
TA
CSA
Z
A
S
STS Allowable Value
T = min(T1 or T2)
R = T1
STS Trip Setpoint (NOM)
Bias
Environmental Allowance (EA)
Process Measurement Accuracy (PMA)
Primary Element Accuracy (PEA)
Sensor Temperature Effects (STE)
Sensor Pressure Effects (SPE)
Rack Temperature Effects (RTE)
Sensor Calibration Accuracy (SCA)
Sensor Drift (SD)
Rack Comparator Setting Accuracy (RCSA)
Rack Calibration Accuracy (RCA)
Rack Drift (RD)

Figure 7-1