ENCLOSURE 2

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

OYSTER CREEK GENERATING STATION

TECHNICAL SPECIFICATION CHANGE REQUEST 280

REGARDING REACTOR WATER CLEAN-UP HIGH ENERGY LINE BREAK

INSTRUMENTATION SETPOINT METHODOLGY

Calculation C-1302-215-E320-063 (16 pages)

ES-002, Instrument Error Calculation and Setpoint Determination, Revision 4 (14 pages)

GPU NUCLEAR

CALCULATION COVER SHEET

Calculation Number:	Rev. #	System Number(s)	
C-1302-215-E320-063	0	215	Sheet 1 of 16

Calculation Subject: RWCW HELB HIGH TEMPERATURE SETPOINT ERROR CALCULATION

	Yes	No
Is this calculation within the OQA Plan Scope? (If Yes, a verification is required)	☒	☐
Does this calculation contain assumptions / design input that requires onfirmation? (If Yes, provide EDTTS No.(s))	☐	☒
Is this calculation performed as a design basis calculation? (If Yes, identify design basis parameters (section 3.3))	☐	☒

Reference Source Documents (Calculations, Safety Evaluations) (Section 4.3.1.3)

DOCUMENT NO.	REV. NO.
1. C-1302-215-E610-060, CLEAN-UP SYSTEM BREAK DETECTION REQUIREMENT EVALUATION	0
2. SE-000215-025, RWCU LOCA DETECTION/ISOLATION SAFETY EVALUATION	0
3. SE-315403-038, MODIFICATION TO PROVIDE ADDITIONAL CLEAN-UP SYSTEM BREAK DETECTION	0

APPROVALS:

Originator P. K. DE	PKDe	Date 3/2/98
Verification Engineer / Reviewer L. SCHREIBER	[illegible]	Date 3-4-98
Section Manager A. P. AGARWAL	A.P. Agarwal	Date 3/6/98

1.0 PURPOSE

THE PURPOSE OF THIS CALCULATION IS TO DETERMINE THE NOMINAL SETPOINT FOR THE TEMPERATURE SWITCHES (TSH-215-6, 7, 8 & 9) BASED ON THE PROCESS SAFETY LIMIT OF 180°F. THE PROCESS SAFETY LIMIT IS ESTABLISHED BY CALCULATION (REF. 3.6). THIS CALCULATION WILL ALSO ESTABLISH AS-LEFT AND AS-FOUND LIMITS AND WILL ALSO VERIFY THAT THE TEMPERATURE SWITCHES WILL PERFORM THEIR SAFETY FUNCTION WITHIN THE PROCESS SAFETY LIMIT.

2.0 SUMMARY OF RESULT

2.1 THE NOMINAL SETPOINT FOR THE TEMPERATURE SWITCHES (TSH-215-6, 7, 8 & 9) IS DETERMINED TO BE 160°F.

2.2 THE AS-LEFT AND AS-FOUND LIMITS ARE ±4°F AND +12°F RESPECTIVELY.

2.3 SEE SECTION 7.8 FOR GRAPHIC SUMMARY OF RESULTS.

3.0 REFERENCES

3.1 GPUN ENGINEERING STANDARD ES-002 REV. 4, INSTRUMENT ERROR CALCULATION AND SETPOINT DETERMINATION.

3.2 GPUN VDC MANUAL VM-OC-2202 REV. 1, EGS CORPORATION TEMPERATURE SWITCHES MODEL 01-170020-090

3.3 GPUN MODIFICATION DOCUMENT OC-MD-G650-001 REV.Ø, RWCU LOCA DETECTION & ISOLATION MODIFICATION.

3.4 GPUN SURVEILLANCE PROCEDURE 619.3.009 REV.13, MAIN STEAM LINE TUNNEL HIGH TEMPERATURE SENSOR CALIBRATION. SURVEILLANCE TREND DATA FROM 5/21/91 TO 10/14/96.

3.5 GPUN ENGINEERING STANDARD ES-027 REV3, ENVIRONMENTAL PARAMETERS - OCNGS

3.6 GPUN CALCULATION C-1302-215-E610-060 REV.Ø, CLEANUP SYSTEM BREAK DETECTION REQUIREMENT EVALUATION

3.7 WAPD-TM-1292, STATISTICS FOR NUCLEAR ENGINEERS AND SCIENTISTS, PART 1 BASIC STATISTICAL INFERENCE, FEBRUARY 1981, PAGE 238, TABLE VII(b)

4.0 ASSUMPTIONS

4.1 ALTHOUGH THE SWITCH IS A SEALED UNIT, THE VENDOR DIDNOT SPECIFY A RELATIVE HUMIDITY RATING. ANY ERROR RELATED TO RELATIVE HUMIDITY SPECIFIED IN SECTION 4.6 IS ASSUMED TO BE INCLUED IN THE HISTORICAL DRIFT.

4.2 ALL MANUFACTURER'S DATA IS ASSUMED TO BE 3 SIGMA CONFIDENCE LEVEL, THIS CALCULATION IS PERFORMED WITH 2 SIGMA VALUES IN ACCORDANCE WITH ENGINEERING STANDARD (REF. 3.1)

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Calculation Sheet

Subject		Calc No. C-1302-215-F320-063	Rev. No. 0	Sheet No. 4 of 16
Originator	Date	Reviewed by		Date

4.3 TEMPERATURE SWITCHES (TSH-215-6, 7, 8, 9) INSTALLED BY MODIFICATION (REF. 3.3) ARE IDENTICAL TO MAIN STM. LINE HIGH TEMPERATURE SWITCHES (TS-IB10'S). HISTORICAL DRIFT DETERMINED FROM TS-IB10'S SURVEILLANCE DATA IS ASSUMED TO BE REPRESENTATIVE FOR RNCU HELB TEMPERATURE SWITCHES (TSH-215-6, 7, 8, 9).

4.4 HISTORICAL CALIBRATION DATA USED TO PERFORM A STATISTICAL ANALYSIS OF DRIFT ERROR IS ASSUMED TO FOLLOW NORMAL DISTRIBUTION

4.5 SINCE CONTROL LOGIC HAS SEAL-IN FEATURE AND SINCE SWITCH WILL ACTUATE WITHIN 1 MINUTE FOLLOWING RNCU HELB, ERROR DUE TO RADIATION AND PRESSURE IS NOT CONSIDERED IN THE CALCULATION.

4.6 THE NORMAL ENVIRONMENTAL CONDITIONS AT THE SWITCHES LOCATION ARE: (REF. 3.5)

	NORMAL
TEMP (°F)	81
PRESS. (PSIA)	14.7
RADIATION (RADS)	1.14×10^4 (40 YRS TID)
REL. HUMIDITY (%)	100

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Calculation Sheet

Subject		Calc No. C-1302-215-E320-063	Rev. No. ϕ	Sheet No. 5 of 16
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5.0 DESIGN INPUT

5.1 THE PROCESS SAFETY LIMIT FOR RWCU HELB HIGH TEMPERATURE SWITCHES (TSH-215-6, 7, 8, 9) IS 180°F PER CALCULATION (REF 3.6)

5.2 THE TEMPERATURE SWITCHES ARE INSTALLED IN EQ ZONE 43. THE AVERAGE TEMPERATURE DURING NORMAL PLANT OPERATION IS 81°F (REF 3.5)

5.3 THE SWITCH WILL DETECT RWCU HELB WITHIN 1 MINUTE FOLLOWING HELB. THE SWITCH FUNCTION 1 MINUTE AFTER HELB IS NO LONGER REQUIRED BECAUSE OF THE SEAL-IN FEATURE IN THE CONTROL CIRCUITRY. THEREFORE TEMPERATURE SWITCH LOOP ERROR IS CALCULATED FOR NORMAL PLANT OPERATION

5.4 TEMPERATURE SWITCH SPECIFICATION PER REFERENCE 3.2 IS:

SPAN : -100 TO +600°F
ACCURACY : ±3°F OR ±2% OF SETPOINT (SP > 100°F)
TEMPERATURE : NOT STATED
RELATIVE HUMIDITY : NOT STATED

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Calculation Sheet

Subject		Calc No. C-1302-215-E320-063	Rev. No. 4	Sheet No. 6 of 16
Originator	Date	Reviewed by		Date

6.0 OVERALL APPROACH AND METHODOLOGY

6.1 THIS CALCULATION IS PERFORMED IN ACCORDANCE WITH THE METHODOLOGY OUTLINED IN ES-002 (REF. 3.1)

6.2 ALL LOOPS ARE IDENTICAL. THIS CALCULATION IS APPLICABLE TO EACH OF THE FOUR (4) TEMPERATURE SWITCHES (TSH-215-6, 7, 8, 9)

6.3 THIS CALCULATION USES THE STANDARD SQUARE ROOT OF THE SUM OF THE SQUARES METHOD TO CALCULATE SWITCH ERROR AND ESTABLISH THE AS-FOUND/AS-LEFT TOLERENCE AND THE SETPOINT. THE VENDOR'S SPECIFICATION, TEST EQUIPMENT AND HISTORICAL DRIFT DATA WERE THE MAJOR ELEMENTS IN THIS CALCULATION

6.4 RWCU HELB HIGH TEMPERATURE SWITCHES ARE IDENTICAL TO THE EXISTING MAIN STEAM LINE BREAK HIGH TEMPERATURE SWITCHES (TS-IB10). THE HISTORICAL DRIFT FOR RWCU HELB TEMPERATURE SWITCHES IS CALCULATED BY STATISTICAL METHOD USING TS-IB10'S SURVEILLANCE DATA.

7.0 CALCULATION

7.1 TEST EQUIPMENT ERROR (Te) (REF. 3.4)

TEST GAUGE 1-250°F WITH A MAXIMUM INACCURACY OF ±1.5°F

$$Te = \pm 1.5 \times 2/3 \text{ (2 SIGMA)}$$
$$= \pm 1\,^{\circ}F$$

7.2 TEMPERATURE SWITCH ERROR (Tse) (REF. 3.2)

IN ACCURACY ±2% OF SETPOINT
SETPOINT = 160°F

$$Tse = \pm 160 \times 2/3 \times 0.02 \text{ (2 SIGMA)}$$
$$= \pm 2.133\,^{\circ}F$$

7.3 UPPER AND LOWER SETPOINT CALIBRATION TOLERENCE (AS-LEFT)

$$\text{AS-LEFT} = \pm (Tse^2 + Te^2)^{1/2}$$
$$= \pm [(2.133)^2 + (1)^2]^{1/2}$$
$$= \pm 2.36\,^{\circ}F$$

7.4 THE CALCULATED AS-LEFT LIMIT IS ±2.36°F. FOR EASE OF CALIBRATION THE AS-LEFT LIMIT OF ±4°F IS CONSIDERED

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Calculation Sheet

Subject		Calc No. C1302-215-E320-063	Rev. No. 4	Sheet No. 8 of 16
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7.5 HISTORICAL DRIFT (H_d) = 7.976°F (FROM SECTION 8.0)

7.6 UPPER AS-FOUND LIMIT

$$\text{AS-FOUND} = (T_{se}^2 + T_e^2 + H_d^2)^{1/2} + \text{AS-LEFT}$$
$$= [(2.133)^2 + (1)^2 + (7.976)^2]^{1/2} + 4.0$$
$$= 8.32 + 4.0 = 12.32 \approx 12^\circ F$$

7.7 THE PROCESS SAFETY LIMIT IS 180°F. THE SETPOINT BASED ON AS-FOUND LIMIT IS ESTABLISHED AS 160°F. THIS STILL PROVIDES A SAFETY MARGIN OF 8°F. THIS SETPOINT WILL NOT HAVE ANY INTERFERENCE WITH NORMAL AMBIENT TEMPERATURE OF 81°F

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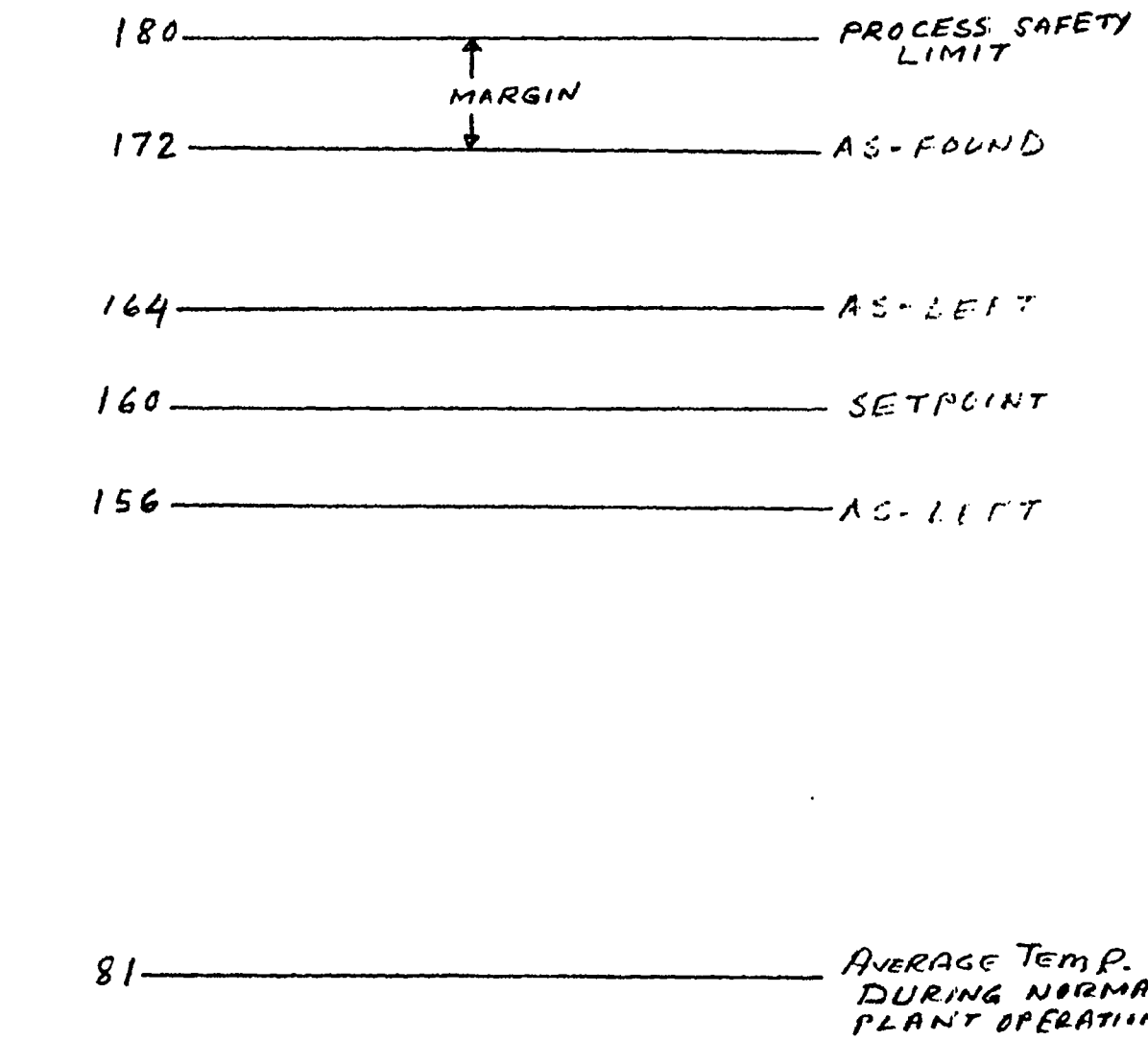
Calculation Sheet

Subject RHCU HELB HIGH TEMPERATURE SETPOINT ERROR CALCULATION		Calc No. C-1302-215-E320-063	Rev. No. Ø	Sheet No. 9 of 16
Originator P. K. DE	Date	Reviewed by		Date

7.8 GRAPHIC SUMMARY OF RESULTS



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Calculation Sheet

Subject		Calc No. C-1302-215-E320-063	Rev. No. 4	Sheet No. 10 of 16
Originator	Date	Reviewed by		Date

8.0 HISTORICAL DRIFT

HISTORICAL DRIFT = $\bar{m} + X\sigma$

$= 1.13 + 2.081 \times 3.29$

$= 1.13 + 6.846$

$= 7.976\,°F$

FACTOR FOR N=47, WITH 95/95 CONFIDENCE LEVEL AND ONE SIDED DISTRIBUTION IS:

$X = 2.081$

NOTE: AS-FOUND DATA FOR TS-IB10D RECORDED ON 10/14/96 IS EXCLUDED FROM THIS CALCULATION BECAUSE THIS SWITCH DEVIATES FROM THE MEAN BY 6.07 TIMES THE STANDARD DEVIATION, AND THUS WOULD BE A RARE RANDOM EVENT, AND IS ASSUMED TO BE AN OUTLIER.

$$\frac{21.1 - 1.13}{3.29} = 6.07$$

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Calculation Sheet

Subject	Originator	Date	Calc No. C-1302-215-E320-063	Reviewed by	Date	Rev. No. 0	Sheet No. 11 of 16

MAIN STEAM LINE TUNNEL TEMP. DETECTORS SURVEILLANCE DATAS.

TS-IB10	5/21/91 AL	1/2/93 AF	m_i	e_i	1/2/93 AL	10/11/94 AF	m_i	e_i	10/11/94 AL	10/14/96 AF	m_i	e_i	ARITHMATIC MEAN $\bar{m}$
A	180	184.9	4.9	3.77	178.5	179	0.5	-0.63	179	181.2	2.2	1.07	
B	176.2	184.4	8.2	7.07	178.3	179.5	1.2	0.07	179.5	181.5	2	0.87	
C	179	179.4	0.4	-0.73	179.4	179.7	0.3	-0.83	179.7	179.6	-0.1	-1.23	1.13
D	177	179.9	2.9	1.77	178.8	178.8	0	-1.13	178.8	199.9	21.1*	—	
E	180	182	2	0.87	177.9	179.6	2.3	1.17	179.6	180.3	0.7	-0.43	
F	178.6	185.7	7.1	5.97	178.8	176.6	-2.2	-3.33	176.6	180.7	4.1	2.97	
G	177	180.7	3.7	2.57	179.4	177.4	-2	-3.13	177.4	179.1	1.7	0.57	
H	178.4	179.3	0.9	-0.23	179.3	177.8	-1.5	-2.63	177.8	177.8	0	-1.13	
J	178.4	188	9.6	8.47	178.1	177	-1.1	-2.23	177	177.7	0.7	-0.43	
K	178	184.2	6.2	5.07	178.7	174.1	-4.6	-5.73	177.6	174.9	-2.7	-3.83	
L	180	181.2	1.2	0.07	178.5	177.2	-1.3	-2.43	177.2	178.1	0.9	-0.23	
M	179.8	182.4	2.6	1.47	178.4	177.8	-0.6	-1.73	177.8	173.5	-4.3	-5.43	
N	179.6	183.8	4.2	3.07	177.5	179.6	2.1	0.97	179.6	174.1	-5.5	-6.63	
P	178	183.2	5.2	4.07	177.8	176.2	-1.6	-2.73	176.2	173.1	-3.1	-4.23	
Q	180	183.9	3.9	2.77	179	176.8	-2.2	-3.33	176.8	175.7	-1.1	-2.23	
R	178	183.5	5.5	4.37	178.6	176.4	-2.2	-3.33	176.4	176.6	0.2	1.07	

* EXCLUDED FROM CALC. SEE NOTE ON PAGE 10.

HISTORICAL DRIFT

$= \bar{m} + \text{VALUE } 95\%\,\sigma$

$= \bar{m} + x\,\sigma$

x = 95% CONFIDENCE LEVEL MULTIPLIER

$$\bar{m} = \frac{1}{n}\sum_{i=1}^{n} m_i \; ; \quad m_i = \text{ASFOUND} - \text{ASLEFT} = AF - AL$$

$$\sigma = \left(\frac{1}{n}\sum_{i=1}^{n} e_i^2\right)^{1/2} ; \quad e_i = m_i - \bar{m}$$

σ = Standard Deviation from arithmatic mean

$\bar{m}$ = Arithmatic Mean

N0016 (10-88)

1.0 Purpose

The purpose of this procedure is to provide instructions for application, installation and calibration of the Patel Temperature Switch.

2.0 Part Numbers

PART NUMBERS	CONTACT CONFIGURATION
01-170230-090	Normally Open (Contact closes on temp. rise)
01-170020-090	Normally Closed (contact opens on temp. rise)

3.0 Specifications

3.1 Set point range: -100 to 600°F

3.2 Electrical ratings: 5 amps at 120 VAC
0.5 amps at 120 VDC

3.3 Accuracy: The specified accuracy is ±5°F for set points below 100°F and the greater of ±3°F or ±2% of set point for set points above 100°F. All switches set by Patel are calibrated at ±2°F or better.

3.4 Lead wire temp. rating: -40 to 194°F

3.5 Lead wire type: Rockbestos Firewall III SIS 18 AWG

3.6 Lead wire length: 36 inches

4.0 Contact Protection

For use of capacitors for contact protection, the following chart is recommended as a guide:

Current	Service	Capacitance (microfarad)
120 VAC or DC	Environmental Temperature Sensor	None required
120 VAC	Resistance	None required
120 VAC or DC	Relays, Magnetic contactors	.001 to .01
15-25 VAC or DC	Relays	.02
120 VAC	Motor	Use relay

NOTE: Capacitors should be wired in parallel with thermostat lead connections. Ascertain that capacitors are environmentally qualified or install them in a mild environment.

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Verification Plan/Summary Sheet
(EP-006)

PLAN

Scope of Verification: SEE BELOW

Item No.	Method/Depth of Verification Required	Req'd Compl. Date
1	VERIFY DESIGN INPUT, METHODOLOGY, DESIGN ADEQUACY AND MATHEMATICS	

Assigned Verification Engineer: L.A. SCHREIBER Qualified per 4.4.1.3.b ☑ Yes ☐ Waived
Justification for Waiver
Section Manager (SM) (sign): [signature] Date: 3/6/98

SUMMARY

Summary of verification scope, methods, results and conclusions.

DESIGN VERIFIED USING COMBINATION OF DESIGN REVIEW AND ALTERNATE CALCULATION. DRIFT DATA STATISTICS VERIFIED BY SOFTWARE PROGRAM SPC/PI+ VER. 2.32d. VERIFIED ASSUMPTION THAT DATA MAY BE ASSUMED TO HAVE A NORMAL DISTRIBUTION. PROGRAM OUTPUT INCLUDED AS ATTACHMENT 1.

COMMENTS GENERATED BY DESIGN VERIFICATION WERE SATISFACTORILY RESOLVED AND INCLUDED AS ATTACHMENT 2.

THIS CALCULATION USES APPROPRIATE METHODS AND ASSUMPTIONS. RESULTS ARE VERIFIED TO BE CONSERVATIVE.

Based on this evaluation, the calculation is verified to be acceptable.
Verification Engineer (print): L.A. SCHREIBER (sign): [signature] Date: 3-4-98

Use additional sheets if necessary

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CALCULATION VERIFICATION CHECKLIST

(Ref. EP-006)

Calc. Title	Calc. No.	Rev.
RWCU HELB HIGH TEMPERATURE SETPOINT ERROR CALCULATION	C-1302-215-E320-063	4
Verification by: (Print Name)	**Section**	**Date**
L. A. SCHREIBER	EP&I	3-4-98

Place a check mark in the applicable box (Yes, No, N/A) for each item.

"NO" may indicate the design or verification is incomplete requiring a task request be assigned by the responsible Section Manager. The Section Manager shall review each "NO" response to determine if Task Request needs to be prepared.

"N/A" (Not Applicable) does not require any further action by the Verification Engineer.

The Verification Summary (VS) (Exhibit 7A) may be used to outline the Verification Engineer's work or for comments deemed appropriate by the Verification Engineer.

ITEMS	Review Check Design Compliance Yes	No	N/A
Design Input & Data - Were the inputs correctly selected, referenced (latest revision) and incorporated into the calculation?	✓		
Assumptions - Are assumptions necessary to perform the calculation adequately described and reasonable?	✓		
Regulatory Requirements - Are the applicable codes and standards and regulatory requirements, including issue and addenda, properly identified and are their requirements met?	✓		
Construction/Operating Experience - Has applicable construction and operating experience been considered?	✓		
Interfaces - Have the design interface requirements been satisfied?	✓		
Methods - Was an appropriate calculation method used? WITH COMMENTS ATTACHED	✓		
Output - Is the output reasonable compared to inputs? WITH COMMENTS ATTACHED	✓		
Acceptance Criteria - Are the acceptance criteria incorporated in the calculation sufficient to allow verification that the design requirements have been satisfactorily accomplished?	✓		
Radiation Exposure - Has the calculation properly considered radiation exposure to the public and plant personnel?	✓		
Comments: SEE ATTACHMENT 2	✓		

DESCRIPTIVE STATISTICS FOR TS-IB0010 DRIFT DATA

Count = 47
Sum = 53.3
Mean = 1.13404
SEM = 0.48017
Standard Deviation = 3.29191
Variance = 10.83664
X-bar + 3S = 11.00976
X-bar - 3S = -8.74167
Process Width (6S) = 19.75143
Minimum Value = -5.5
Maximum Value = 9.6
Range = 15.1
25th Percentile = -1.3
Median (50th p.) = 0.9
75th Percentile = 2.9

Normal Distribution Test
Shapiro-Wilk Value = 0.98171.
P-Value > .05.
The data can be assumed to have a normal distribution.

Comment Resolution

Request: Design Verification
Document Title: RWCU HELB Hi Temp Setpt. Calc.
Document #: C-1302-215-E320-63 Rev. #: 0

B/A No.: 400017
W.O. No.: E330-32017
Plant: DC

☐ Appealing Disposition
Date of Notice: _____

Reviewer Name (print)	Ext.	Resolved by (print)	Ext.
L.A. Schreiber	4082	P. K. DE	4427
Reviewer Signature	**Date**	**Resolver Signature**	**Date**
[signature]	3/3/98	[signature]	3/4/98

Item Number	Reference Page/Para.	Comments Show Actual Proposed Rewording, If Possible	Accept Comment	Reject Comment	Remarks
1	3/3.3,3.4	SHOULD ADD REVISION LEVELS	✓		
2	4/4.6	CLARIFY RADIATION NUMBER. IS THIS ACCUMULATED DOSE OVER SOME PERIOD OF TIME?	✓		
3	6/6.2	"PSH" SHOULD BE "TSH".	✓		
4	8/7.6	SINCE DRIFT IS CALCULATED FROM ACTUAL SURV. DATA, IT INCLUDES THE TEMP. SW. ERROR (TSE). IT IS OVERLY CONSERVATIVE TO THEN FURTHER INCLUDE TSE IN THE AS-FOUND CALCULATION.	✓		DRIFT CALCULATED FROM SURVEILLANCE DATA IS CONSIDERED TO BE EQUIVALENT TO VENDOR GIVEN DRIFT VALUE. THIS APPROACH IS OVERLY CONSERVATIVE.
		ALSO IT IS NOT CORRECT TO USE A SYMMETRICAL CALCULATION (±) WITH A ONE-SIDED DISTRIBUTION X FACTOR. WHEN CALCULATING BOTH + AND − LIMITS, THE TWO-SIDED DISTRIBUTION X FACTOR SHOULD BE USED.	✓		AS-FOUND LOWER LIMIT IS REMOVED.
5	10/8.0	MEAN AND STANDARD DEVIATION OF THIS DATA CALCULATED BY COMPUTER PGM. & CALCULATOR IS 1.13 AND 3.29.	✓		INCORPORATED

C-1302-215-E320-063 SHEET 16 of 18
ATTACHMENT 2 Page 1 of 1

N0229 (06-92)