Attachment 2

Technical Specification Proposed Change No. 273, Supplement 6

Vermont Yankee Nuclear Power Station

Sample Set-point Calculations

VY CALCULATION CHANGE NOTICE (CCN) VYC-462C-CCN-01
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CCN Number: 01 Calculation Number: VYC-462C Rev. No. 0

Calculation Title: Reactor Core Isolation Cooling Steam Line Areas High Temperature Setpoint

Initiating Document: PO 99-59110-00; Commitment VYC-0462CR0-03
VYDC/MM/TM/Spec. No./ other

Safety Evaluation Number: N/A

Superseded Document: N/A

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Reason for Change:

Provide a basis for increase in Technical Specification Surveillance Interval from Monthly to Quarterly.

Description of Change:

1. Evaluate CTS Quarterly testing interval on calculation outputs.
2. Address commitment memo issues.
   SEE PAGE 4 FOR DETAILS

Technical Justification for Change:

Technical Specification proposed change No. 217 requests surveillance test interval change from monthly to quarterly.

Conclusions:

For CTS Quarterly:
1. Existing setpoint and uncertainties supports Quarterly functional testing of logic.
2. Setpoint, calibration attributes remain unchanged.
   SEE PAGE 5 FOR ADDITIONAL CONCLUSIONS

Prepared By/Date	Interdiscipline Review By/Date	Independent Review By/Date	Approved By/Date
Michael W. Anderson 12/27/99	See pages 24-27 attached	John H. Lewis 2/3/00 John Lewis	James W. Allen 2/3/00 James W. Allen

Installation Verification _____ / _____
Signature Date

Note: VYAPF 0017.07 should be included immediately following this form. VYAPF 0017.08 (Sample)

VY CALCULATION DATABASE INPUT FORM

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VYC-462C-CCN-01	0	N/A	N/A
VY Calculation/CCN Number	Revision Number	Vendor Calculation Number	Revision Number

Vendor Name: N/A PO Number: N/A

Calculation Type (Originating Department): VY Design Engineering (EI&C)

Implementation Required? ☒ Yes ☐ No 2/3/00 ☑ Yes

Asset/Equipment ID Number(s): Various

Asset/System ID Number(s): 13

Keywords: No New Keywords

General References

Reference #	Reference Title (including Rev. No. and Date, if applicable) (See App. A, Section 3.1.7 for Guidance)	Critical Reference (_)
1	Technical Specification Proposed Change #217	

Design Input Documents - The following documents provide design input to this calculation.

Document #	Document Title (including Rev. No. and Date, if applicable)	Critical Reference (_)
	No New Design Input Documents	

Design Output Documents - This calculation provides output to the following documents.

Document #	Document Title	Critical Reference (_)
	No New Design Output Documents	

VY CALCULATION OPEN ITEM LIST

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Open Item	Resolution	Method of OI Tracking or Date Closed
~~Note~~ JP 2/3/00		
① I&C to change OP-4366 As Found Tolerance from ±11°F to ±8°F		2AP0028# VYCØ462CRØCCN1 - Ø1
② I&C to change OP-4366 to reflect Lsp for TS-13-79A, 80A, 81A & 82A to be equal to 191°F. Note: Lsp for TS-13-79B,C,D; 80B,C,D; 81B,C,D and 82B,C,D is equal to 187°F (No change)		

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VY CALCULATION SHEET VYC-462C-CCN-01

Calculation Number: VYC-462C

Revision Number: 0

CCN Number: 01

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Description of Change

1. This change is a CCN because, for these loops, the identified impact is not technically significant relative to the existing calculation's output.
2. Monthly to Quarterly test interval for CTS
   A. Differentiate between Monthly Functional and Refueling Cycle Calibration tasks.
   B. Determine that Monthly (or Quarterly) is a Logic test only.
   C. Evaluate Quarterly Functional relative to instrument uncertainties.
3. Commitment Memo:
   Correct minor numeric/typo errors.
4. Other:
   A. Identify the inherent Conservatism in the Seismic Effect term.
5. Limitations/Conditions Reviewed.
6. This CCN and associated output does not require a Safety Evaluation. The CCN is not an implementing document. Any changes to plant procedures would be screened during the procedure change process.

Conclusions

1. For OP 4366, Rev 15 (current Rev) the following Anomolies were noted:
   A. For all switches, As-Found tolerance is given as ± 11 °F. Should be ± 8 °F.
   This discrepancy has already been identified in the above referenced Commitment Memo.
   B. LSP = 187 °F is given in the Surveillance Setpoint Criteria Matrix for all switches. LSP = 191 °F should be used for the "A" switches (Steam Tunnel).
   This discrepancy similarly noted.
2. Commitment VYC-0462CR0-03 Memo
   The last bulleted item on said memo suggests switch DA was sourced from a Rev 0 DA calculation. That is incorrect – See VYC-462C, Rev 0, Attachment H, pp 1 to 3. Values used as input from VYC-1599 were those posted in the calculation drawer (then at VY-Bolton) as Rev 1 output.

1.0 PURPOSE

1.1 Calculation Objectives

This calculation is performed in support of the Vermont Yankee Setpoint Program and has the following major objectives:

1. Document the loop function and the basis for the setpoint and operator decision points associated with that function.
2. Determine the normal and total loop uncertainty and verify consistency with the design basis.
3. Calculate the limiting setpoint and operator decision points.
4. Evaluate the adequacy of the existing setpoint, calibration limits and procedural decision points.
5. Provide as-left and as-found tolerances for use in calibration procedures; determine Measuring and Test Equipment selection and accuracy criteria; document process corrections, instrument scaling, calibration methods.
6. VYDEP-15 requires that applicable operating procedures, alarm responses, standard, off-normal and emergency operating procedures be included in the evaluation. This requirement is accomplished by the inter-disciplinary review which supplements the WE-103 review process and is documented in Attachment O.

Insert 1

1.2 System/Components

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This calculation applies to the Reactor Core Isolation Cooling (RCIC) Steam Line Area's High Energy Line Break (HELB) detection switches in the RCIC System. The specific components to be addressed are:

TABLE 1 Component Identification

Ref.	TAG Number	Location	Description	MFG	Model	CWD
6.6, 6.7, 6.14	TS-13-79A TS-13-80A TS-13-81A TS-13-82A	Steam Tunnel El. 252' 6"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79B TS-13-80B TS-13-81B TS-13-82B	Rx Bldg. El. 213' 9"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79C TS-13-80C TS-13-81C TS-13-82C	Rx Bldg. El. 213' 9"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79D TS-13-80D TS-13-81D TS-13-82D	Rx Bldg. El. 213' 9" RCIC Room	Temperature Switch	Fenwal	01-170230-090	1179, 1180

Insert 1

1.1.7 Provide a basis for CTS surveillance test interval from Monthly to Quarterly.

2.1.4 Calibration Effect Considerations

Per the Design Guide, CE is typically taken as the sum of the vendor's Rated Accuracy (RA) and the As-Left Calibration Tolerance (CT). Based on the number of samples used to determine DA (count = 199 as per VYC-1599, Table 4), a test will be applied to determine if credit can be taken for RA being encompassed by DA. Test methodology is described in detail in Reference 6.13. In essence:

- If $DA < [RA^2 + CT^2 + \text{vendor's rated drift}^2 + MTE^2]^{1/2}$,

  then CE = CT

- If $DA \geq [RA^2 + CT^2 + \text{vendor's rated drift}^2 + MTE^2]^{1/2}$,

  then CE = CT + A

where:

CT = Present Calibration Tolerance
DA = Analyzed Drift from VYC-1599
RA = Vendor's Rated Accuracy
MTE = the Measuring & Test Equipment used in calibration

and where the vendor's rated drift is valued at 0 because the vendor has no published drift specifications.

2.1.5 Sign Convention

The sign convention used in the Design Guide is based on the effect of uncertainties on an instrument (or loop's) output signal. For this type of device, where there is no analog process input/signal output relationship the effect of uncertainties are manifested as a shift in the setpoint away from the ideal value. This results in a sign convention which is the reverse of that which is generically defined in the Design Guide.

2.1.6 Class 3 Assessment

This analysis will determine the 95%/95% (single-sided/Section 2.1.3) uncertainty applicable to a Class 1 setpoint. Appendix R/Station Blackout considerations do not require the same level of rigor and can be evaluated as a Class 3 setpoint (95%/75%, single sided). In accordance with the Design Guide, the Class 1 uncertainty value can be converted to a Class 3 uncertainty (e_{u3}). From the design guide (reference 6.1, Appendix F, Table 1), a multiplier is determined as follows:

$$0.68/1.96 = 0.35$$

Appendix R/Station Blackout support is an NNS function. Therefore, accident parameters do not apply.

Insert 2 (see next page)

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2.1.7 Surveillance Criteria

2.1.7.1 Functional Test

Per the Technical Specifications surveillance functional tests are performed Monthly. TS proposed change No. 217 and TS Table 4.2.2 (Note 1) suggests Quarterly functionals are a viable option. Per OP 4366, Rev 15, the functional is implemented by energizing the Test Heater until the output relays change state. Since the functional is not to known inputs it is essentially a logic test only.

2.1.7.2 Calibration Test

Calibration is performed to known inputs, performed on a Refueling Cycle interval.

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2.2.9 Per Reference 6.1, no uncertainty is credited against the relays controlled by these devices.

2.2.10 Based on the design location of these devices (see FSAR Sections 7.3.4.8.7 and 7.3.5) the nonconservative affects of Process Measurement (PM) are negligible.

2.2.11 Per CTS, the specified calibration interval is "each refueling outage." Per Reference 6.9, this interval is typically bounded by 18 months and is taken as limiting (by the refueling event, not calendar days).

To allow for a refueling cycle extended to beyond a nominal 18 months, this calculation will base extrapolated DA on a maximum interval of 684 days (using the criteria of once per operating cycle +25% as a convenience). If the calibration interval extends, for whatewver reason, beyond 684 calendar days, an evaluation to determine the interval increase effect on setpoint is REQUIRED.

2.2.12 Per VYC-1599, Section 5.4, the analyzed drift data for these devices (pooled Procedures OP 4322 and OP 4366) indicated little time dependency. Consequently, it is assumed the RSS extrapolation of calibration interval is appropriate.

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For the functional interval, either Monthly or Quarterly, there are no time-sensitive instrument effects associated with the logic test.

Insert 3

$MTE_2 = \pm 4.00°F$

Consequently,

$MTE_{ACTUAL} = \pm[1.005^2 + 4.00^2]^{1/2}°F$

$= \pm 4.13°F$

4.1.5 Analyzed Drift (DA)

From VYC-1599 (Attachment H), switches calibrated per OP 4366 (the scope of this calculation) and OP 4322 (Main Steam HELB Detection) met the criteria for pooled data. The output of VYC-1599 (per Section 4.2)is a 95% probability/95% confidence level value, which meets the criteria of a Class 1 setpoint as per Reference 6.1. The following data applies to DA:

- Average time interval is 544 days
- DA is ± 7.54°F
- Data is evenly distributed about zero with a slope on the time dependency line equivalent to <0.2 % per approximately 550 days showing, consequently, little time dependency.
- The data is normally distributed with a highly peaked narrow distribution.
- The average drift value for this group is -0.008% CS; since this value is less than 0.1% CS, bias effects are considered negligible.

Per assumption 2.2.11, extrapolation of DA from a baseline of 544 days to a maximum of 684 days take the form:

DA_{684} Insert 4

$\cancel{DA} = \pm DA_{544}\,(684/544)^{1/2}$

$= \pm 7.54°F(684/544)^{1/2}$

$\cancel{\pm 8.54°F}$ $= \pm 8.45\ °F$ Insert 5

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4.1.6 Temperature Effect (TE)

Typically, DA accounts for a 20°F ΔT TE during calibration conditions. In this case, TE has the following considerations:

- The measured process parameter is temperature, for which the device is designed.
- Calibration technique is to preheat the switch (and associated calibration T/C) and use a prefabricated test heater assembly to minimize any external influences and approximate normal operating conditions prior to temperature ramp-up to setpoint. Consequently, normal TE as an error determinant is considered to be negligible.

TE = 0

4.1.7 Radiation Effect (RE)

Per Reference 6.1, normal radiation effect is encompassed by DA.

RE = 0

4.1.8 Humidity Effect (HE)

No humidity effect is specified by the vendor. In addition, per Reference 6.1, normal humidity effect is encompassed by DA.

HE = 0

4.2 Test Uncertainty (e_t)

From Reference 6.1 for this type of device, and where there are no significant testing condition biases:

Initially,

$e_t = \pm [CE^2 + DA^2]^{1/2}$

Substituting:

$e_t = \pm[5.00°F^2 + \cancel{5.45°F^2}]^{1/2}$ ← $8.45\ °F^2]^{1/2}$ Insert 6

$= \pm 9.82°F$

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Accounting for a single side of interest approach as per Section 2.1.3:

$e_t = \pm[9.82°F \times 0.85]$

$= \pm 8.347°F$

To facilitate the calibration process, e_t is conservatively rounded (with regard to setpoint development) to:

$e_t = 8.00°F$

4.3 Normal Module Uncertainty (e_n)

In this case, there are no additional terms to those accounted for in the un-rounded e_t

$e_n = e_t$

$= \pm 8.347°F$, conservatively rounded to:

$e_n = \pm 8.40°F$

Substituting:

$$e_{HELB} = \pm [5.00°F^2 + 8.45°F^2]^{1/2} (0.85) + 0.20°F$$

$$= + 8.55°F/-8.35°F$$

4.4.3 Seismic Module Uncertainty ($e_{H/S}$)

For HELB mitigation channels, $e_{H/S}$ is determined by HELB conditions of over-pressure coincident with, or subsequent to seismic effect. From Reference 6.7.1 (Attachment P), post-seismic effect ranged from -3.1°F to +4.2°F. For conservatism, the post-seismic simulation functional acceptance criteria of ±5°F is taken as limiting.

Insert 7 (see next page) CCN-1 mr 12/26/99 2/3/00

Initially:

SE = ±5.00°F

Accounting for uncertainties introduced by a seismic event followed by switch actuation caused by a RCIC turbine steam line HELB:

$$e_{H/S} = \pm [CE^2 + DA^2 + SE^2]^{1/2} + OP$$

Substituting:

$$e_{H/S} = \pm [5.00°F^2 + 8.45°F^2 + 5.00°F^2]^{1/2} (0.85) + 0.20°F$$

$$= + 9.57°F/-9.37°F$$

4.4.4 Appendix R/Station Blackout Considerations

From Section 2.1.6, a multiplier of 0.35 is applied to the normal module uncertainty to obtain a Class 3 normal uncertainty (e_{n3}). From Section 4.3, the normal module uncertainty (e_n) = ±8.40°F. Applying the 0.35 multiplier:

$$e_{n3} = \pm 8.40°F * 0.35 = \pm 2.94°F$$

However, as CT > e_{n3}, the CT value of ±5°F will be applied.

4.5 Setpoint Evaluations

4.5.1 Custom Technical Specification (CTS)

LSP = TS - |TLU|

However, because AL < TS, the AL becomes the more limiting condition. Therefore:

4.5.1.1 TS-1[3]-79,80,81,82 (B,C,D)

LSP_{IBCD} = AL - |TLU|

Where:

This represents a significant inherent conservatism. Should additional margin be required a position could be taken that, since post-seismic results were bounded by the test's acceptance criteria (equivalent to this calculation's RA), SE as an independent term is negligible.

Insert 7

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4.6.1.3 HELB/Seismic Safety Margin (M_3) to Existing AL

From Section 4.4.3 $e_{H/S}$ (positive vector) is ~~12.80°F~~ 9.57°F. CCN-1 12/26/99 2/3/00

Insert 8

TS-13-79,80,81,82 (B,C,D)

Consequently:

M_{3BCD} = 196°F - [185°F + 9.57°F]

= +1.43°F

TS-13-79,80,81,82 (A)

Consequently:

M_{3A} = 200°F - [185°F + 9.57°F]

= +5.43°F

4.6.2 Improved Technical Specifications (ITS)

From References 6.18 (Attachment B) and 6.22, the current AL is 196°F for outside the steam tunnel and 200°F inside the steam tunnel. For ITS:

- By inspection, it can be seen that the limiting nominal margin from LSP_{2BCD} (186°F) to existing SP (185°F) is +1°F.
- By inspection, it can be seen that the limiting nominal margin from LSP_{2A} (190°F) to existing SP (185°F) is +5°F.
- Per Reference 6.16 (Attachment M), the original plant design was for an SP which was 200°F. From a review of plant area temperature trends (Attachment G), maximum base temperature is assumed to be 140°F. Since LSP_{ITS} accounts for the combined effects of HELB (as applicable) and seismic effect, no additional safety margin relative to LSP_{ITS} is required.

4.6.2.1 Improved Technical Specification Operating Margin (M_4)

For an e_N of (-)8.4°F (non-worst case vector), and a maximum base temperature of 140°F (T_{MAX}), operating margin is expected to be:

$M_4 = [LSP - |e_N|] - T_{MAX}$

TS-13-79,80,81,82 (B,C,D)

Substituting:

M_{4BCD} = [186°F - | - 8.4°F |] - 140°F
= +37.6°F

1.	Per OP 4366 Revision 12
2.	For ITS the AV is the TS Limit
3.	From (SP + e_{HELB}) to AL
4.	From (SP + $e_{HELB/SEISMIC}$) to AL
5.	From (SP_3 – e_n) to maximum normal temperature

5.2.1 TS-13-79,80,81,82 (B,C,D) – Outside Steam Tunnel

From the above table it can be seen that to support ITS and the current AL of 196°F the existing setpoint of 185°F is acceptable for both CTS and ITS considerations.

5.2.2 TS-13-79,80,81,82 (A) – Switches Inside the Steam Tunnel

The existing 185°F setpoint is acceptable for both the EQ Program limit of 200°F, the Technical Specification limit of 212°F, and the Appendix R/Station Blackout temperature limit of 174°F.

5.3 Graphic Representation of Setpoint Data

FIGURE 1
Graphic Representation of Setpoint (CTS)

Technical Specification	—	212°F
Analytical Limit (inside steam tunnel)	—	200°F
Analytical Limit (outside steam tunnel)	—	196°F
LSP_{1A} Insert 9	—	191°F
LSP_{1BCD} $SP_{A,B,C,D}$	—	187°F
SP^2 & SP_4 (Setpoint is retained)	—	185°F
LSP_3	—	179°F
SBO Main Steam Tunnel Heatup	—	174°F
Normal (MAX) – steam tunnel	—	140°F

1. Calculated for normal conditions (to include OP_{HELB})
2. Existing setpoint per OP 4366, Revision 12
3. Not to scale, provides relative position only

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FIGURE 2 Graphic Representation of Setpoint (ITS)		
Analytical Limit (inside steam tunnel)	—	200°F
Analytical Limit (outside steam tunnel)	—	196°F
Allowable Value[1] (AV_A)	—	198°F
Allowable Value[1] (AV_{BCD}) Insert 10	—	194°F
LSP_{2A}	—	190°F
LSP_{2BCD} $SP_{A,B,C,D}$	—	186°F
SP[2] & (SP_A) (Setpoint is retained)	—	185°F
LSP_3	—	179°F
SBO Main Steam Tunnel Heatup	—	174°F
Normal (MAX) – steam tunnel	—	140°F
1. For ITS, the Allowable Value is the ITS value. 2. Not to scale; provides relative position only.		

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5.4 Calibration Criteria Insert 11 (see next page)

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In order to support and implement the results of this calculation, the temperature switches are to be calibrated according to the following table:

TABLE 8 Calibration Attributes			
Description		Value	Units
Setpoint (CTS)	Inside steam tunnel	185	°F
	Outside steam tunnel	185	°F
Setpoint (ITS)	Inside steam tunnel	185	°F
	Outside steam tunnel	185	°F
As-Left Tolerance		±5	°F
As-Found Tolerance		±8	°F

5.5 Measuring & Test Equipment Requirements Insert 12 (see next page)

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Testing is accomplished with the following equipment:

- Monitoring thermocouple (Type K) (Installed)
- T/C Reader (Digital Thermometer)
- Heat source (Test Heater)
- Digital Multimeter
- Variac

Surveillance Criteria

5.4.1 Calibration Test

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Insert 11

5.4.2 Functional Test

For the purpose of Logic-only functional testing, where relay actuation to a KNOWN temperature input is not a requirement, a Quarterly functional interval is supported by this calculation.

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Insert 12

Memorandum

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TO: James Allen
FROM: Mark McKinley
RE: Commitment VYC-0462CR0_03
DATE: December 23, 1999

Jim,

The Setpoint Database has been updated per Commitment VYC-0462CR0_03. Attached are the printed forms from the Database for the components listed by the commitment. The following discrepancies were noted during review:

EMPAC:

- The following EMPAC equipment should have applicable calculation added to EMPAC References: TS-13-79A-D/80A-D/81A-D/82A-D: (VYC-462C)
  This item has been addressed with submittal of an EMPAC Equipment Change Form.

- The EMPAC model number for the identified instruments needs to be corrected from 01-170230-**09** to 01-170230-**090**.
  This item has been addressed with submittal of an EMPAC Equipment Change Form.

Surveillance / Calibration Procedure: OP 4366 (Revision 15)

- Surveillance Procedure identifies an As-Found Tolerance of ± 11 Deg. F. The correct As-Found Tolerance should be ± 8 Deg. F.

- The VYC Limiting Setpoint is identified as 187 Deg. F for all identified switches. This is correct for the B,C, and D switches. However, the LSp for the A switches is 191 Deg. F.

PP 7007, Interdepartmental Review Form:

- Section 3.1.a (1.a) specifies to add the LSp value of 187 Deg. F for all switches to the surveillance procedure. The LSp associated with the "A" switches should be 191 Deg. F.

- Section 3.1.a (1.b) specifies to add the As-Found value of ± 11 Deg. F to the surveillance procedure. The correct As-Found value should be ± 8 Deg. F.

Calculation: VYC-462C (Rev 0)

- Section 4.1.5 identifies the DA term to be ± 8.54. This is a typographical error and should be ± 8.45. (Note: the correct value was used in subsequent calculation steps). ✓ 12/27/99

- Section 4.2 identifies the DA term as 5.45. This is a typographical error and should be 8.45. The calculated value for e_t is correct based on an 8.45 DA term. ✓ 12/27/99

- Section 4.6.1.3 indicates that the $e_{H/S}$ (positive vector) is 12.80. This is a typographical error and should be 9.57. The 9.57 value was correctly used in subsequent calculation steps. ✓ 12/27/99

- Drift Calculation VYC-1599 was revised on 6/7/98. VYC-462C Rev. 0 was completed, reviewed and approved after this date but did not use the updated drift values.

Thanks

Mark S. McKinley

Compilation of ISP A-- . ; Errors ER99- 0733

Item	Calculation	Description of Error	Resolution	How Identified 1. Database Entry 2. DBD Validation 3. Engineering Review 4. Other	Type of Error A = Administrative T = Technical Note:	Operability Concern Yes/No
1	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	OP-4366 & IRF – Shows AF = 11° F. Should be 8° F.	This information is provided in the procedure discussion section and is used by the E&C engineer as an aid in evaluations. The AF values are not used for calibration acceptance criteria. The correct AF values were used in the calculation. Action Required: None immediately. E&C to DI OP-4366 prior to next scheduled calibration.	1	A	N
2	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	OP-4366 & IRF – Shows LSP = 187° F. This is correct for the B, C & D switches. The A switch LSP = 191° F.	Use of a single LSP is more limiting and is conservative. This was done intentionally. However, for accuracy, the LSP associated with the A switch should also be shown. Action Required: None immediately. E&C can include the LSP at their discretion via DI to OP-4366.	1	A	N
3	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	Calculation Text – Typographical errors were noted as follows: - Section 4.1.5 shows DA = 8.54. Should be 8.45 - Section 4.2 shows DA = 5.45. Should be 8.45 - Section 4.6.1.3 shows error = 12.80. Should be 9.57	These typographical errors occurred as part of the conversion of Word Perfect to Microsoft Word. Similar issue was addressed in ER99-0462. In this case, the correct values were used in the analysis. Action required: None immediately. VYC-462C will correct the typographical errors when next revised.	1 ✓ 12/27/99	A	N
4	VYC-1596 Rev 0 Head Calculation Approved: 2-15-97 Preparer: RR	Section 4.6 identifies switches as PS-115-134A through D. Should be PS-2-134A through D.	This is a typographical error that cannot be confused with any other switch evaluation. Action Required: None immediately. VYC-1596 will correct the typographical error when next revised.	1	A	N
5	VYC-466 Rev 3 MSL Pressure Approved: 2-27-98 Preparer: DK	Calculation Text & OP-4324 - Discussion on setpoint in regards head correction is confusing and appears to be incorrect.	The discussion is confusing. In particular, the head correction identified in Table 13 implies it is negative. However, the note associated with the head correction is specific in it being a positive head correction – the negative value provided to indicate where the process trip would occur. The 835-psig field setting will result in a process trip of 833-psig. The field setting is referenced instead of the process trip throughout the calculation. This is specified to be the case by the statement in VYC-466 Attachment B Section 4.0 (head correction is not included in the analysis). Action Required: OP-4324 is correct as is – no change required. Action Required: VYC-466 should be revised to clarify the difference between the field setting and the process setting. Although the values shown throughout the calculation are correct for field setting the head correction needs to be considered to clarify the process trip point.	1	A	N

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N/A any items not applicable to the calculation or CCN.

	Requirement	Preparer	Reviewer
1.	Ensure the title page is properly filled out (items that are applicable).		
	• Calculation or CCN number on cover • Title reflects subject • Correct QA record status box checked • Page numbering and count is correct • Cycle number is included ("NA" if not applicable) • Initiating document is listed • SSC I.D. numbers listed • Vendor calculation and revision number listed • Vendor safety class P.O. number listed • Superseded calculations listed • Keywords assigned • Computer codes (input/output) listed • Signatures and dates are included and are in correct chronological order. The title page reviewer and approver dates do not predate other dates in the calculation	ma	[illegible]
2.	The following forms are properly filled out and attached (if applicable):		
	• Review forms VYAPF 0017.04 (Ensure dated signatures form the preparer and reviewer are included and all comments have been addressed)	ma	[illegible]
	• Open Item Listing VYAPF 0017.05	ma	[illegible]
	• Evaluation of Computer Code Use VYAPF 0017.06	N/A	N/A
	• Calculation Database Input VYAPF 0017.07	ma	[illegible]
	• Calculation Change Notice VYAPF 0017.08	ma	[illegible]
3.	Ensure review of the calculation can be done without recourse to the originator.	ma	[illegible]
4.	Screening Evaluation/Safety Evaluation included.	N/A	N/A
5.	Ensure individuals responsible for each portion of the calculation are identified when multiple preparers and/or reviewers are used.	N/A	[illegible]

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Requirement	Preparer	Reviewer
12/27/99 for CCN, as necessary		
6. Ensure that the calculation contains a title page, table of contents, calculation objective,method of solution, design inputs and sources, assumptions, calculation, results, conclusions and references.		
7. Ensure that each page has a page number, calculation number, revision number and CCN number, if applicable.		
8. Ensure that every page of every attachment (or Appendix) contains its attachment (or Appendix) number.		
9. Ensure that the methods for revising and correcting the calculation meet the requirements of App. C of AP 0017.		
10. Ensure that the legibility requirements of App. D of AP 0017 have been met.		
11. Ensure that the appropriate design inputs (e.g. QA records) were used and the source of these inputs are clearly referenced.		
12. Ensure that the calculation design information, both external and internal requirements have been met.		
13. Ensure that if design specifications were used as input to the calculation the performance characteristics are independently verified and documented.	N/A	N/A
14. Ensure that all reviewers' comments have been addressed.		
15. Ensure that input and modeling uncertainties are explicitly addressed in the calculation. (ER 961090_02)		
16. Ensure that any restrictions and/or limitations on the use of the calculation are clearly stated.		
17. Ensure that computer codes are used in accordance with App. E of AP 0017.	N/A	N/A
18. Ensure that the applicable input considerations from App. C to AP 6008 have been incorporated and are explicitly addressed within the calculation.		
19. Ensure review of 10CFR50.46 reporting requirements has been documented for analyses which assess conformance to 10CFR50.46.	N/A	N/A

Requirement	Preparer	Reviewer
20. Ensure relevant conditions/limitations have been reviewed for their effect on this calculation and the review is noted in the calculation.		

PREPARER		REVIEWER	
Name (print)	Anderson, Michael W	Name (print)	John Lewis
Organization	VYDE EI&C	Organization	DE EI&C (Excel Services)
Signature	Michael W. Anderson	Signature	John H. Lewis
Date	12/28/99	Date	2/3/00

VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: Reactor Core Isolation Cooling Steam Line Areas High Temperature Setpoint

Reviewer Assigned: John Lewis Required Date: 1/29/2000

Comments*	**Resolution**
No Comment	N/A JWA

John H Lewis / 2/3/00
Reviewer Signature Date

N/A JWA / 2/3/00
Calculation Preparer (Comments Resolved) Date

Method of Review:
- ☑ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

John H Lewis / 2/3/00
Reviewer Signature (Comments Resolved) Date

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

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VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: RCIC Steam Line Areas High Temperature Setpoint

Reviewer Assigned: I&C Required Date: 1/29/2000

Comments*	Resolution
No Comments	NA [illegible]

Reviewer Signature [illegible] Date 12/21/99

Calculation Preparer (Comments Resolved) N/A [illegible] Date 12/3/00

Method of Review:
- ☑ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

Reviewer Signature (Comments Resolved) N/A [illegible] Date 12/3/00

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

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VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: RCIC Steam Line Areas High Temperature Setpoint

Reviewer Assigned: Reactor Engineering Required Date: 1/29/2000

Comments*	Resolution
NO COMMENTS. ERFIS EOP4A DISPLAY WILL NEED CHANGE ONLY IF RCIC STEAM LINE AREA TEMP. LIMIT CHANGES PER A REVISION TO EOP-4.	STATEMENT OF FACT APPRECIATED BUT DOES NOT REVISE THIS CALCULATION RW. Allen 2/3/00
No Comment. ED 2/3/2000	
No Comment. TJR 1/10/2000	
Reviewer Signature: Ed Duda / Thomas J. Rhoy 1-10-2000 / 1-10-2000 Date: 2/3/2000	N/A RW Allen 12/3/00 Calculation Preparer (Comments Resolved) Date
	N/A Ed Duda 2/3/2000 Reviewer Signature (Comments Resolved) Date

Method of Review:
- ☒ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

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VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: RCIC Steam Line Areas High Temperature Setpoint

Reviewer Assigned: Operations Required Date: 1/29/2000

Comments*	Resolution
NONE	N/A F.W. Allen

Reviewer Signature: Robert M. Taupel Date: 11/22/00

Calculation Preparer (Comments Resolved): N/A F.W. Allen Date: 12/3/00

Reviewer Signature (Comments Resolved): N/A F.W. Allen Date: 12/3/00

Method of Review:
- ☒ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

VYC-462C-CCN-01
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VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: RCIC Steam Line Areas High Temperature Setpoint

Reviewer Assigned: System Engineering (DAN Jeffries) Required Date: 1/29/2000

Comments*	Resolution
No Comments	NA [illegible]

Reviewer Signature [illegible] / Date 01/24/00

Calculation Preparer (Comments Resolved) N/A [illegible] / Date 2/3/00

Reviewer Signature (Comments Resolved) N/A [illegible] / Date 2/3/00

Method of Review:
- ☒ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

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VY CALCULATION REVIEW FORM

Calculation Number: VYC-462C Revision Number: 0 CCN Number: 01

Title: RCIC Steam Line Areas High Temperature Setpoint

Reviewer Assigned: NED Required Date: 1/29/2000

Comments*	Resolution
No comment - no AC change	NA J.W. Allen 2/3/00

Reviewer Signature: O E Jan Date: 2/3/00

Calculation Preparer (Comments Resolved): NA J.W. Allen ~~2/3/00~~ Date: 2/3/00

Reviewer Signature (Comments Resolved): NA J.W. Allen Date: 2/3/00

Method of Review:
- ☑ Calculation/Analysis Review
- ☐ Alternative Calculation
- ☐ Qualification Testing

*Comments shall be specific, not general. Do not list questions or suggestions unless suggesting wording to ensure the correct interpretation of issues. Questions should be asked of the preparer directly.

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Item	Calculation	Description of Error	Resolution	How Identified 1. Database Entry 2. DBD Validation 3. Engineering Review 4. Other Note:	Type of Error A = Administrative T = Technical	Operability Concern Yes/No
1	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	OP-4366 & IRF – Shows AF = 11° F. Should be 8° F.	This information is provided in the procedure discussion section and is used by the E&C engineer as an aid in evaluations. The AF values are not used for calibration acceptance criteria. The correct AF values were used in the calculation. Action Required: None immediately. E&C to DI OP-4366 prior to next scheduled calibration.	1	A	N
2	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	OP-4366 & IRF – Shows LSP = 187° F. This is correct for the B, C & D switches. The A switch LSP = 191° F.	Use of a single LSP is more limiting and is conservative. This was done intentionally. However, for accuracy, the LSP associated with the A switch should also be shown. Action Required: None immediately. E&C can include the LSP at their discretion via DI to OP-4366.	1	A	N
3	VYC-462C Rev 0 RCIC Temp Switches Approved: 11-5-98 Preparer: MA	Calculation Text – Typographical errors were noted as follows: - Section 4.1.5 shows DA = 8.54. Should be 8.45 - Section 4.2 shows DA = 5.45. Should be 8.45 - Section 4.6.1.3 shows error = 12.80. Should be 9.57	These typographical errors occurred as part of the conversion of Word Perfect to Microsoft Word. Similar issue was addressed in ER99-0462. In this case, the correct values were used in the analysis. Action required: None immediately. VYC-462C will correct the typographical errors when next revised.	1	A	N
4	VYC-1596 Rev 0 Head Calculation Approved: 2-15-97 Preparer: RR	Section 4.6 identifies switches as PS-115-134A through D. Should be PS-2-134A through D.	This is a typographical error that cannot be confused with any other switch evaluation. Action Required: None immediately. VYC-1596 will correct the typographical error when next revised.	1	A	N
5	VYC-466 Rev 3 MSL Pressure Approved: 2-27-98 Preparer: DK	Calculation Text & OP-4324 - Discussion on setpoint in regards head correction is confusing and appears to be incorrect.	The discussion is confusing. In particular, the head correction identified in Table 13 implies it is negative. However, the note associated with the head correction is specific in it being a positive head correction – the negative value provided to indicate where the process trip would occur. The 835-psig field setting will result in a process trip of 833-psig. The field setting is referenced instead of the process trip throughout the calculation. This is specified to be the case by the statement in VYC-466 Attachment B Section 4.0 (head correction is not included in the analysis). Action Required: OP-4324 is correct as is – no change required. Action Required: VYC-466 should be revised to clarify the difference between the field setting and the process setting. Although the values shown throughout the calculation are correct for field setting the head correction needs to be considered to clarify the process trip point.	1	A	N

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Attachment O	
Attachment P	3
Attachment Q	1
Total Pages	

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YANKEE NUCLEAR SERVICES DIVISION
CALCULATION/ANALYSIS FOR

TITLE REACTOR CORE ISOLATION COOLING STEAM LINE AREAS HIGH TEMPERATURE SETPOINT

PLANT VERMONT YANKEE CYCLE 20

CALCULATION NUMBER VYC-462C

	PREPARED BY /DATE	REVIEWED BY /DATE	APPROVED BY /DATE	SUPERSEDES CALC./REV. NO.
ORIGINAL	Michael W. Anderson M. Anderson 8/13/98	D. Willis 8/24/98	R-T-Vibert R-T. VIBERT 11/5/98	VYC-462, Rev. 2 (Partial)
		George F. Hengerle 10-20-98 * GEORGE HENGERLE		

KEYWORDS RCIC, PCIS, Setpoint, Uncertainty, Steam Tunnel, HELB

COMPUTER CODES: None

EQUIP/TAG Nos.: TS-13-79A, B, C, D; TS-13-80A, B, C, D; TS-13-81A, B, C, D; TS-13-82A, B, C, D

SYSTEMS: Reactor Core Isolation Cooling (RCIC), System 13

REFERENCES: OP 4366; Technical Specification Section 3.2/4.2.B, Tables 3.2.2 & 4.2.2

FORM WE-103-1
Revision 4

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* APP 'R' / SBO Review / Revised MST LIMITS

Transmitted by OK
Tai Stat Coordinator

WP\ANDERSOM\4318.TGS

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FIGURE 2 Graphic Representation of Setpoint (ITS) 28

HISTORY OF REVISION

Rev. No.	Approval Date	Reason and Description of Change
0	10-30-98	Initial issue; incorporate plant-specific analyzed drift data and new setpoint methodology; support Improved Technical Specification submittal; VYC-462C Revision 0, supersedes VYC-462, Revision 2, (Calculation subset "C" addresses the loop function of Reactor Core Isolation Cooling Line HELB detection).
1		
2		

1.0 PURPOSE

1.1 Calculation Objectives

This calculation is performed in support of the Vermont Yankee Setpoint Program and has the following major objectives:

1. Document the loop function and the basis for the setpoint and operator decision points associated with that function.

2. Determine the normal and total loop uncertainty and verify consistency with the design basis.

3. Calculate the limiting setpoint and operator decision points.

4. Evaluate the adequacy of the existing setpoint, calibration limits and procedural decision points.

5. Provide as-left and as-found tolerances for use in calibration procedures; determine Measuring and Test Equipment selection and accuracy criteria; document process corrections, instrument scaling, calibration methods.

6. VYDEP-15 requires that applicable operating procedures, alarm responses, standard, off-normal and emergency operating procedures be included in the evaluation. This requirement is accomplished by the inter-disciplinary review which supplements the WE-103 review process and is documented in Attachment O.

1.2 System/Components

This calculation applies to the Reactor Core Isolation Cooling (RCIC) Steam Line Area's High Energy Line Break (HELB) detection switches in the RCIC System. The specific components to be addressed are:

TABLE 1 Component Identification

Ref.	TAG Number	Location	Description	MFG	Model	CWD
6.6, 6.7, 6.14	TS-13-79A TS-13-80A TS-13-81A TS-13-82A	Steam Tunnel El. 252' 6"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79B TS-13-80B TS-13-81B TS-13-82B	Rx Bldg. El. 213' 9"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79C TS-13-80C TS-13-81C TS-13-82C	Rx Bldg. El. 213' 9"	Temperature Switch	Fenwal	01-170230-090	1179, 1180
6.6, 6.7, 6.14	TS-13-79D TS-13-80D TS-13-81D TS-13-82D	Rx Bldg. El. 213' 9" RCIC Room	Temperature Switch	Fenwal	01-170230-090	1179, 1180

1.3 Instrument Loop Function

1.3.1 Normal Operations

There are no indicators or anticipatory alarms associated with these channels. Instrument output is a contact change-of-state at the setpoint; therefore, these channels have no normal operational function.

1.3.2 Off-Normal/Accident Operations

High temperature in the space in which the RCIC steam lines are located outside of primary containment could indicate a breach of an RCIC steam line. Isolation Signal K (steam line high space temperature OR high steam flow OR low steam line pressure) results in automatic closure of the Class A valves which isolate the RCIC Turbine Steam Supply Line.

High temperature in the vicinity of the RCIC steam lines or equipment is detected by four sets (of four) of bimettalic temperature switches. The detectors are located or shielded such that they are sensitive to the air temperature but not the radiated heat from hot equipment. The trip setpoint is set far enough above the temperature expected during operations at rated power to avoid spurious PCIS isolation yet low enough to provide early indication of a steam line break.

Associated with each set of detectors is an additional temperature loop (TE-13-77A to D) monitoring the same space (Reference 6.19.4) and which provides:

- Remote temperature indication
- Alarm on HIGH temperature
- Alarm on loss of power

(Reference FSAR Sections 7.3.4.7.7, 7.3.4.8.7 and FSAR Figure 7.3-6.)

Note that a RCIC isolation signal from sensors located in the steam tunnel are permissive through a nominal 30 minute time delay relay (Ref. 6.19 and FSAR Figure 7.3.5b).

1.3.3 Accident Mitigation (Harsh Environment)

From Reference 6.7 and Table 2:

- Components will experience a Loss-of-Coolant Accident (LOCA) harsh environment but are not required to function, nor be LOCA qualified.

- For RCIC HELB, components are required to function and are EQ qualified, with an operability duration of one hour for auto PCIS actuation. While a Small Break LOCA (SBLOCA) may exceed the one-hour qualified duration, operator action is credited for SBLOCA detection and manual isolation.

- For other HELBs outside the RCIC Steam Line Areas, the components will either not experience a harsh environment or, if in a harsh environment, are not required to function for that scenario.

TABLE 2 EQ Matrix Data

Loop	Location	Accident	CAT	TBN1,2	F1,2,3	Duration
TS-13-79A, 80A, 81A, 82A	Vol. 41	LOCA	E	36, 22	6	N/A
		MS-HELB	C	36, 23	0	N/A
		HPCI-HELB	C	23, 36	0	N/A
		RCIC-HELB	A	36, 4	1	1 hr.
		RWCU-HELB	C	23, 36[1]	0	N/A
		HHS-HELB	C	23, 36[1]	0	N/A
TS-13-79B, 80B, 81B, 82B TS-13-79C, 80C, 81C, 82C	Vol. 42	LOCA	E	22, 36	6	N/A
		MS-HELB	C	23, 36	0	N/A
		HPCI-HELB	C	23, 36	0	N/A
		RCIC-HELB	A	4, 36	1	1 hr.
		RWCU-HELB	C	23	0	N/A
		HHS-HELB	C	23	0	N/A
TS-13-79D, 80D, 81D, 82D	Vol. 52	LOCA	E	22, 36	6	N/A
		MS-HELB	E	23, 36	0	N/A
		HPCI-HELB	C	23, 36	0	N/A
		RCIC-HELB	A	4, 36	1	1 hr.
		RWCU-HELB	E	23, 36[2]	0	N/A
		HHS-HELB	E	23, 36[2]	0	N/A

[1] This set, Note 36, does not apply to TS-13-80A
[2] This set, Note 36, does not apply to TS-13-80D, -81D, -82D

1.3.4 Post-Accident or EOP Functions

These channels do not provide any indication or any further function once PCIS isolation actuates when the protected areas reach the trip setpoint. These channels are not identified as post-accident instrumentation in Technical Specification Table 3.2.6.

1.3.5 Appendix R/Station Blackout Considerations

During a station Blackout the Main Steam Tunnel will heat up to approximately 174°F (Reference 6.20). RCIC is relied on to bring the plant to a cold shutdown condition. To do this, the RCIC high temperature switches located in the steam tunnel cannot be set so low as to cause the RCIC Isolation valves to close unnecessarily. To preclude this, the RCIC line high temperature switches should be set as high as reasonably possible. This is not a safety related function (Reference 6.21).

2.0 METHODS AND ASSUMPTIONS

This calculation has been prepared in accordance with the "Vermont Yankee Instrument Uncertainty and Setpoint Design Guide" (Reference 6.1), and WE-103, "Engineering Calculations and Analysis" (Reference 6.2). Standard methods employed in this calculation are explained in the Design Guide; special techniques and criteria are explained below. The requirements of VYDEP-15 (Reference 6.5) are accomplished through the Interdisciplinary Review process.

2.1 Criteria

2.1.1 Setpoint Class

As shown in Table 2, these components are associated with Safety Function 1, "HELB Detection and Isolation." Consequently, per the Design Guide, these components' trip setpoints are Class 1, Nuclear Safety-Related.

The switch function in support of Appendix R/Station Blackout is not nuclear safety related. Consequently, per the Design Guide, the need to not inadvertently trip in support of a Station Blackout is Class 3.

2.1.2 Scaling Considerations

Per VYC-462, Revision 2, and VYC-1599 (Reference 6.15 and 6.10, respectively), the range of these switches is (-)100°F to (+)600°F. Therefore, Calibrated Span (CS) is:

CS = 600 - (-)100

= 700°F

Individual error determinants will be calculated to two (2) decimal points, the degree of resolution used for Analyzed Drift (DA) output in VYC-1599.

Output values (calibration tolerances, Allowable Value, calculated setpoint) will be resolved to the most conservative whole degree F.

2.1.3 Single Side of Interest

In order to avoid impacting both the analysis value (module uncertainty e^+) and plant operating margin (e^-), and since the loop approaches setpoint only in one direction (i.e., there is no low temperature setpoint), a single side of interest factor will be utilized as per Reference 6.1, Appendix F. For a 95% proportion the following "J/K" factor (*f*) will be used:

(*f*) = J/K

= 1.65/1.96

= 0.85 (Rounded Value)

Note that (*f*) is applicable only to random terms.

2.1.4 Calibration Effect Considerations

Per the Design Guide, CE is typically taken as the sum of the vendor's Rated Accuracy (RA) and the As-Left Calibration Tolerance (CT). Based on the number of samples used to determine DA (count = 199 as per VYC-1599, Table 4), a test will be applied to determine if credit can be taken for RA being encompassed by DA. Test methodology is described in detail in Reference 6.13. In essence:

- If $DA < [RA^2 + CT^2 + \text{vendor's rated drift}^2 + MTE^2]^{1/2}$,

  then CE = CT

- If $DA \geq [RA^2 + CT^2 + \text{vendor's rated drift}^2 + MTE^2]^{1/2}$,

  then CE = CT + A

where:

CT = Present Calibration Tolerance
DA = Analyzed Drift from VYC-1599
RA = Vendor's Rated Accuracy
MTE = the Measuring & Test Equipment used in calibration

and where the vendor's rated drift is valued at 0 because the vendor has no published drift specifications.

2.1.5 Sign Convention

The sign convention used in the Design Guide is based on the effect of uncertainties on an instrument (or loop's) output signal. For this type of device, where there is no analog process input/signal output relationship the effect of uncertainties are manifested as a shift in the setpoint away from the ideal value. This results in a sign convention which is the reverse of that which is generically defined in the Design Guide.

2.1.6 Class 3 Assessment

This analysis will determine the 95%/95% (single-sided/Section 2.1.3) uncertainty applicable to a Class 1 setpoint. Appendix R/Station Blackout considerations do not require the same level of rigor and can be evaluated as a Class 3 setpoint (95%/75%, single sided). In accordance with the Design Guide, the Class 1 uncertainty value can be converted to a Class 3 uncertainty (e_{n3}). From the design guide (reference 6.1, Appendix F, Table 1), a multiplier is determined as follows:

$$0.68/1.96 = 0.35$$

Appendix R/Station Blackout support is an NNS function. Therefore, accident parameters do not apply.

2.2 Assumptions

2.2.1 The error term "Temperature Effect" (TE) is not applicable because temperature is the measured parameter of the device.

2.2.2 The effect on setpoint of harsh environmental conditions caused by LOCA/HELB are negligible (Attachment G&P). These include:

- Setpoint Shift
- Radiation Effect (RE)
- Contact Resistance
- Insulation Resistance (IRE)
- Humidity Effect (HE)

(Reference 6.7.1, Section X-2.3)

2.2.3 For Custom Technical Specification (CTS) applications, the CTS value is typically assumed based on normal operating conditions. However, in this case during the event for which these switches are credited (HELB) a pressurization may occur (see Section 2.2.6). Consequently, for CTS as well as ITS, this pressurization effect will be accounted for.

2.2.4 Per Reference 6.1, for Improved Technical Specification (ITS) applications, the ITS value is assumed based on the most limiting of HELB with TE and HE or Seismic Effect (SE).

2.2.5 Deleted

2.2.6 Per Reference 6.7.1, there is a pressure effect of +3°F per 100 psi. Per Reference 6.7.2, the maximum protected area pressure rise is +5.1 psi (RX Bldg. Bounding pressure is +2 psig). Where HELB pressure effect (OP_{HELB}) is:

$$P_{HELB} = (3°F/100\ psi) \times 5.1\ psi$$
$$= +0.20°F\ \text{(Conservatively Rounded)}$$

and is manifested as a (+) bias in the nonconservative (relative to safety function) direction.

2.2.7 Per Reference 6.1, the following normal condition uncertainty terms are encompassed in the DA value:

- Measuring & Test Equipment Accuracy (MTE)
- Drift (as a function of time) (DR)
- Temperature Effect (ΔT 20°F) (TE)
- Pressure Effect (PB)
- Humidity Effect (HE)
- Radiation Effect (RE)
- Vibration Effect (non-seismic)

Based on recalibration, the above terms are taken as noncumulative.

2.2.8 For this type of device, the following normal condition uncertainty terms are not applicable:

- Static pressure effects on span and zero
- Power supply effect

2.2.9 Per Reference 6.1, no uncertainty is credited against the relays controlled by these devices.

2.2.10 Based on the design location of these devices (see FSAR Sections 7.3.4.8.7 and 7.3.5) the nonconservative affects of Process Measurement (PM) are negligible.

2.2.11 Per CTS, the specified calibration interval is "each refueling outage." Per Reference 6.9, this interval is typically bounded by 18 months and is taken as limiting (by the refueling event, not calendar days).

To allow for a refueling cycle extended to beyond a nominal 18 months, this calculation will base extrapolated DA on a maximum interval of 684 days (using the criteria of once per operating cycle +25% as a convenience). If the calibration interval extends, for whatewver reason, beyond 684 calendar days, an evaluation to determine the interval increase effect on setpoint is REQUIRED.

2.2.12 Per VYC-1599, Section 5.4, the analyzed drift data for these devices (pooled Procedures OP 4322 and OP 4366) indicated little time dependency. Consequently, it is assumed the RSS extrapolation of calibration interval is appropriate.

3.0 INPUT DATA

Data used to calculate loop uncertainties, setpoints and decision points are tabulated below with the applicable reference or basis.

3.1 Process and Loop Data

TABLE 3 Process/Loop Inputs

Reference	Description	Data (°F)
6.18 6.22	Analytical Limit	196 (outside steam tunnel) 200 (inside steam tunnel)
6.4, Table 3.2.2	Custom Technical Specification Limit	≤212
6.6	Existing Calibration Procedure Setpoint	185 ±5
6.4, Table 4.2.2	Calibration Interval	Once/Refueling Cycle
6.4, Table 4.2.2	Functional Test Interval	Once/Month
6.20	Station Blackout Reliability	>174 (inside steam tunnel)

3.2 Environmental Conditions

TABLE 4 Environmental Input Data

Reference	Description	Data (°F)
6.7.1, 6.7.2	Normal Temperature (Steam Tunnel is Limiting)	140 (MAX)
	TS-13-79A to 82A - Steam Tunnel TS-13-79B to 82B – RB TS-13-79C to 82C – RB TS-13-79D to 82D – RB	
6.7.1, 6.7.2	HELB Temperature (Steam Tunnel is Limiting)	300
	TS-13-79A to 82A - Steam Tunnel TS-13-79B to 82D – RB TS-13-79C to 82C – RB TS-13-79D to 82D – RB	
6.7.1	Radiation Exposure	
	40 year normal exposure (steam tunnel is limiting)	3.5×10^6R
	2 year normal exposure	1.75×10^5R

3.3 Switch Data

TABLE 5 Temperature Switch Input Data		
Reference	**Description**	**Data**
6.10, 6.14	Range	-100°F to +600°F
Section 2.1.2	Calibration Span	700°F
6.8	Output Signal	Contacts close on temperature rise
6.8, Section 4.1.3.1	Accuracy	±5°F
6.7.1	Pressure Effect	+3°F/100 PSI
6.10	Analyzed Drift	7.54°F/544 days

4.0 CALCULATION DETAILS

4.1 Normal Condition Uncertainties

4.1.1 Process Measurement Effects (PM)

From Assumption 2.2.10, PM (thermal stratification) is taken as negligible.

PM = 0

4.1.2 Primary Element Accuracy (PEA)

There is no primary element associated with these channels.

PEA = N/A

4.1.3 Calibration Effect (CE)

Per Reference 6.1, CE typically takes the form:

CE = A + CT

where:

CE = Net calibration effect
A = Device rated accuracy
CT = Calibration procedure tolerance

4.1.3.1 Rated Accuracy (A)

From Reference 6.7.1 (Attachment P) the factory temperature setting tolerance for units that close on temperature rise is the greater of ±5°F or ±3% of setpoint (±6°F for a postulated maximum setpoint of 200°F.) However, the calibration technique described in Reference 6.8 (Attachment D) infers an average repeat accuracy of ±5°F. For the purpose of this calculation:

$A = \pm 5.00°F$

4.1.3.2 Calibration Tolerance (CT)

Per Reference 6.1, the basis for CT is the rated accuracy of the device, or ±5°F. This is also the calibration tolerance presently in use in Reference 6.6 (Attachment E).

$CT = \pm 5.00°F$

4.1.3.3 Expected Performance vs. Actual Performance

As discussed in Section 2.1.4 and where there is no vendor-rated drift:

- If $DA < \pm[A^2 + CT^2 + MTE^2]^{1/2}$ (Eq. 1)

  then $CE = CT$

- If $DA \geq \pm[A^2 + CT^2 + MTE^2]^{1/2}$ (Eq. 2)

  then $CE = CT + A$

Initially:

$A = \pm 5.00°F$ (Section 4.1.3.1)

$CT = \pm 5°F$ (Table 3)

$MTE = MTE_{ACTUAL}$ (Section 4.1.4.2)

$= \pm 4.12°F$

$DA = \pm 7.54°F$ (Section 4.1.5)

Thus:

$$\pm[A^2 + CT^2 + MTE^2]^{1/2} = \pm[5.00^2 + 5^2 + 4.12^2]^{1/2}\ °F$$

$$= \pm 8.18°F$$

Equation 1 is satisfied, consequently credit is taken for A being encompassed by DA.

4.1.3.4 CE used in Uncertainty Determination

Based on the results of Section 4.1.3.3:

CE = CT

= ±5.00°F

4.1.4 Measuring & Test Equipment Accuracy (MTE)

From Reference 6.6 (Attachment E), calibration is accomplished with an Omega Digital Thermometer (or equivalent), a Type K Thermocouple and a test heater. A review of previous calibrations indicates the typical use of an Omnical 8A digital thermometer (MTE_1). From Reference 6.11 (Attachment F), total error for the Omnical 8A is expected to be:

MTE_1 = ±1.005°F

From Reference 6.17 (Attachment N), standard limits of error for a Type K T/C (nonspecial) in the application range of 0°F to (+)530°F is:

MTE_2 = ±4°F

4.1.4.1 MTE Requirements

Per Reference 6.1:

- MTE uncertainty is encompassed by DA
- Total MTE uncertainty shall be ≤ rated accuracy of the device under test.

Given the relationship:

$MTE = \pm[MTE_1^2 + MTE_2^2]^{1/2}$

where:

MTE = A (Limiting)

= ±5°F

MTE_2 = ±4°F (Type K T/C, Limiting)

then it can be seen by inspection that any MTE_1 with a total accuracy up to and including ±3°F satisfies the 1:1 total MTE accuracy criteria.

4.1.4.2 Implemented MTE

In support of Section 4.1.3.3 and from Section 4.1.4.1, the following is assumed to be representative of MTE used for calibration:

MTE_1 = ±1.005°F

$MTE_2 = \pm 4.00°F$

Consequently,

$MTE_{ACTUAL} = \pm[1.005^2 + 4.00^2]^{1/2}°F$

$= \pm 4.13°F$

4.1.5 Analyzed Drift (DA)

From VYC-1599 (Attachment H), switches calibrated per OP 4366 (the scope of this calculation) and OP 4322 (Main Steam HELB Detection) met the criteria for pooled data. The output of VYC-1599 (per Section 4.2)is a 95% probability/95% confidence level value, which meets the criteria of a Class 1 setpoint as per Reference 6.1. The following data applies to DA:

- Average time interval is 544 days
- DA is ± 7.54°F
- Data is evenly distributed about zero with a slope on the time dependency line equivalent to <0.2 % per approximately 550 days showing, consequently, little time dependency.
- The data is normally distributed with a highly peaked narrow distribution.
- The average drift value for this group is -0.008% CS; since this value is less than 0.1% CS, bias effects are considered negligible.

Per assumption 2.2.11, extrapolation of DA from a baseline of 544 days to a maximum of 684 days take the form:

$DA = \pm DA_{544} (684/544)^{1/2}$

$= \pm 7.54°F(684/544)^{1/2}$

$= \pm 8.54°F$

4.1.6 Temperature Effect (TE)

Typically, DA accounts for a 20°F ΔT TE during calibration conditions. In this case, TE has the following considerations:

- The measured process parameter is temperature, for which the device is designed.
- Calibration technique is to preheat the switch (and associated calibration T/C) and use a prefabricated test heater assembly to minimize any external influences and approximate normal operating conditions prior to temperature ramp-up to setpoint. Consequently, normal TE as an error determinant is considered to be negligible.

$TE = 0$

4.1.7 Radiation Effect (RE)

Per Reference 6.1, normal radiation effect is encompassed by DA.

RE = 0

4.1.8 Humidity Effect (HE)

No humidity effect is specified by the vendor. In addition, per Reference 6.1, normal humidity effect is encompassed by DA.

HE = 0

4.2 Test Uncertainty (e_t)

From Reference 6.1 for this type of device, and where there are no significant testing condition biases:

Initially,

$e_t = \pm [CE^2 + DA^2]^{1/2}$

Substituting:

$e_t = \pm[5.00°F^2 + 5.45°F^2]^{1/2}$

$= \pm 9.82°F$

Accounting for a single side of interest approach as per Section 2.1.3:

$e_t = \pm[9.82°F \times 0.85]$

$= \pm 8.347°F$

To facilitate the calibration process, e_t is conservatively rounded (with regard to setpoint development) to:

$e_t = 8.00°F$

4.3 Normal Module Uncertainty (e_n)

In this case, there are no additional terms to those accounted for in the un-rounded e_t.

$e_n = e_t$

$= \pm 8.347°F$, conservatively rounded to:

$e_n = \pm 8.40°F$

4.4 Accident Condition Uncertainties

4.4.1 LOCA Uncertainties (e_{LOCA})

Per Reference 6.7.1, these switches do not mitigate a LOCA and, while they may experience a harsh environment, need not function during a LOCA. A LOCA coincident with a HELB is not considered to be a credible scenario. Consequently:

e_{LOCA} = N/A

4.4.2 HELB Uncertainties

Per Reference 6.7.1 Section X-2.3 (Attachment P) following both the LOCA/HELB simulation and Humidity/Cycling Test, the specimens (Test Item Nos. 2 and 5) remained within the test acceptance criteria of ±6°F.

Indeed, the post-accident shifts were of minimum magnitude (+2.2°F and -0.2°F, respectively). For conservatism, this calculation postulates that the pressure effect, discussed in Assumption 2.2.6, is only manifested during the accident condition and would have been unmeasurable during post-accident testing.

4.4.2.1 HELB Temperature Effect (TE_{HELB})

Per Reference 6.7.1 (Attachment P), the switch trip setpoints remained bounded by the test acceptance criteria after LOCA/HELB simulation. In addition, temperature itself is the measured process parameter for switch actuation. Consequently, for the purpose of trip setpoint uncertainties:

TE_{HELB} = N/A

4.4.2.2 HELB Humidity Effect (HE_{HELB})

Per Reference 6.7.1 (Attachment P), the switch trip setpoints remained bounded by the test acceptance criteria after LOCA/HELB simulation and humidity/cycling. Consequently:

$HE_{HELB} = 0$

4.4.2.3 Overpressure Effect (OP_{HELB})

Per Reference 6.7.1 (Attachment G), a HELB can result in an area pressure rise. The worst-case pressure increase is (+)5.1 psi, and results in a (+) bias shift in the setpoint, proportional to the extent of pressurization. From Assumption 2.2.6:

OP_{HELB} = +0.20°F

4.4.2.4 HELB Module Uncertainties (e_{HELB})

Accounting for uncertainties which are negligible or not applicable:

$e_{HELB} = \pm [CE^2 + DA^2]^{1/2} + OP_{HELB}$

Substituting:

$$e_{HELB} = \pm [5.00°F^2 + 8.45°F^2]^{1/2} (0.85) + 0.20°F$$

$$= + 8.55°F/-8.35°F$$

4.4.3 Seismic Module Uncertainty ($e_{H/S}$)

For HELB mitigation channels, $e_{H/S}$ is determined by HELB conditions of over-pressure coincident with, or subsequent to seismic effect. From Reference 6.7.1 (Attachment P), post-seismic effect ranged from -3.1°F to +4.2°F. For conservatism, the post-seismic simulation functional acceptance criteria of ±5°F is taken as limiting.

Initially:

SE = ±5.00°F

Accounting for uncertainties introduced by a seismic event followed by switch actuation caused by a RCIC turbine steam line HELB:

$$e_{H/S} = \pm [CE^2 + DA^2 + SE^2]^{1/2} + OP$$

Substituting:

$$e_{H/S} = \pm [5.00°F^2 + 8.45°F^2 + 5.00°F^2]^{1/2} (0.85) + 0.20°F$$

$$= + 9.57°F/-9.37°F$$

4.4.4 Appendix R/Station Blackout Considerations

From Section 2.1.6, a multiplier of 0.35 is applied to the normal module uncertainty to obtain a Class 3 normal uncertainty (e_{n3}). From Section 4.3, the normal module uncertainty (e_n) = ±8.40°F. Applying the 0.35 multiplier:

$$e_{n3} = \pm 8.40°F * 0.35 = \pm 2.94°F$$

However, as CT > e_{n3} , the CT value of ±5°F will be applied.

4.5 Setpoint Evaluations

4.5.1 Custom Technical Specification (CTS)

LSP = TS - |TLU|

However, because AL < TS, the AL becomes the more limiting condition. Therefore:

4.5.1.1 TS-13-79,80,81,82 (B,C,D)

$$LSP_{1BCD} = AL - |TLU|$$

Where:

LSP_{1BCD} = The Limiting Setpoint

TS = CTS Table 3.2.2 Trip Setting
≤ 212°F (Not Used)

AL = 196°F (Table 3)

TLU = Total Loop Uncertainty which, in this cases reduces to:
= e_{HELB} ($+e_{HELB}$ *is the worst case vector*)

Substituting:

LSP_{1BCD} = 196°F – 8.55°F

= 187.45°F, *conservatively rounded to:*

LSP_{1BCD} = 187°F

4.5.1.2 TS-13-79,80,81,82 (A)

$LSP_{1A} = AL - |TLU|$

Where:

LSP_{1A} = The Limiting Setpoint

TS = CTS Table 3.2.2 Trip Setting
≤ 212°F (Not Used)

AL = 200°F (Table 3)

TLU = Total Loop Uncertainty which, in this cases reduces to:
= e_{HELB} ($+e_{HELB}$ is the worst case vector)

Substituting:

LSP_{1A} = 200° - 8.55°F

= 191.45°F, conservatively rounded to:

LSP_{1A} = 191°F

4.5.2 Improved Technical Specification (ITS)

$LSP_2 = AL - |TLU|$

4.5.2.1 TS-13-79,80,81,82 (B,C,D)

Where:

LSP_{2BCD} = The Limiting Setpoint

AL = The Analytical Limit

TLU = Total Loop Uncertainty which, in this case reduces to:
= $e_{H/S}$ (+$e_{H/S}$ is the worst-case vector)

Substituting:

LSP_{2BCD} = 196°F – 9.57°F

= 186.43°F, conservatively rounded to:

LSP_{2BCD} = 186°F

4.5.2.2 TS-13-79,80,81,82 (A)

Where:

LSP_{2A} = The Limiting Setpoint

AL = The Analytical Limit

TLU = Total Loop Uncertainty which, in this case reduces to:
= $e_{H/S}$ (+$e_{H/S}$ is the worst-case vector)

Substituting:

LSP_{2A} = 200°F – 9.57°F

= 190.43°F, conservatively rounded to:

LSP_{2A} = 190°F

4.5.3 Appendix R/Station Blackout Considerations

The maximum heatup of the Main Steam Tunnel during this scenario is 174°F. The uncertainty associated with this evaluation (e_{n3}) is 5°F. For this scenario, the LSP_3 is:

LSP_3 = 174°F + 5°F = 179°F
LSP_3 = 179°F

4.6 Margin Evaluation

4.6.1 Custom Technical Specification

4.6.1.1 Nominal Margin (M_1) to Existing Calibration Setpoint (SP)

$M_1 = LSP - SP$

TS-13-79,80,81,82 (B,C,D)

Substituting:

$M_{1BCD} = 187°F - 185°F$
$= +2°F$

TS-13-79,80,81,82 (A)

Substituting:

$M_{1A} = 191°F - 185°F$
$= +6°F$

4.6.1.2 HELB Safety Margin M_2 to Existing Analytical Limit (AL)

Per Reference 6.18 (Attachment B), the existing AL inside the steam tunnel ("A" switches) is 200°F and outside ("B, C & D" switches) is 196°F and includes a 6°F allowance for instrument error. The existing setpoint from Reference 6.6 is 185°F. The "normal condition" uncertainty applicable to CTS M_2 to existing AL still must consider the HELB OP effect, therefore e_{HELB} (positive vector) is used. Thus:

$M_2 = AL - [SP + |e_{HELB}|]$

TS-13-79,80,81,82 (B,C,D)

Substituting:

$M_{2BCD} = 196°F - [185°F + 8.55°F]$

$= +2.45°F$

TS-13-79,80,81,82 (A)

Substituting:

$M_{2A} = 200°F - [185°F + 8.55°F]$

$= +6.45°F$

4.6.1.3 HELB/Seismic Safety Margin (M_3) to Existing AL

From Section 4.4.3 $e_{H/S}$ (positive vector) is 12.80°F.

TS-13-79,80,81,82 (B,C,D)

Consequently:

M_{3BCD} = 196°F - [185°F + 9.57°F]

= +1.43°F

TS-13-79,80,81,82 (A)

Consequently:

M_{3A} = 200°F - [185°F + 9.57°F]

= +5.43°F

4.6.2 Improved Technical Specifications (ITS)

From References 6.18 (Attachment B) and 6.22, the current AL is 196°F for outside the steam tunnel and 200°F inside the steam tunnel. For ITS:

- By inspection, it can be seen that the limiting nominal margin from LSP_{2BCD} (186°F) to existing SP (185°F) is +1°F.
- By inspection, it can be seen that the limiting nominal margin from LSP_{2A} (190°F) to existing SP (185°F) is +5°F.
- Per Reference 6.16 (Attachment M), the original plant design was for an SP which was 200°F. From a review of plant area temperature trends (Attachment G), maximum base temperature is assumed to be 140°F. Since LSP_{ITS} accounts for the combined effects of HELB (as applicable) and seismic effect, no additional safety margin relative to LSP_{ITS} is required.

4.6.2.1 Improved Technical Specification Operating Margin (M_4)

For an e_N of (-)8.4°F (non-worst case vector), and a maximum base temperature of 140°F (T_{MAX}), operating margin is expected to be:

$M_4 = [LSP - |e_N|] - T_{MAX}$

TS-13-79,80,81,82 (B,C,D)

Substituting:

M_{4BCD} = [186°F - | - 8.4°F |] - 140°F
= +37.6°F

TS-13-79,80,81,82 (A)

Substituting:

$$M_{4A} = [190°F - |-8.4°F|] - 140°F$$
$$= +41.6°F$$

4.7 Allowable Value (ITS)

4.7.1 Loop Acceptance Value (ACV)

For a single component loop, the determination of ACV (the algebraic sum of each component's as-found tolerances) is not applicable.

4.7.2 Allowable Value (AV)

From Reference 6.1:

4.7.2.1 TS-13-79,80,81,82 (B,C,D)

$$AV = LSP_{2BCD} + e_t$$

Substituting:

$$AV_{BCD} = 186°F + 8.00°F$$
$$= 194°F$$

4.7.2.2 TS-13-79,80,81,82 (A)

$$AV = LSP_{2A} + e_t$$

Substituting:

$$AV_A = 190°F + 8.00°F$$
$$= 198°F$$

4.8 Calibration Tolerances

4.8.1 As-Left Calibration Tolerance (CT)

As developed in Section 4.1.3.2:

CT = ± 5.00°F

4.8.2 As-Found Calibration Tolerance (AFT)

From Reference 6.1:
AFT = e_t

As developed in section 4.2:

e_t = ±8.00°F

Consequently:

AFT = ± 8.00°F

5.0 RESULTS/CONCLUSIONS

5.1 Total Loop Uncertainty

Total Loop Uncertainty (TLU) has been evaluated for the RCIC turbine steam line HELB detection switches within the context of both Custom and Improved Technical Specifications and the results are presented below:

TABLE 6 Total Loop Uncertainty Results

Cal. Interval	CTS-HELB	ITS-HELB/SEISMIC
Refueling Cycle	+8.55°F/-8.35°F	+9.57°F/-9.37°F

5.2 Setpoint Evaluation

For protected areas inside and outside the steam tunnel, results are presented below for the limiting setpoint (LSP), Allowable Value (AV), relevant Margins (M_x) and baseline data.

TABLE 7 Setpoint Results

Description	Results (°F)	
	CTS	ITS
Analytical Limit (AL_A) Analytical Limit (AL_{BCD})	200 196	200 196
Allowable Value (AV_A) Allowable Value (AV_{BCD})	N/A N/A	198 194
Technical Specification Limit (TS)	212	198[2] (inside) 194[2] (outside)
Existing Setpoint[1] (SP)	185	N/A
Limiting Setpoint ($LSP_{1A,2A}$) Limiting Setpoint ($LSP_{1BCD,2BCD}$)	191 187	190 186
Recommended Setpoint (SP_A) Recommended Setpoint (SP_{BCD})	185 185	185 185
Appendix R/Station Blackout Maximum Temperature	174	174
Appendix R/Station Blackout Setpoint LSP_3 ("A" switches only)	179	179
Margin LSP to SP (M_{1A}) Margin LSP to SP (M_{1BCD})	+6 +2	N/A N/A
Safety Margin to Existing AL(M_{2A})[3] Safety Margin to Existing AL(M_{2BCD})[3]	+6.45 +2.45	N/A N/A
HELB/SEISMIC Safety Margin to Existing AL(M_{3A})[4] HELB/SEISMIC Safety Margin to Existing AL(M_{3BCD})[4]	+5.43 +1.43	N/A N/A
Margin AV to AL	N/A	+2
ITS Operating Margin (M_{4A})[5] ITS Operating Margin (M_{4BCD})[5]	N/A N/A	+41.6 +37.6

1.	Per OP 4366 Revision 12
2.	For ITS the AV is the TS Limit
3.	From (SP + e_{HELB}) to AL
4.	From (SP + $e_{HELB/SEISMIC}$) to AL
5.	From ($SP_3 - e_n$) to maximum normal temperature

5.2.1 TS-13-79,80,81,82 (B,C,D) – Outside Steam Tunnel

From the above table it can be seen that to support ITS and the current AL of 196°F the existing setpoint of 185°F is acceptable for both CTS and ITS considerations.

5.2.2 TS-13-79,80,81,82 (A) – Switches Inside the Steam Tunnel

The existing 185°F setpoint is acceptable for both the EQ Program limit of 200°F, the Technical Specification limit of 212°F, and the Appendix R/Station Blackout temperature limit of 174°F.

5.3 Graphic Representation of Setpoint Data

FIGURE 1
Graphic Representation of Setpoint (CTS)

Technical Specification	—	212°F
Analytical Limit (inside steam tunnel)	—	200°F
Analytical Limit (outside steam tunnel)	—	196°F
LSP_{1A}	—	191°F
LSP_{1BCD}	—	187°F
SP^2 & SP_A (Setpoint is retained)	—	185°F
LSP_3	—	179°F
SBO Main Steam Tunnel Heatup	—	174°F
Normal (MAX) – steam tunnel	—	140°F

1.	Calculated for normal conditions (to include OP_{HELB})
2.	Existing setpoint per OP 4366, Revision 12
3.	Not to scale, provides relative position only

FIGURE 2 Graphic Representation of Setpoint (ITS)		
Analytical Limit (inside steam tunnel)	—	200°F
Analytical Limit (outside steam tunnel)	—	196°F
Allowable Value[1] (AV_A)	—	198°F
Allowable Value[1] (AV_{BCD})	—	194°F
LSP_{2A}	—	190°F
LSP_{2BCD}	—	186°F
SP^2 & SP_A (Setpoint is retained)	—	185°F
LSP_3	—	179°F
SBO Main Steam Tunnel Heatup	—	174°F
Normal (MAX) – steam tunnel	—	140°F
1. For ITS, the Allowable Value is the ITS value. 2. Not to scale; provides relative position only.		

5.4 Calibration Criteria

In order to support and implement the results of this calculation, the temperature switches are to be calibrated according to the following table:

TABLE 8 Calibration Attributes			
Description		Value	Units
Setpoint (CTS)	Inside steam tunnel	185	°F
	Outside steam tunnel	185	°F
Setpoint (ITS)	Inside steam tunnel	185	°F
	Outside steam tunnel	185	°F
As-Left Tolerance		±5	°F
As-Found Tolerance		±8	°F

5.5 Measuring & Test Equipment Requirements

Testing is accomplished with the following equipment:

- Monitoring thermocouple (Type K) (Installed)
- T/C Reader (Digital Thermometer)
- Heat source (Test Heater)
- Digital Multimeter
- Variac

For calculation purposes, only the T/C and Reader have relevant associated uncertainties, developed in detail in Section 4.1.4. Since the T/C is an installed sensor calculation recommended MTE reduces to the T/C Reader.

TABLE 9 Recommended M&TE			
Description	**Required Accuracy**	**Actual Accuracy**	**Reference**
Omega Omnical 4A & 8A	±3°F	±1.005°F	6.11
Omega CL-505A	±3°F	±1.005°F	6.11

5.6 Recommendations

5.6.1 Subsequent to this calculation's approval, revise FSAR Table 7.3.2 as per Attachment K.

5.6.2 In order to support Analytical Limits of 200°F and 196°F, revise OP 4366 in accordance with Table 8 and Table 9.

5.6.3 Ensure that a calibration tracking system exists to evaluate consequences of a calibration interval greater than 684 days. [Note: There are no plans to extend the calibration interval beyond 684-days].

5.6.4 Revise the minor FSAR Figure 7.3-5b discrepancy regarding HPCI/RCIC temperature switch sets. The following discussion relates to RCIC; HPCI is comparable. There are four sets of four sensors, each set providing HELB detection protection to specific plant areas (one set covers the steam tunnel and three sets cover various zones of the Reactor Building.) This is shown in block diagram form in FSAR Figure 7.3-5b. The block diagram section regarding the Reactor Building sensor sets refers parenthetically to "typical of four located outside steam tunnel." This should be "typical of three..."

5.6.5 Add VYC-462C to the List of References in OP-4366.

5.6.6 Evaluate the acceptability of an analysis limit that is less than the Technical Specification Limit for an increasing trip setpoint.

5.6.7 Revise Section 7.5.3 of the EQ manual, various places, which indicates 200°F as the isolation trip setting. This should be the nominal setpoint of 196°F as implemented by the HELB analysis. The 200°F applies to the steam tunnel only.

5.6.8 Close PORC follow item PFI9604101 (Attachment R).

5.7 VYDEP-15 Criteria

VYDEP-15 requires the impact to plant programs, procedures and licensing and design documents are considered. This calculation has been reviewed for impact considerations. To fully satisfy VYDEP-15 requirements, this calculation undergoes a review of all departments and programs that could be impacted by the results and conclusions.

The following has been considered and is either addressed in this analysis or via the interdepartmental review process:

- FSAR changes
- Technical Specifications (custom and improved Technical Specifications)
- Procedures
- Technical programs
- Prints
- Related Design Basis Calculations (input/output)
- Design Basis Documents

Based on the above, all impact considerations of VYDEP-15 are addressed.

5.8 Evaluation of Existing Setpoint

The temperature switches located inside and outside the steam tunnel are acceptable for the full surveillance interval with a setpoint of 185°F.

6.0 REFERENCES

6.1 "Instrument Uncertainty and Setpoint Design Guide," Vermont Yankee, Revision 0.

6.2 WE-103, "Engineering Calculations and Analyses," Revision 17 .

6.3 Vermont Yankee Final Safety Analysis Report. Section 7.3.4.

6.4 Vermont Yankee Technical Specifications, through Amendment 150.

6.5 Vermont Yankee Project Procedure VYDEP-15, "Calculations," Revision 2.

6.6 OP 4366, "RCIC Steam and Space High Temperature Functional/Calibration Test," Revision 12.

6.7 Vermont Yankee Environmental Qualification Program Manual, Revision 36.

6.7.1 QDR 9.4, Revision 10.

6.7.2 EQDI 95-55, "Draft EQ Manual Revision."

6.8 VYEM 0029, "Instructions for Patel Temperature Switches," Revision 0.

6.9 "Selected Definitions and Clarifications Associated with the Vermont Yankee Technical Specification."

6.10 VYC-1599, "Drift Calculation for Fenwal Temp SW Models 01-170020-090 and 01-170230-090," Revision 1.

6.11 VYC-1758, "Measuring and Test Equipment Uncertainties Calculation," Revision 0.

6.12 Memo, Hengerle to File, "Improved Setpoint Program/CTS vs ITS Setpoint Evaluation," VYI 37/97, dated April 25, 1997.

6.13 Memo, Hengerle to Distribution, "Application of CT, CE and A for Single Point Devices," VYI 92/97, Revision 1, dated June 26, 1998.

6.14 MPAC.

6.15 VYC-462, "Fenwall (sic) Temperature Switch Loop Accuracy Review," Revision 2.

6.16 "Instrument Data Sheets," GE Drawing 225A5600, Sheet 98, Revision 0.

6.17 "Nuclear Power Reactor Instrumentation Systems Handbook," Volume 1, Joseph Harrer and James Beckerly.

6.18 NED Analysis Matrix, dated January 21, 1998.

6.19 Plant Drawings:

6.19.1 Flow Diagram, RCIC System, G-191174, Sh 1, Revision 33.

6.19.2 CWD-1179, "RCIC Logic System," Revision 15.

6.19.3 CWD-1180, "RCIC Logic System," Revision 16.

6.19.4 CWD-748, "Steam Leak Detection System," Revision 5.

6.20 VYC-1347 Revision 0, "Main Steam Tunnel Heatup Calculation"

6.21 Safety Class Worksheet [for RCIC temperature switches dated 10-20-98]

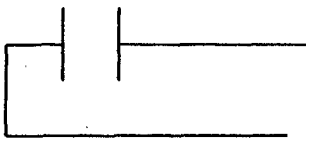
6.22 Memo VYE 98/214, G.J. Hengerle/E. Goodwin to R.T. Vibert, "Assessment of VYC-462A,C & D Temperature Limits", October 5, 1998.

7.0 ATTACHMENTS

Attachment A, Loop Block Diagram
Attachment B, NED Analysis Matrix Excerpt
Attachment C, MPAC Data Excerpt
Attachment D, Vendor Data, VYEM 0029 Excerpt
Attachment E, Calibration Data, OP 4358 Excerpt
Attachment F, MTE Accuracies, VYC-1758 Excerpt
Attachment G, EQ Manual and QDR Excerpt
Attachment H, Analyzed Drift Data, VYC-1599 Excerpt
Attachment I, CTS Data
Attachment J, FSAR Data
Attachment K, FSAR Table 7.3.2 Proposed Markup
Attachment L, VY Project Memorandum VYI 37/97 and VYI 92/97
Attachment M, GE Instrument Data Sheets
Attachment N, Type K T/C Accuracies, Reference 7 Excerpt
Attachment O, WE-103 Review Sheets and Associated Interdisciplinary Reviews.
Attachment P, Additional QDR Data
Attachment Q, Telecon Record with VYE&C
Attachment R, Procedure Review PORC Memorandum, May 20, 1996
Attachment S, Memo VYE 98/214 and Safety Class Worksheet dated 9-29-98

BLOCK DIAGRAM RCIC HELB

TS – 13 – XXXY



To Relays in
CRP 9 - 30 and 9 - 33

TS	-13	-79A	:	79B	:	79C	:	79D
		-80A	:	80B	:	80C	:	80D
		-81A	:	81B	:	81C	:	81D
		-82A	:	82B	:	82C	:	82D

Note/ Analysis Matrix - Condensed

1/21/98

TAG No.	ENGINEERING FUNCTION	CALC No.	TITLE	VALUE 1	VALUE 2	STPT PU	TS PU
TS-12-101-103, 106 112A, B	Reactor Water Cleanup High Space Temperature Switch - Sensors RWCU Line Break & Closes RWCU Isolation Valves.	VYC-1078	RWCU STEAM TUNNEL			120.0 INC	
		VYC-1169	RWCU SEPARATOR ROOM			120.0 INC	
		VYC-1227	RWCU HEAT EXCHANGER ROOM			120.0 INC	
		VYC-1463	EQ UPDATE			120.0 INC	
		VYC-147	RWCU RETURN LINE			120.0 INC	
		VYC-1422	RWCU NEW - BREAKS			120.0 INC	
		VYC-462	FENWALL TEMPERATURE SWITCH LOOP ACCURACY REVIEW	± 16.0 DEG F	± 16.0 DEG F	120.0 INC	
TS-13-79-82A-D	Steam Line Areas - Temperature Switch - Auto Isolation of RCIC Steam Lines	PROPOSED	ORIG PROP ANALYTICAL LIMITS	218°F	Chgd to 196°F	185.0 INC	<=212.0
		VYC-1463	EQ UPDATE			185.0 INC	<=212.0
		VYC-848	RCIC BREAKS	196°F (Proposed)		185.0 INC	<=212.0
		VYC-1334	SMALL STEAM BREAKS (ASSESS)			185.0 INC	<=212.0
		VYC-286	EQ STEAM TUNNEL - MSLB IN STM TUNNEL HPCI/RCIC BREAKS			185.0 INC	<=212.0
		VYC-462	FENWALL TEMPERATURE SWITCH LOOP ACCURACY REVIEW	± 6.0 DEG F	± 6.0 DEG F	185.0 INC	<=212.0
TS-2-121-124A-D	Main Steam Line Area High Temperature Switch (Steam Tunnel) - PCIS Group 1	PROPOSED	ORIG PROP ANALYTICAL LIMITS	218°F	Chgd to 196°F	185.0 INC	<=212.0
		VYC-1463	EQ UPDATE			185.0 INC	<=212.0
		VYC-286	EQ STEAM TUNNEL - MSLB IN STM TUNNEL HPCI/RCIC BREAKS	196		185.0 INC	<=212.0
		VYC-462	FENWALL TEMPERATURE SWITCH LOOP ACCURACY REVIEW	± 6.0 DEG F	± 6.0 DEG F	185.0 INC	<=212.0
TS-23-101-104A-D	HPCI Steam Line Area Temperature Switches - Auto Isolation of the HPCI Steam Isolation Valves.	PROPOSED	ORIG PROP ANALYTICAL LIMITS	218°F	Chgd to 196°F	185.0 INC	<=212.0
		VYC-846	HPCI ROOMS	196°F (Proposed)		185.0 INC	<=212.0
		VYC-1463	EQ UPDATE			185.0 INC	<=212.0
		VYC-1334	SMALL STEAM BREAKS (ASSESS)			185.0 INC	<=212.0
		VYC-286	EQ STEAM TUNNEL - MSLB IN STM TUNNEL HPCI/RCIC BREAKS			185.0 INC	<=212.0
		VYC-462	FENWALL TEMPERATURE SWITCH LOOP ACCURACY REVIEW	± 6.0 DEG F	± 6.0 DEG F	185.0 INC	<=212.0

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
Rev 0
ATTACHMENT B PAGE 1 OF 1

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. YYC-462C
REV 0
ATTACHMENT C PAGE 1 OF 3

15:53:34 Mar 10 1997 EQUIPMENT INQUIRY PAGE 1 OF 11

	EQUIPMENT NO ...	TS-13-79A	
1.	KEYWORD	SWITCH	
2.	QUALIFIER	TEMPERATURE	
3.	DESCRIPTION	RCIC STEAM LEAK DETECTION; FLOW DIAG: G-191174 SH 1; MFG: FENWAL; MODEL: 01-170230-09; SERIAL NO.: YA-58; CWD: 1180	
4.	LOCATION	REACTOR 287' W	
5.	SYSTEM ID	RCIC	16. DESIGN PRESS .....
6.	PARENT ID NO ...		17. DESIGN TEMP .....
7.	EQUIPMENT TYPE .	TEMP SWITCH	18. SIZE .....
8.	INSPECTION TYPE.		19. ERFIS .....
9.	PRIORITY	1	20. OPS SYS ACRONYM ..
10.	PM NOTICE (Y/N).	N	21. CWD 1180
11.	MANUFACTURER ...	FENWAL	
12.	SERIAL NO	YA-58	22. SURV PROCEDURE ... OP4366
13.	MODEL NO	01-170230-09	23. MNT PROCEDURE ....
14.	DRAWING NO	G-191174 SH 1, L-2	24. VYEM 0029
15.	LAST REVISION ..		

WHICH ONE ? (E=EXIT, P#=PAGE)

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
REV D
ATTACHMENT C PAGE 2 OF 3

15:53:55 Mar 10 1997 EQUIPMENT NOTES INQUIRY PAGE 6 OF 11
4 LINES SCREEN 1 OF 1

EQUIPMENT NO ... TS-13-79A SWITCH,TEMPERATURE

CABLE #11180B
****
NAME PLATE DATA: RANGE: -100 DEG F TO +600 DEG F CONTACTS CLOSE ON HIGH TEMP RATING: 5A - 115 VAC .5A - 115 VDC THERMOSWITCH

WHICH ONE ? (E=EXIT, P#=PAGE, S#=SCROLL)

15:54:26 Mar 10 1997 EQUIPMENT ENGINEERING DATA INQUIRY PAGE 10 OF 11

EQUIPMENT NO ... TS-13-79A 000
DESCRIPTION .... SWITCH,TEMPERATURE,MASTER EQUIPMENT

1. SAFETY CLASS . SCE
2. VERIFIED BY ..
3. SAFETY CLASS BASIS: QDR-9.4

APPLICABLE PROGRAMS

4. EQ PROGRAM ..... Y
5. APPENDIX J ..... N
6. ISI ..... N
7. IST ..... N
8. FIRE PROGRAM ...
9. MOV PROGRAM ....
10. SEISMIC .....
11. SQUG .....
12. APP. R SAFE S/D .....
13. REG. GUIDE 1.97 .....
14. MECHANICAL RAD QUAL .

WHICH ONE ? (E=EXIT, P#=PAGE, N=NEXT, H=SCREEN HELP, H#=ITEM HELP)

EQUIPMENT MANUAL COVER SHEET

EQUIPMENT MANUAL

TITLE: Instructions for Patel Temperature Switches

MODEL: 01-170020-090 & 01-170230-090

VYEM No.: 0029

Vendor: Patel Engineers

Vendor Manual No.: N/A Rev.: N/A Date: N/A

System Title(s): Nuclear Boiler (2), Reactor Water Cleanup (12), Reactor Core Isolation Cooling (13), High Pressure Coolant Injection (23)

Safety Classification of Manual: Safety Related

Tag No.(s): See Applicability List

VYEM Cover Sheet:

VYEM Rev. No.: 0

VYEM Rev. Date: 05/26/89

APPLICABILITY LIST

INSTRUMENT NO.	MODEL NO.	COMPONENT DESCRIPTION
TS-2-121 A,B,C,D	01-170020-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-2-122 A,B,C,D	01-170020-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-2-123 A,B,C,D	01-170020-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-2-124 A,B,C,D	01-170020-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-12-(101-103)A,B	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-12-(106-112)A,B	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-13-79 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-13-81 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-13-80 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-13-82 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-23-101 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-23-102 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-23-103 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection
TS-23-104 A,B,C,D	01-170230-090	Thermoswitch Temperature Controller Steam Leak Detection

EQUIPMENT MANUAL VENDOR CONTACT SHEET

VYEM No.: 0029

Manual Title INSTRUCTIONS FOR PATEL TEMPERATURE SWITCHES

Vendor EGS

Address 301 150 West Park Loop
Suite Street P.O. Box

Huntsville ALABAMA 35806
City State Zip

Contact Gary Elam / ENG /
Name Title Dept.

Phone No. 205-722-8500

1. Is the vendor still in business? NOT PATEL Sold LINE-No Longer Support (Y/N) N
2. Is the vendor information/VYEM up to date for currently installed components? (Y/N) Yes
3. Are there supplemental data sheets, tech. bulletins, etc.? (Y/N) N

   Will vendor send the required data? (Y/N) N/A
4. Indicate below data necessary to update manual.

ITEM	MFG. NO.	DATE	COST

Comments (Attach Additional Sheets if Required)
EGS formerly PATEL - SWITCHES NO LONGER Supported. ENGINEERING STAFF OF PATEL NOW AT EGS. GARY ELAM STATED THAT NO Changes have been MADE TO SWITCH AS FAR AS HE KNOWS. NO FURTHER INFORMATION WILL BE AVAILABLE from EGS (PATEL)

Cognizant Person: S Wendt Date: 8/20/91

INSTRUCTIONS FOR PATEL TEMPERATURE SWITCHES

Testing and Adjustment

The arrow on the head of the temperature switch unit indicates the direction to turn the adjusting screw to increase the temperature setting. (Torque in excess of 15 inch pounds on adjusting screw will deform slot.)

Each full turn of the adjusting screw will change the temperature the approximate number of degrees as follows: (Important: Before making temperature adjustments, release locking device (1/2 turn) otherwise adjusting screw threads will be damaged.)

Adjustment Rates for Temperature Switches

Tension Operated			Compression Operated	
Catalog Number	Approx. °F per full turn of adj. screw		Catalog Number	Approx. °F per full turn of adj. screw
01-~~010~~-170020-090	175		01-~~010~~-170230-090	101

After the temperature switch unit has been installed, final adjustment can be made by allowing the unit to operate for several cycles to permit the controlled system to stabilize and then adjust to desired temperature. After adjustment the system should be allowed to recycle several more times before checking the setting.

Where extremely accurate temperature control is desired, several readjustments may be necessary to stabilize the temperature switch after which the adjustment will be maintained.

Contact Protection

Capacitors are not required under average conditions. For smoother control at small loads, on D.C. applications, or to prevent contact bounce due to vibration, the following chart is recommended as a guide:

Current	Service	Capacitance MFD
120VAC	Resistance	None required
120VAC or DC	Relays, Magnetic contactors	.001 to .01
15-25VAC or DC	Relays	.02
120VAC	Motor	Use relay

NOTE: Capacitors should be wired in parallel with thermostat lead connections.

If Testing Temperature Set Point is Required

All Temperature Switch units are set at room temperature (75°F ± 15°F) unless otherwise specified. Testing the temperature set point of a Temperature Switch in an application or under conditions where the heat source is remotely located from the Temperature Switch, or where ambient temperature conditions are significantly above or below 75°F, may give misleading results.

DATED 9/10/84 FROM: TOM HANCOCK - PATE
TO: T.J.O.

ATTACHMENT 1

CALIBRATION AND VERIFICATION PROCEDURE

FOR PATEL TEMPERATURE SWITCHES

1. Insert the THERMOSWITCH (adjusting screw end down) into the standard (5/8") hole in the heater block of the Fenwal Test Kit Model Number 80001-0.

2. Connect the receptacle leads to the THERMOSWITCH unit leads.

3. Install a calibrated thermocouple in the heater block access hole.

4. Set control switch #2 on "Regular" for P/N 01-170020-090 and on "Inverse" for P/N 01-170230-090.

5. Set the control switch #3 on "LOW" for switches with set points 68°F to 200°F and on "HIGH" for set points greater than 200°F.

6. Set control switch #1 on the "ON" position. The line pilot light will light.

7. When the temperature approaches the set point of the THERMOSWITCH, the system will begin to cycle as denoted by the heater pilot light going "ON" and "OFF." Allow the THERMOSWITCH to stabilize at set point for 10 to 15 minutes; then take six (6) successive readings at make of contacts (heater light "OFF" for inverse unit, P/N 01-170230-090; heater light "ON" for regular units, P/N 01-170020-090). Average of six (6) readings indicates set point of the THERMOSWITCHES.

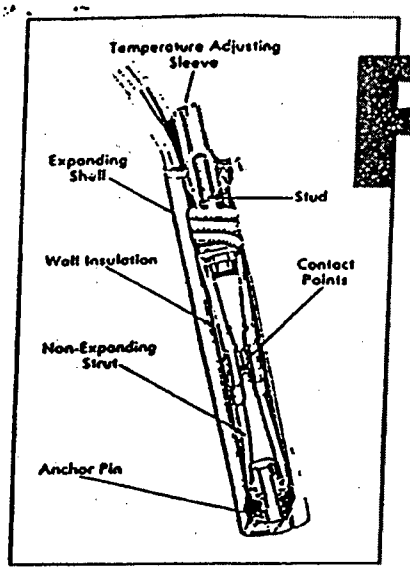
8. If any two of the six (6) readings recorded in Step 7 vary by more than 5°F, the THERMOSWITCH should be returned to Patel for recalibration, or replacement, during the standard eighteen-month warranty period.

REFERENCE ONLY!

SEE APPLICABLE PLANT PROCEDURE FOR CALIBRATION

ATTENTION: TO ASSURE SAFE AND PROPER PERFORMANCE READ THESE INSTRUCTIONS

1.10.N



FENWAL®

THERMOSWITCH® TEMPERATURE CONTROLLERS
INSTRUCTIONS

GENERAL INFORMATION

The shell of each THERMOSWITCH unit contains the catalog number, the current rating, the temperature range and the contact arrangement.

The fifth digit of the catalog number describes whether contacts open or close on temperature rise. If contacts open on temperature rise, the fifth digit of the catalog number is an even number such as 17000, 17002, etc. If contacts close on temperature rise, the fifth digit is an odd number such as 17021, 17023, etc.

UL Component recognized units will either have a "4" as the first digit (47002, etc.) or will bear the new UL logo and utilize a 17000 series catalog number (17021, etc.).

The fourth digit of the catalog number will quickly determine whether the unit is tension or compression operated.

Tension operated indicates that the contacts are operated by exerting tension on the ends of the strut mechanism. If the fourth digit is other than "2" or "7" (such as 17000, 17030, etc.) it is tension operated. Tension operated units may be subjected to momentary temperature exposure of 100°F above their set point within their temperature range, or subjected to any temperature below their set point without damage.

Compression operated indicates that the contacts are operated by varying the compressive force on the ends of the strut mechanism. If the fourth digit is "2" or "7" (such as 17021, 17071, etc.) it is compression operated. Compression units are recommended if overshoots are to be encountered. The compression feature allows overshooting low temperature units up to 500°F and high temperature units up to 700°F for intervals not exceeding one hour.

INSTALLATION

Fenwal THERMOSWITCH® units are supplied in five basic head configurations — Cartridge, Block Head, Hex Head, Coupling Head and Circular Flange.

To avoid restricting shell expansion or contraction when making installations in solid metal blocks, a 5/8" diameter reamed hole for 5/8" diameter units or a 13/16" diameter reamed hole for 13/16" diameter heavy duty units, is recommended. See specific controller style listing for additional installation instructions.

1 Cartridge (includes moisture resistant high and low temperature units, A and C.) Hole should have short spline to receive the 1/8" locating pin. This prevents the cartridge unit from rotating when the adjusting sleeve is turned. It may also be used for surface control if inserted into a Fenwal surface mounting block (Cat. No. 11100-2).

2 Block Head — is mounted in a similar manner to the cartridge type. If the unit is to be inserted into a reamed hole, two short pins should be mounted on either side of the hole. The pins should rest against the sides of the block head to prevent rotation of the unit.

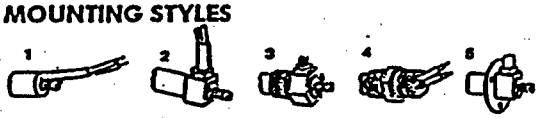
3 and 4 Hex and Coupling Head (includes hex-head moisture resistant high and low temperature units, B and D) — can be installed like any pipe fitting. Avoid applying undue torque to the unit. Torque in excess of 35-foot pounds for the standard size (5/8" diam. shell) or 70-foot pounds for the heavy duty unit (13/16" diam. shell) will offset the present temperature of the control.

When Teflon® tape lubricant is used, torque in excess of 4-foot pounds for the standard size controller or 8-foot pounds for the heavy duty unit will offset the preset temperature of the control.

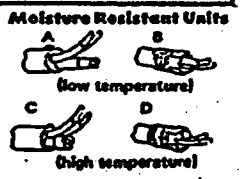
If the threaded units are installed in a pipe tee, the tee should be large enough to allow adequate circulation of the fluid around the temperature sensitive section of the unit.

5 Circular Flange — Three holes in flange allow for easy mounting on any flat surface.

MOUNTING STYLES



Moisture Resistant Units



CAUTION!

DO connect THERMOSWITCH controller leads in series with the load and power supply.

DO be certain that there is sufficient but not excess room for the installed THERMOSWITCH unit to expand in diameter and length.

DO use stainless steel heliarc welded thermowells, (Series 11100, 11200) or various platings or coatings which may increase controller life where corrosion or electrolysis is suspect.

DO insulate head of the THERMOSWITCH unit where large external temperature variation may occur. This precaution is not necessary on the junction box type. (Series 17700, 17800).

DON'T immerse your unit in liquids or vapors unless it was specified for that job.

DON'T exceed the ratings indicated on THERMOSWITCH unit shell.

DON'T thermally shield unit from medium being controlled.

DON'T *remove adjusting screw or turn adjusting screw in further than necessary for desired operation. This action may permanently damage the unit and may void standard Fenwal warranty!*

DON'T oil your unit. Oil around adjusting screw will flow inside, contaminating contacts.

DON'T allow moisture buildup in head cavity area of 37X0X0-000 Moisture Resistant Units. Where excessive moisture is a problem, specify Special Feature 01-982039-00X when ordering.

DON'T try to repair unit yourself.

DON'T handle unit with pliers or force it into position either by hand or tools, or apply excessive torque in tightening threaded units.

DON'T subject shell of unit to deformation.

NOTE:

Certain gases or liquids including water at elevated temperature could be corrosive and may also cause electrolytic action, which could severely shorten the life of the controller.

The rate of corrosion or electrolysis is influenced by a great many system parameters such as chemical makeup and temperature of the solution, stray electric currents, etc. Consult the supplier of your chemicals or the factory for suggestions.

A

TESTING AND ADJUSTMENT

The arrow on the head of THERMOSWITCH unit indicates direction to turn adjusting screw to increase temperature setting. Torque in excess of 15 inch pounds on adjusting screw will deform slot.

Each full turn of adjusting screw will change the temperature the approximate number of degrees as follows:

ADJUSTMENT RATES for THERMOSWITCH UNITS			
Tension Operated		Compression Operated	
Catalog Series Number	Approx. F° per full turn of adj. screw	Catalog Series Number	Approx. F° per full turn of adj. screw
—	—	13121-1	1000
15050 to 16051	165	—	—
17000 to 17503	90-115	17020 to 17523	90-100
17700 to 17701	145	17720 to 17721	85
17702 to 17703	180	17722 to 17723	100-150
17800 to 17801	125	17820 to 17821	75
17802 to 17803	160	17822 to 17823	115
18000 to 18003	80-100	18020 to 18023	70-135
01-37XXXX0-000	90		

After the THERMOSWITCH unit has been installed, final adjustment can be made by allowing the unit to operate for several cycles to permit the controlled system to stabilize and then adjust to desired temperatures. The system should then be cooled to ambient temperature, reheated and stabilized to check the setting.

To adjust a high temperature moisture resistant THERMOSWITCH unit (Cat. No. 01-370020-000) it is necessary to remove the seal cap. A screwdriver adjustment is then made internally. *Use caution when making adjustments at temperature extremes.*

Where extremely accurate temperature control is desired several readjustments may be necessary to stabilize the THERMOSWITCH control after which the adjustment will be maintained.

CONTACT PROTECTION

Capacitors are not required under average conditions. For smoother control at small loads, on D.C. applications or to prevent contact bounce due to vibration, the following chart is recommended as a guide:

Voltage	Service	Capacitance MFD w/600VAC Rating
120 V.A.C.	Resistance	None required
240 V.A.C.	Resistance	.1
120 or 240 V.A.C. or D.C.	Relays, Magnetic Contactors	.001 to .01
15 — 25 V.A.C. or D.C.	Relays	.02
120 or 240 V.A.C	Motor	Use Relay

NOTE: Capacitors should be wired in parallel with thermostat lead connections.

TESTING TEMPERATURE SET POINT

The Set Point Temperature is the temperature at which the contacts on a THERMOSWITCH unit just "make" (close). All THERMOSWITCH units are set at room temperature (75°F ± 15°F) unless otherwise specified in which case they are factory preset at any specified temperature within listed temperature range and setting tolerance of THERMOSWITCH unit.

If customer requires testing of temperature set point, it is recommended that testing devices be used similar to those at the factory. An ideal thermal installation may require that the THERMOSWITCH unit be located as near as possible to the heat source. Testing the temperature set point of a THERMOSWITCH unit in an application or under conditions where heat source is remotely located from THERMOSWITCH unit, or when ambient temperature conditions are far below or above 75°F, may give misleading results. In some cases, this has led to rejection of units which were actually within proper setting tolerance. Therefore we recommend the use of a Fenwal Model 80001-0 Test Kit, for testing temperature set points on Fenwal THERMOSWITCH units of the 17XXX, 18XXX and 67XXX Series types.

For customers who wish to build their own test equipment we recommend that you contact your nearest Fenwal Representive. He is equipped to give you further guidance in setting up a good thermal test system.

LIMITED WARRANTY STATEMENT

Fenwal Incorporated represents that this product is free from defects in material and workmanship, and it will repair or replace any product or part thereof which proves to be defective in workmanship or material for a period of twelve (12) months from the date of purchase but not to exceed eighteen (18) months after shipment by the seller. For a full description of Fenwal's LIMITED WARRANTY, which, among other things, limits the duration of warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and EXCLUDES liability for CONSEQUENTIAL DAMAGES, please read the entire LIMITED WARRANTY on the Fenwal Quotation, Acceptance of Order and/or Original Invoice which will become a part of your sales agreement. Defective units should be returned to the factory, Ashland, Massachusetts, shipment prepaid. Fenwal Incorporated will repair or replace and ship prepaid.

M.P.S.S. 7/5/75

FENWAL INCORPORATED
Division of Walter Kidde & Company, Inc.
KIDDE
Ashland, Massachusetts 01721

Dept. Mgr.		Proc. No.	OP 4366
PORC mtg 96053		Rev. No.	12
Plant Mgr.		Issue Date	07/02/96
		Review Date	07/02/98

RCIC STEAM LINE TUNNEL/SPACE HIGH TEMPERATURE FUNCTIONAL/CALIBRATION TEST

PURPOSE

To provide the information necessary for Instrument and Control Department personnel to perform a functional/calibration of the RCIC Steam Line Tunnel and Space High Temperature instruments.

Performance of the Functional Section of this procedure satisfies the Functional Test requirements specified by Technical Specifications in Table 4.2.2.

Performance of the Calibration Section of this procedure satisfies both the Functional and Calibration Test requirements specified by Technical Specifications in Table 4.2.2.

The use classification of this procedure is Continuous Use.

DISCUSSION

The RCIC Steam Line/Space High Temperature monitoring instruments are designed to continuously monitor temperatures around the RCIC Steam Lines and RCIC Area Spaces for steam leaks and isolate RCIC if setpoint temperatures exceeded. The instruments installed for this purpose are FENWAL Thermoswitch Temperature Controllers. These devices have contacts that will actuate from the expansion/contraction response characteristics of metals when exposed to changes in temperature. This isolating system consists of sixteen (16) temperature switches located in four (4) locations with four (4) switches each. The RCIC Steam Line/Space High Temperature instruments are designated as follows:

Instrument Number	Location	Function	Associated Relay
13-79A	Main Steam Line Tunnel	Auto Isolation Signal	13A-K3 CRP 9-30
13-80A	(North)	Auto Isolation Signal	13A-K38 CRP 9-33
13-81A	"	Auto Isolation Signal	13A-K4 CRP 9-30
13-82A	"	Auto Isolation Signal	13A-K39 CRP 9-33
13-79B	Torus-West	Auto Isolation Signal	13A-K44 CRP 9-30
13-80B	(5 ft above catwalk)	Auto Isolation Signal	13A-K45 CRP 9-30
13-81B	"	Auto Isolation Signal	13A-K29 CRP 9-33
13-82B	"	Auto Isolation Signal	13A-K40 CRP 9-33
13-79C	Torus-West	Auto Isolation Signal	13A-K44 CRP 9-30
13-80C	(15 ft above catwalk)	Auto Isolation Signal	13A-K45 CRP 9-30
13-81C	"	Auto Isolation Signal	13A-K29 CRP 9-33
13-82C	"	Auto Isolation Signal	13A-K40 CRP 9-33

Instrument Number	Location	Function	Associated Relay
13-79D	RCIC Pump Room	Auto Isolation Signal	13A-K44 CRP 9-30
13-80D	(15 ft above floor)	Auto Isolation Signal	13A-K45 CRP 9-30
13-81D	"	Auto Isolation Signal	13A-K29 CRP 9-33
13-82D	"	Auto Isolation Signal	13A-K40 CRP 9-33

The functional test is performed by energizing an installed test heater to simulate a steam line break. The calibration test uses a portable test heater installed over the temperature switch that has a permanently mounted thermocouple. The switch is initially preheated to simulate the more uniform heating of the metal sensor that would be experienced with a steam leak/break. The mounted thermocouple is used to measure the actual trip point of the temperature switch.

SURVEILLANCE SETPOINT CRITERIA

Instrument Number	Measured Parameter	Action	Tech Spec Setting	VY Trip Setting
TS-13-79A,B,C,D TS-13-80A,B,C,D TS-13-81A,B,C,D TS-13-82A,B,C,D	SPACE AROUND RCIC STEAM LINES	AUTO ISOLATION SIGNAL	≤212°F	185±5°F

ATTACHMENTS

1. VYOPF 4366.01 RCIC Steam Line Area High Temperature Functional Data Sheet
2. VYOPF 4366.02 RCIC Steam Line Area High Temperature Calibration Data Sheet

REFERENCES

1. Technical Specifications
   a. Tables 3.2.2 and 4.2.2
2. Administrative Limits
   a. AP 0125, Plant Equipment Control
3. Other
   a. GEK-32441, RCIC System
   b. VYNPS FSAR, Sections 4.7, 7.3.4.7.7, 7.3.4.8.7 and Figure 7.3.6
   c. CWD Sheets 1179, 1180
   d. EQ File #13-1
   e. AP 6807, Collection, Temporary Storage and Retrieval of QA Records
   f. AP 0310, Surveillance, Preventative and Corrective Maintenance Program
   g. AP 0047, Work Order Request
   h. RP 4394, Process Temperature Monitoring/Steam Leak Detection System Functional/Calibration

PRECAUTIONS

1. Only one (1) instrument will be calibrated at a time.

2. Ensure that the associated instrument relay is DE-ENERGIZED prior to actuating another temperature switch.

3. If the need for corrective maintenance is determined during the performance of this procedure, initiate a Work Order Request per AP 0047.

4. If this procedure cannot be completed as written, hold at the most secure point, notify the Shift Supervisor and discuss the possible resolution with an I/C supervisor.

PREREQUISITES

1. Measurement and Test Equipment Required:

   a. Test key (13A)
   b. Omega digital thermometer or equivalent for K type (calibration only)
   c. Variac (calibration only)
   d. Test heater (calibration only)
   e. DVM/DMM (calibration only)

2. The station will be in a shutdown condition to perform a calibration test.

3. Environmental Qualification (calibration only):

   a. Review the File EQ 13-1 for any maintenance requirements necessary to ensure continued qualification.

   b. Obtain any parts required to be changed per EQ File instructions.

PROCEDURE

A. FUNCTIONAL TEST

1. *The Shift Supervisor is fully knowledgeable of the scope of this procedure* and by initialing the data sheet, grants his permission to perform the work.

2. Verify that the following associated instrument relays are DE-ENERGIZED:

CRP 9-30	CRP 9-33
13A-K3	13A-K29
13A-K4	13A-K38
13A-K44	13A-K39
13A-K45	13A-K40

3. Insert the panel test jack into the test connection for the instrument to be tested at the heater test panel.

4. Turn power switch ON.

5. Momentarily depress and release the panel test switch.

6. Verify that the panel test lamp is ON.

7. Verify that the CRP 9-30 or 9-33 associated instrument relay ENERGIZES.

8. Immediately upon energization of the CRP 9-30 or 9-33 relay, turn the power switch to OFF.

9. After the temperature switch has cooled down, verify that the CRP 9-30 or 9-33 associated instrument relay DE-ENERGIZES.

10. Remove the panel test jack from the switch test connection.

11. Repeat Steps A.3 through A.10 for the remaining instruments.

12. After functional testing is complete, ensure power is OFF and test lead is disconnected on the heater test panel.

13. On completion of functional test, proceed to Final Conditions.

B. CALIBRATION

NOTE

Calibration will be done in conjunction with applicable sections of RP 4394.

1. The Shift Supervisor is fully knowledgeable of the scope of this procedure and by initialing the data sheet, grants his permission to perform the work.

2. Establish phone communication between the temperature switch location, CRP 9-30 and 9-33.

3. Verify that the following associated instrument relays are DE-ENERGIZED:

CRP 9-30	CRP 9-33
13A-K3	13A-K29
13A-K4	13A-K38
13A-K44	13A-K39
13A-K45	13A-K40

NOTE

Calibration of temperature switches can be subject to the influence of test conditions such as orientation of the heater, thermocouple location and speed of temperature change. Be as consistent as possible with testing methodology in order to minimize unwanted influences.

4. Connect the M/TE to the thermocouple (which is attached to side of temperature switch) for switch being tested.

5. Place test heater over Fenwal temperature switch being tested.

6. Turn the Variac ON with an AC power setting of 30 volts AC (measured with DVM).

7. When switch actuates, turn OFF Variac and remove test heater.

8. Set Variac to an AC power setting of 26 volts AC (measured with DVM).

9. Allow Fenwal temperature switch to reset and cool to ~150°F.

10. Re-install test heater and turn on Variac.

11. Record the As-Found reading when switch actuates.

    Required: 185 ± 5°F

12. Verify the associated instrument relay ENERGIZES.

13. Turn the Variac OFF and remove Test Heater (allowing switch to cool down) and verify the associated instrument relay DE-ENERGIZES after temperature switch resets.

14. If recalibration is necessary, adjust the switch to trip at the temperature settings specified in Step B.11. Repeat Steps B.8 through B.14 as required. Record the "As-Left" readings.

15. Repeat Steps B.3 through B.14 for the remaining temperature switches.

16. After all calibrations are complete, ensure Variac is OFF and Test Heater is removed.

17. Applicable environmental qualification requirements, listed in the Reference EQ File, have been satisfied.

18. On completion of the calibration, proceed to Final Conditions.

ACCEPTANCE CRITERIA

1. Successful operation of all temperature switches and relays.
2. Setpoint values shall be within the tolerance as specified on the data sheet.
3. All applicable EQ requirements are satisfied.

FINAL CONDITIONS

1. Notify the Shift Supervisor on completion of functional/calibration test and of any discrepancies.
2. Return the completed VYOPF 4366.01 and/or VYOPF 4366.02 to an I/C supervisor for review (AP 0310) and filing in accordance with AP 6807.

TITLE: RCIC STEAM LINE AREA HIGH TEMPERATURE FUNCTIONAL DATA SHEET

STEP	REQUIRED							
1.	SS Permission							
2.	CRP 9-30/9-33 Associated Relays DE-ENERGIZED							
	Temp Switch #	13-79A		13-80A		13-81A		13-82A	
7.	Relay ENERGIZED	13A K3		13A K38		13A K4		13A K39	
9.	Relay DE-ENERGIZED	13A K3		13A K38		13A K4		13A K39	
	Temp Switch #	13-79B		13-80B		13-81B		13-82B	
7.	Relay ENERGIZED	13A K44		13A K45		13A K29		13A K40	
9.	Relay DE-ENERGIZED	13A K44		13A K45		13A K29		13A K40	
	Temp Switch #	13-79C		13-80C		13-81C		13-82C	
7.	Relay ENERGIZED	13A K44		13A K45		13A K29		13A K40	
9.	Relay DE-ENERGIZED	13A K44		13A K45		13A K29		13A K40	
	Temp Switch #	13-79D		13-80D		13-81D		13-82D	
7.	Relay ENERGIZED	13A K44		13A K45		13A K29		13A K40	
9.	Relay DE-ENERGIZED	13A K44		13A K45		13A K29		13A K40	

Discrepancies/Remarks:

Tested By: Date:

hift Supervisor Review: Date:

I/C supervisor Review: Date:

TITLE: RCIC STEAM LINE AREA HIGH TEMPERATURE CALIBRATION DATA SHEET

STEP	REQUIRED								
1.	SS Permission								
3.	CRP 9-30/9-33 DE-ENERGIZED								
	Temp Switch #	13-79A		13-80A		13-81A		13-82A	
11.	As-Found Temperature								
12.	Relay ENERGIZES	13A K3		13A K38		13A K4		13A K39	
13.	Relay DE-ENERGIZES	13A K3		13A K38		13A K4		13A K39	
14.	As-Left Temperature 180 to 190°F								
	Temp Switch #	13-79B		13-80B		13-81B		13-82B	
11.	As-Found Temperature								
12.	Relay ENERGIZES	13A K44		13A K45		13A K29		13A K40	
13.	Relay DE-ENERGIZES	13A K44		13A K45		13A K29		13A K40	
14.	As-Left Temperature 180 to 190°F								
	Temp Switch #	13-79C		13-80C		13-81C		13-82C	
11.	As-Found Temperature								
12.	Relay ENERGIZES	13A K44		13A K45		13A K29		13A K40	
13.	Relay DE-ENERGIZES	13A K44		13A K45		13A K29		13A K40	
14.	As-Left Temperature 180 to 190°F								
	Temp Switch #	13-79D		13-80D		13-81D		13-82D	
11.	As-Found Temperature								
12.	Relay ENERGIZES	13A K44		13A K45		13A K29		13A K40	
13.	Relay DE-ENERGIZES	13A K44		13A K45		13A K29		13A K40	
14.	As-Left Temperature 180 to 190°F								
17.	EQ Req.								

Attachments:

1	3	Pgs	14	1	Pg	27	3	Pgs
2	1	Pg	15	4	Pgs	28	6	Pgs
3	14	Pgs	16	2	Pgs	29	6	Pgs
4	56	Pgs	17	3	Pgs	30	4	Pgs
5	11	Pgs	18	4	Pgs	31	7	Pgs
6	25	Pgs	19	4	Pgs	32	4	Pgs
7	1	Pg	20	4	Pgs	33	5	Pgs
8	18	Pgs	21	8	Pgs	34	1	Pg
9	1	Pg	22	8	Pgs	35	1	Pg
10	5	Pgs	23	2	Pgs	36	1	Pg
11	7	Pgs	24	3	Pgs	37	1	Pg
12	19	Pgs	25	4	Pgs	38		Pg
13	4	Pgs	26	12	Pgs			

Total Pages: 53 +

QA RECORD?

☒ YES

☐ NO

ORIGINAL: PAGE 1 OF 53 PAGES
Rev 1: PAGE 1 OF ____ PAGES
Rev 2: PAGE 1 OF ____ PAGES
Rev 3: PAGE 1 OF ____ PAGES

RECORD TYPE NO. 09.C16.004

Safety Class/P.O. NO. _____

YANKEE NUCLEAR SERVICES DIVISION
CALCULATION/ANALYSIS FOR

TITLE MEASURING & TEST EQUIPMENT UNCERTAINTY CALCULATION

PLANT VERMONT YANKEE - CYCLE 19

CALCULATION NUMBER VYC-1758

	PREPARED BY /DATE	REVIEWED BY /DATE	APPROVED BY /DATE	SUPERSEDES CALC. /REV. NO.
ORIGINAL	JHLewis 3/26/98 JH Lewis 3/26/98			
REVISION 1				
REVISION 2				
REVISION 3				

KEYWORDS: Calculation/Uncertainty/Test/Equipment/Multimeter/Gauge/Thermometer/Voltage/Source

COMPUTER CODES: None

EQUIP/TAG NOs.: Refer to Table 1 Equipment Summary

SYSTEMS: M&TE

REFERENCES: Refer to Section 6

MODELS: Ashcroft 1082AS; Brooklyn Thermometer; Electro-Scientific Inc. DB-62, 62, 655, 877, DC-57; Fluke 27, 77, 87, 8062A, 8520A; Helse CM, CMM, 730, 901; HP 3466A, 34401A; Jofra 600S, Omega 4A, 6A, CL-505A, 868F, 2176A; Rosemount Readout Assembly; Transmation 1040

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Revision 4

2.3.9.3. Temperature Effect is based on Max Reading of desired calibration span and not the range of the DMM. [Att. 25]

2.3.9.4. The uncertainties listed by HP for volts and amps AC are frequency dependent. This calculation used the frequency ranges closest to 60Hz for the determination of uncertainty for volts and amps AC. The following table provides a listing of frequencies that were used to calculate the uncertainty for volts and amps AC. [Att. 6]

Table 4 - HP DMM AC Frequency Used

Model	Units	Frequency
HP 3456A	VAC	60Hz - 20kHz
	Amps AC	30Hz - 10kHz
HP 34401A	VAC	10Hz - 20kHz
	Amps AC	10Hz-5kHz

2.3.10. Omega 4A & 8A Omnical Temperature Calibrators

2.3.10.1. Reference Accuracy includes accuracy, stability, conformity, range and reference junction temperature compensation. The 1 year Reference Accuracy specification includes all uncertainties for the device. [Att. 28 & 37]

2.3.10.2. The specifications for the 4A & 8A are the same. The difference between the units is that the 4A covers thermocouple types J, K and T where the 8A covers J, K, T, E, R, S and C. [Att. 28 & 37]

2.3.10.3. Range temperature compensation applies from 14 to 104°F (-10 to 40°C) and is assumed to be included in the Reference Accuracy. [Att. 28]

2.3.10.4. Reference junction compensation of 0.017° per degree is applicable from 95 to 590°F (35 to 150°C) and is assumed to be included in the Reference Accuracy. [Att. 28]

2.3.11. Omega 868F Handheld RTD Thermometers

2.3.11.1. Reference Accuracy includes accuracy, DIN 43760 conformity, repeatability, temperature coefficients (65-82°F), time stability and errors with up to 50Ω of lead resistance. The 1 year Reference Accuracy specification includes all uncertainties for the device if within specified ranges of temperature. [Att. 30 & 37]

2.3.11.2. Three wire accuracy is the same as four wire RTD if contact resistance errors are removed by calibration of instrument plus probe @ 32°F. [Att. 30]

2.3.12. Omega CL-505A Precision Temperature Calibrator

2.3.12.1. Reference Accuracy includes accuracy, maximum linerization error, A/D conversion, internal instrument noise, and cold-junction compensation. The 1 year Reference Accuracy specification includes all uncertainties for the device. [Att. 29 & 37]

2.3.12.2. The resolution specification includes repeatability and other variables but is bounded by the 1 year accuracy specification. [Att. 29 & 37]

2.3.13. Omega 2176A Multipoint Digital Thermometer

2.3.13.1. Reference Accuracy includes accuracy, reference junction compensation (if within range of 59-95°F), repeatability and conformity errors. Excludes thermocouple errors. The 1 year Reference Accuracy specification includes all uncertainties for the device if within specified ranges of temperature. [Att. 31& 37]

5.1.9. Jofra Temperature Calibrator [Att. 7, Ref. 6.1.2]

Table 77 Jofra Temperature Calibrator Total Device Errors (Attachment 7)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	1.7032	2.433%	21.11	1.5723	7.448%
100	1.8244	1.824%	37.78	1.6320	4.320%
150	2.0349	1.357%	65.56	1.7358	2.648%
200	2.2535	1.127%	93.33	1.8442	1.976%
212	2.3069	1.088%	100.00	1.8708	1.871%
250	2.4781	0.991%	121.11	1.9565	1.615%
300	2.7071	0.902%	148.89	2.0720	1.392%
350	2.9395	0.840%	176.67	2.1902	1.240%
400	3.1746	0.794%	204.44	2.3107	1.130%
450	3.4119	0.758%	232.22	2.4332	1.048%
500	3.6508	0.730%	260.00	2.5573	0.984%
550	3.8911	0.707%	287.78	2.6829	0.932%
600	4.1326	0.689%	315.56	2.8098	0.890%
1112	6.6417	0.597%	600.00	4.1533	0.692%

5.1.10. Omega Temperature Devices [Att. 8, Ref. 6.1.2]

Table 78 Omega Omnical 4A Thermocouple Calibrator Total Device Errors (Attachment 8)

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
J	(-)346 to 2192°F	1.005°F	(-)210 to 1200°C	0.608°C
K	(-)328 to 2501°F	1.005°F	(-)200 to 1372°C	0.608°C
T	(-)337 to 752°F	1.005°F	(-)205 to 400°C	0.608°C
	(-)405 to (-)337°F	10.000°F	(-)243 to (-)205°C	5.601°C

Table 79 Omega Omnical 4A mV Calibrator Total Device Errors (Attachment 8)

[illegible]	[illegible]	[illegible]	[illegible]
(-)20 to 20mV	20	0.0552%	0.0110
(-)101.1 to (-)20mV	-20	0.1393%	-0.0279
(-)101.1 to (-)20mV	-50	0.0728%	-0.0364
20 to 101.1mV	20	0.1393%	0.0279
20 to 101.1mV	50	0.0728%	0.0364
(-)20 to 20mV	20	0.0552%	0.0110
(-)101.1 to (-)20mV	-101.1	0.0508%	-0.0513
20 to 101.1mV	101.1	0.0508%	0.0513

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Table 80 Omega Omnical 8A Thermocouple Calibrator Total Device Errors (Attachment 8)

TC Type	Range (°F)	TDE (°F)	Range (°C)	TDE (°C)
J	(-)346 to 2192°F	1.005°F	(-)210 to 1200°C	0.608°C
K	(-)328 to 2501°F	1.005°F	(-)200 to 1372°C	0.608°C
T	(-)337 to 752°F	1.005°F	(-)205 to 400°C	0.608°C
	(-)405 to (-)337°F	10°F	(-)243 to (-)205°C	5.601°C
E	(-)389 to 1832°F	1.005°F	(-)234 to 1000°C	0.608°C
	(-)422 to (-)389°F	5.001°F	(-)252 to (-)234°C	2.802°C
R	(-)58 to 3214°F	2.236°F	(-)50 to 1768°C	1.487°C
S	(-)58 to 3214°F	2.236°F	(-)50 to 1768°C	1.487°C
C	32 to 2192°F	1.414°F	0 to 1200°C	1.166°C
	2192 to 3812°F	2.236°F	1200 to 2100°C	1.487°C
	3812 to 4200°F	3.162°F	2100 to 2315°C	1.972°C

Table 81 Omega Omnical 8A mV Calibrator Total Device Errors (Attachment 8)

Range	Reading	TDE (%Rdg)	TDE (mV)
(-)20 to 20mV	20	0.0552%	0.0110
(-)101.1 to (-)20mV	-20	0.1393%	-0.0279
(-)101.1 to (-)20mV	-50	0.0728%	-0.0364
20 to 101.1mV	20	0.1393%	0.0279
20 to 101.1mV	50	0.0728%	0.0364
(-)20 to 20mV	20	0.0552%	0.0110
(-)101.1 to (-)20mV	-101.1	0.0508%	-0.0513
20 to 101.1mV	101.1	0.0508%	0.0513

Table 82 Omega 888F RTD Thermometer Total Device Errors (Attachment 8)

Range	TDE (°F)	TDE (°F)	TDE (°F)	TDE (°F)	TDE (°F)
(-)150 to 199.9°F	0.419°F	0.528°F	0.538°F	0.547°F	0.578°F
(-)199.9 to (-)150.1°F	1.008°F	1.058°F	1.063°F	1.068°F	1.084°F
(-)360 to 1100°F	2.237°F	2.26°F	2.263°F	2.265°F	2.272°F

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FACILITY: VERMONT YANKEE
DOCKET NO.: 50-271

APPENDIX II

ID NO.: TS-13-79A

SYSTEM COMPONENT EVALUATION WORKSHEET

ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
PARAMETER	SPECIFIED	QUALIFIED	SPECIFIED	QUALIFIED		
Operating Time	RCIC-1H	>1H	001	004	Sequential Test and Eng. Analysis	No
Temperature	300°F	355°F (Peak)	002	004	Simultaneous Test	No
Pressure	4 psig	26 psig (Peak)	002	004	Simultaneous Test	No
Relative Humidity	100%	100%	002	004	Simultaneous Test	No
Chemical Spray	N/A	—	—	—	—	—
Radiation	3.5×10^6R	5×10^7R	003	004	Sequential Test	No
Aging	40Y	40Y Note 2	Note 1	004	Sequential Test and Eng. Analysis	No
Submergence	N/A	—	—	—	—	—

Component:
Temperature Switch

Manufacturer:
Patel-Fenwal

Model or Type:
01-170230-090 (NO)

Location:
Area: Reactor Building - Vol. 41
Elevation: 252'-6"

Flood Level:
Elevation: N/A
Above Flood Level: N/A

Previous Worksheet Number: RCIC-4

System:
Reactor Core Isolation Cooling

Function:
Steam Leak Detection

Service:
TS-13-79A

QDR NO. 9.4
REVISION 6

FACILITY: VERMONT YANKEE
DOCKET NO.: 50-271

APPENDIX II

SYSTEM COMPONENT EVALUATION WORKSHEET

ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
PARAMETER	SPECIFIED	QUALIFIED	SPECIFIED	QUALIFIED		
Operating Time	RCIC-1H	>1H	001	004	Sequential Test and Eng. Analysis	No
Temperature	RCIC-42	355°F (Peak)	002	004	Simultaneous Test	No
Pressure	RCIC-42	26 psig (Peak)	002	004	Simultaneous Test	No
Relative Humidity	100%	100%	002	004	Simultaneous Test	No
Chemical Spray	N/A	—	—	—	—	—
Radiation	1.4×10^6R	5×10^7R	003	004	Sequential Test	No
Aging	40Y	40Y Note 2	Note 1	004	Sequential Test and Eng. Analysis	No
Submergence	N/A	—	—	—	—	—

Component:
Temperature Switch

Manufacturer:
Patel-Fenwal

Model or Type:
01-170230-090 (NO)

Location:
Area: Reactor Building - Vol. 42
Elevation: 213'-9"

Flood Level:
Elevation: N/A
Above Flood Level: N/A

Previous Worksheet Number: N/A

System:
Reactor Core Isolation Cooling

Function:
Steam Leak Detection

Service:
TS-13-79B

QDR NO. 9.4
REVISION 6

FACILITY: VERMONT YANKEE
DOCKET NO.: 50-271

APPENDIX II

ID NO.: TS-13-79C

SYSTEM COMPONENT EVALUATION WORKSHEET

ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
PARAMETER	SPECIFIED	QUALIFIED	SPECIFIED	QUALIFIED		
Operating Time	RCIC-1H	>1H	001	004	Sequential Test and Eng. Analysis	No
Temperature	RCIC-42	355°F (Peak)	002	004	Simultaneous Test	No
Pressure	RCIC-42	26 psig (Peak)	002	004	Simultaneous Test	No
Relative Humidity	100%	100%	002	004	Simultaneous Test	No
Chemical Spray	N/A	—	—	—	—	—
Radiation	1.4×10^6R	5×10^7R	003	004	Sequential Test	No
Aging	40Y	40Y Note 2	Note 1	004	Sequential Test and Eng. Analysis	No
Submergence	N/A	—	—	—	—	—

Component:
Temperature Switch

Manufacturer:
Patel-Fenwal

Model or Type:
01-170230-090 (NO)

Location:
Area: Reactor Building - Vol. 42
Elevation: 213'-9"

Flood Level:
Elevation: N/A
Above Flood Level: N/A

Previous Worksheet Number: N/A

System:
Reactor Core Isolation Cooling

Function:
Steam Leak Detection

Service:
TS-13-79C

FACILITY: VERMONT YANKEE
DOCKET NO.: 50-271

APPENDIX II

ID NO.: TS-13-79D

SYSTEM COMPONENT EVALUATION WORKSHEET

ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
PARAMETER	SPECIFIED	QUALIFIED	SPECIFIED	QUALIFIED		
Operating Time	RCIC-1H	>1H	001	004	Sequential Test and Eng. Analysis	No
Temperature	RCIC-52	355°F (Peak)	002	004	Simultaneous Test	No
Pressure	RCIC-52	26 psig (Peak)	002	004	Simultaneous Test	No
Relative Humidity	100%	100%	002	004	Simultaneous Test	No
Chemical Spray	N/A	—	—	—	—	—
Radiation	3.5×10^6R	5×10^7R	003	004	Sequential Test	No
Aging	40Y	40Y Note 2	Note 1	004	Sequential Test and Eng. Analysis	No
Submergence	N/A	—	—	—	—	—

Component:
Temperature Switch

Manufacturer:
Patel-Fenwal

Model or Type:
01-170230-090 (NO)

Location:
Area: Reactor Building - Vol. 52
Elevation: 213'-9"

Flood Level:
Elevation: N/A
Above Flood Level: N/A

Previous Worksheet Number: N/A

System:
Reactor Core Isolation Cooling

Function:
Steam Leak Detection

Service:
TS-13-79D

PRINTED: 03/08/94 VERMONT YANKEE EQUIPMENT QUALIFICATION MATRIX REVISION: 15
(SORTED BY SYSTEM & TAG NO) REV DATE: 03/08/94

SYSTEM ID: RCIC, REACTOR CORE ISOLATION COOLING SYSTEM

TAG NO.	SERVICES	LOCATION		EQUIPMENT QUALIFICATION MATRIX DATA CAT	TEN1	TEN2	F1	F2	F3	DURATION
SV	REMOTE TURB TRIP/SOL	VOL 52	LOCA:	E	22		6			-
			MS :	E	23		0			-
			HPCI:	C	23		0			-
			RCIC:	C	23		0			-
			RWCU:	E	23		0			-
			HHS :	E	23		0			-
TS-13-79A	HI SPACE TEMP TRIP	VOL 41	LOCA:	E	22	36	6			-
			MS :	C	36	23	0			-
			HPCI:	C	36	23	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	~~E~~ C	23	36	0			-
			HHS :	C	23	36	0			-
TS-13-79B	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	36	23	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			HHS :	C	23		0			-
TS-13-79C	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			HHS :	C	23		0			-
TS-13-79D	HI SPACE TEMP TRIP	VOL 52	LOCA:	E	22	36	6			-
			MS :	E	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	E	23	36	0			-
			HHS :	E	23	36	0			-
TS-13-80A	HI SPACE TEMP TRIP	VOL 41	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	~~E~~ C	23		0			-
			HHS :	C	23		0			-
TS-13-80B	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			HHS :	C	23		0			-

PRINTED: 03/08/94 VERMONT YANKEE EQUIPMENT QUALIFICATION MATRIX REVISION: 15
(SORTED BY SYSTEM & TAG NO) REV DATE: 03/08/94

SYSTEM ID: RCIC, REACTOR CORE ISOLATION COOLING SYSTEM

TAG NO.	SERVICES	LOCATION	EQUIPMENT QUALIFICATION MATRIX DATA	CAT	TEM1	TEM2	F1	F2	F3	DURATION
TS-13-80C	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			RHS :	C	23		0			-
TS-13-80D	HI SPACE TEMP TRIP	VOL 52	LOCA:	E	22	36	6			-
			MS :	E	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	E	23		0			-
			RHS :	E	23		0			-
TS-13-81A	HI SPACE TEMP TRIP	VOL 41	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	~~E~~ C	23	36	0			-
			RHS :	C	23	36	0			-
TS-13-81B	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			RHS :	C	23		0			-
TS-13-81C	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			RHS :	C	23		0			-
TS-13-81D	HI SPACE TEMP TRIP	VOL 52	LOCA:	E	22	36	6			-
			MS :	E	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	E	23		0			-
			RHS :	E	23		0			-
TS-13-82A	HI SPACE TEMP TRIP	VOL 41	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	~~E~~ C	23	36	0			-
			RHS :	C	23	36	0			-

PRINTED: 10/06/95 VERMONT YANKEE EQUIPMENT QUALIFICATION MATRIX REVISION: 16
(SORTED BY SYSTEM & TAG NO) REV DATE: 10/05/95

SYSTEM ID: RCIC, REACTOR CORE ISOLATION COOLING SYSTEM

TAG NO.	SERVICES	LOCATION	EQUIPMENT QUALIFICATION MATRIX DATA	CAT	TBN1	TBN2	F1	F2	F3	DURATION
TS-13-82B	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			HHS :	C	23		0			-
TS-13-82C	HI SPACE TEMP TRIP	VOL 42	LOCA:	E	22	36	6			-
			MS :	C	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	C	23		0			-
			HHS :	C	23		0			-
TS-13-82D	HI SPACE TEMP TRIP	VOL 52	LOCA:	E	22	36	6			-
			MS :	E	23	36	0			-
			HPCI:	C	23	36	0			-
			RCIC:	A	4	36	1			1HR
			RWCU:	E	23		0			-
			HHS :	E	23		0			-
V13-16	VALVE DC STARTER	VOL 30	LOCA:	B	67		3	6		LT
			MS :	C	67		0			-
			HPCI:	C	67		0			-
			RCIC:	A	67		1			LT
			RWCU:	C	67		0			-
			HHS :	C	67		0			-
VAC-PP	GLAND SEAL VAC PP/MTR	VOL 52	LOCA:	E	22		6			-
			MS :	E	23		0			-
			HPCI:	C	23		0			-
			RCIC:	C	23		0			-
			RWCU:	E	23		0			-
			HHS :	E	23		0			-

TABLE 7.5.1 (Continued)

Reactor Building High Energy Line Break Environments

Location & RB Floor Elevation	Pipe Peak Temp. (F) Fig. No.	Steam MSLB Press. Fig. No.	Steam MSLB Humidity Fig. No.	HPCI MSLB Peak Temp. (F) Fig. No.	HPCI MSLB Press. Fig. No.	HPCI MSLB Humidity Fig. No.	RCIC MSLB Peak Temp. (F) Fig. No.	RCIC MSLB Press. Fig. No.	RCIC MSLB Humidity Fig. No.	RHR MSLB Peak Temp. (F) Fig. No.	RHR MSLB Press. Fig. No.	RHR MSLB Humidity Fig. No.	RHR MSLB Peak Temp. (F) Fig. No.	RHR MSLB Press. Fig. No.	RHR MSLB Humidity Fig. No.
Vol. 32 RF RHR Rm. El. 213'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Vol. 34 El. 252'	149 MS-34	MS-34	100%	148 HPCI-34	HPCI-34	100%	N	N	N	146 RHCD-34	N	100%	195 RHR-34	N	100%
Vol. 35 Pers.Ann. El. 252'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Vol. 36 El. 252'	100 MS-36	MS-36	100%	200 HPCI-36	HPCI-36	100%	N	N	N	186 RHCD-36	RHCD-36	100%	156 RHR-36	N	100%
Vol. 37 El. 252'	202 MS-37	MS-37	100%	220 HPCI-37	HPCI-37	HPCI-37	N	N	N	277 RHCD-37	RHCD-37	100%	142 RHR-37	N	100%
Vol. 38 El. 252'	207 MS-38	MS-38	100%	242 HPCI-38	HPCI-38	HPCI-38	134 HPCI / RCIC-38 (Note 4)	HPCI / RCIC-38	100%	288 RHCD-38	RHCD-38	100%	147 RHR-38	N	100%
Vol. 40 CRD Rm.Rm El. 252'	202 MS-40	MS-40	MS-40	270 HPCI-40	HPCI-40	HPCI-40	195 HPCI / RCIC-40 (Note 4)	HPCI / RCIC-40	100%	222 RHCD-40	RHCD-40	100%	170 RHR-40	N	100%
Vol. 41 Ste.Tunnel El. 250	200 MS-41, MS-ST-41 (Note 5)	MS-41	100%	200 HPCI-41, MS-ST-41 (Note 5)	HPCI-41	HPCI-41	211 HPCI / RCIC-41 (Note 4)	HPCI / RCIC-41	100%	227 RHCD-41	RHCD-41	RHCD-41	192 RHR-41	N	100%
Vol. 42 Turb Bm. El. 213'	143 MS-42	MS-42	100%	272 HPCI-42	HPCI-42	HPCI-42	188 RCIC-42	RCIC-42	100%	280 RHCD-42	RHCD-42	100%	154 RHR-42	N	100%
Vol. 43 RF Corner El. 232'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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TABLE 7.5.1 (Continued)

Reactor Building High Energy Line Break Environments

Location & Rb Floor Elevation	Main Steam HELB Peak Temp. (F) Fig. No.	Main Steam HELB Press. Fig. No.	Main Steam HELB Humidity Fig. No.	HPCI HELB Peak Temp. (F) Fig. No.	HPCI HELB Press. Fig. No.	HPCI HELB Humidity Fig. No.	RCIC HELB Peak Temp. (F) Fig. No.	RCIC HELB Press. Fig. No.	RCIC HELB Humidity Fig. No.	RWCU HELB Peak Temp. (F) Fig. No.	RWCU HELB Press. Fig. No.	RWCU HELB Humidity Fig. No.	RHR HELB Peak Temp. (F) Fig. No.	RHR HELB Press. Fig. No.	RHR HELB Humidity Fig. No.
Vol. 44 Torus Rm. El. 213'	129 MS-44	MS-44	100%	206 HPCI-44	HPCI-44	100%	114 RCIC-44	RCIC-44	100%	168 RWCU-44	RWCU-44	100%	176 RHR-44	N	100%
Vol. 45 NE RHR Rm. El. 232'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Vol. 46 Torus Rm. El. 213	148 MS-46	MS-46	100%	226 HPCI-46	HPCI-46	HPCI-46	N	N	N	159 RWCU-46	RWCU-46	100%	144 RHR-46	N	100%
Vol. 47 SE RHR Rm. El. 232'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Vol. 48 Torus Rm. El. 213'	171 MS-48	MS-48	100%	234 HPCI-48	HPCI-48	HPCI-48	113 HPCI / RCIC-48	HPCI / RCIC-48	100%	176 RWCU-48	RWCU-48	100%	132 RHR-48	N	100%
Vol. 49 CRD Pp Rm. El. 232'	191 MS-49	MS-49	100%	254 HPCI-49	HPCI-49	HPCI-49	120 HPCI / RCIC-49	HPCI / RCIC-49	100%	187 RWCU-49	RWCU-49	100%	142 RHR-49	N	100%
Vol. 50 HPCI Rm. El. 213'	N	N	N	266 HPCI-50	HPCI-50	HPCI-50	N	N	N	N	N	N	N	N	N
Vol. 51 SW Corner El. 213'	181 MS-51	MS-51	100%	264 HPCI-51	HPCI-51	HPCI-51	124 HPCI / RCIC-51	HPCI / RCIC-51	100%	184 RWCU-51	RWCU-51	100%	139 RHR-51	N	100%
Vol. 52 RCIC Rm. El. 213'	N	N	N	See Note 3	See Note 3	See Note 3	222 RCIC-52A	RCIC-52B	RCIC-52A	N	N	N	N	N	N
Vol. 53 NE RHR Rm. El. 213'	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

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→ SEE EQDI 95-191 for ←
Pending Changes

For environmental qualification purposes the Steam Tunnel includes Volume 41, as illustrated in Appendix D.

HPCI TURBINE ROOM (Turbine in Standby)

	Below Elev. 230'	Elev. 230' and Above
Average Temperature (°F): (Ref. 58)	100	120
Average Humidity (%):	60	60
Peak Allowable Temperature (°F):	106	140
Pressure:	Ambient	Ambient

For environmental qualification purposes the HPCI Turbine Room includes Volume 50, as illustrated in Appendix D.

RCIC TURBINE ROOM (Turbine in Standby)

Average Temperature (°F):	100
Average Humidity (%):	60
Peak Allowable Temperature (°F):	112
Pressure:	Ambient

For environmental qualification purposes the RCIC Turbine Room includes Volume 52, as illustrated in Appendix D.

TURBINE BUILDING - OCCUPIED AREAS ONLY (EXCEPT AREAS NOTED BELOW)
(Operating and Hot Standby Modes)

Average Temperature (°F):	100
Average Humidity (%):	60
Peak Allowable Temperature (°F):	105
Pressure:	Ambient

TURBINE BUILDING - HEATER BAY AREA (Elev. 272'-6")
(Operating and Hot Standby Modes)

Average Temperature (°F):	125°F
Average Humidity (%):	60%
Peak Allowable Temperature (°F):	130°F
Pressure:	Ambient

TURBINE BUILDING - FRONT STANDARD AREA (Elev. 252'-6")
(Operating and Hot Standby Modes)

Average Temperature (°F):	125°F
Average Humidity (%):	60%
Peak Allowable Temperature (°F):	130°F
Pressure:	Ambient

TURBINE BUILDING - LUBE OIL HALLWAY AREA (Elev. 248')
(Operating and Hot Standby Modes)

Average Temperature (°F):	100°F
Average Humidity (%):	60%
Peak Allowable Temperature (°F):	104°F
Pressure:	Ambient

Note: For components in the vicinity of steam piping, the steam tunnel conditions listed on the previous page should be utilized for aging analysis. Actual measured values (properly documented) may be utilized for specific components when desired.

7.4.2 Radiation

Normal radiation conditions extracted from Reference 4 are listed in Appendix A. This data represents bounding conditions accounting for local

hot spots. Actual measured values (properly documented) may be utilized for specific components when desired.

7.5 DESIGN BASIS ACCIDENT ENVIRONMENTS

7.5.1 Introduction

The tables, figures, and associated notes in Appendix B provide the environmental conditions in many areas of the Reactor Building after a LOCA, MS HELB, HPCI HELB, RCIC HELB, or RWCU HELB.

Note: The Reactor Building temperature and pressure profiles included in Appendix B represent average conditions throughout the applicable volume (or area) of building. When a component is located in the vicinity of a high energy line, it should be reviewed to insure the average volume conditions are appropriate for that component.

Section 7.5.2 summarizes the controlling analyses that form the basis for the HELB environments listed in Table 7.5.1 of Appendix B.

Section 7.5.3 discusses the environmental consequences associated with the HELBs postulated in the steam tunnel and Turbine Building.

Section 7.5.4 addresses all other design basis accidents within the scope of 10CFR50.49.

7.5.2 Summary of Controlling Analyses for HELB Environments

HELB	Location	Computer Run	Remarks
Main Steam	Steam Tunnel	ABGQAEBO	
Feedwater	Steam Tunnel	— N/A —	See Note 5
HPCI (DEG)	Steam Tunnel	ABGQADMJ	See Note 6
HPCI/RCIC (10 GPM)	Steam Tunnel	ABGQAFVR	See Note 7
HPCI	Torus Room	ABGUSHR	See Note 4
HPCI	Turbine Room	ABGUAAO	
RCIC	Torus Room	ABGUHMB	
RCIC	Turbine Room	ABGUAYZ	
RWCU	Pump Cubicles (El. 280')	ABGUMOB	See Notes 2 and 3
RWCU	Heat Exchanger Room (El. 280')	ABGUHPD	

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HELB	Location	Computer Run	Remarks
RWCU	Phase Sep. Room (El. 303')	ABGUSEI	
RWCU	Elev. 318'	ABGUSFX	
RWCU	Return Line (El. 252')	ABGUHYF	
HHS	6" at Elev. 252'	ABGQAJFZ	
HHS	4" at Elev. 252'	ABGQAIJH	
HHS	3" at Elev. 280'	ABGQAEBI	
HHS	3" at Elev. 303'	ABGQAEBU	
HHS	3" at Elev. 318'	ABGQABWW	
HHS	3" at Elev. 345'	ABGQAGBQ	

Notes: 1) Unless otherwise noted, an initial average Reactor Building temperature of 100°F was used in analysis.

2) This computer analysis used an initial average Reactor Building temperature of 90°F. The difference between 90°F and 100°F starting temperature has been either incorporated into affected curve (Appendix B) or, the effect of using this lower initial temperature has been judged to be minimal in regard to calculated peak HELB temperatures. See Table 7.5.2, Appendix B.

3) This RWCU HELB analysis postulated a break in the pump suction piping and assumed forward flow only due to the pump discharge check valve. All other RWCU analyses assumed a system blowdown after isolation valve closure.

4) This analysis assumes the concrete block walls of NW stairwell enclosure fail on all floors. A design change to strengthen the block walls and provide a vent path to El. 345' has been done. The environments from this analysis are equal to or more severe in all areas of the Reactor Building than the environments calculated based upon the block wall fix.

5) A main steamline break in the steam tunnel (Volume 41) was analyzed by the RELAP4/MOD5 program, described in Section 7.3, with the results summarized in Appendix B. This analysis showed a peak temperature of 300°F. This peak temperature is bounding for all other HELB events in the steam tunnel. This includes the Feedwater, HPCI, and RCIC piping systems. However, the duration of the event, temperature decay rate, and resulting temperature/pressure profile versus time will be different for each event (See Appendix B, Table 7.5.1).

6) The isolation characteristics of the HPCI and RCIC systems for a HELB in the steam tunnel are identical, i.e. excessive flow (>300%) initiates immediate isolation, excessive area temperature (>200°F) isolation is delayed 30 minutes. However HELBs in the HPCI system, being the larger system, will result in greater mass energy release, therefore environments resulting from HPCI HELBs in the steam tunnel should be considered to bound the affects of RCIC HELBs.

7) This break is of a magnitude applicable to either HPCI or RCIC.

7.5.3 Steam Tunnel and Turbine Building HELBs

Sections 7.5.3.1, 7.5.3.2, and 7.5.3.3 address the postulated HELBs that could occur in the steam tunnel. For any size leak, the worst case steam tunnel flooding is not expected to build up to the elevation of the main steam lines (approximately Elevation 253'-6"). The door between the steam tunnel and the CRD Repair Room is designed to blow out at 2 psig, therefore any large size breaks will blow out this door, and drainage out the door will limit any appreciable level buildup in the tunnel. For smaller leaks that do not pressurize the tunnel, water level buildup will be at a slow rate and the leak would be detected and isolated before the water level in the steam tunnel reached the steam lines.

7.5.3.1 Main Steam Line Break in Steam Tunnel

As described in Section 7.5.2, Note 5, the main steam line break in the steam tunnel (Volume 41) was analyzed to have a peak temperature and pressure in accordance Appendix B, Figure MS-41. Many areas of the Reactor Building and the Turbine Building will experience some heatup following this HELB, but the essential electrical components in these locations necessary to mitigate this accident are environmentally qualified.

7.5.3.2 HPCI and RCIC Steam Line Leaks in the Steam Tunnel

In order to realistically compare and assess the environmental conditions resulting from a HPCI or RCIC steam line break in the steam tunnel the following cases were analyzed:

1) A double ended guillotine HPCI steam line break with subsequent isolation initiated by high flow. This case represents a large potential mass energy release, similar to the MSLB for which immediate isolation is initiated, but requires a longer time to isolate.

2) A "small" HPCI/RCIC steam leak with flow equivalent to 10 gpm. condensate. This break is representative of a significant small break well within detection capability for which time delayed isolation on high temperature would apply and which is of sufficient size to impact areas beyond the steam tunnel. (It is not credible for the HPCI/RCIC steam lines in the steam tunnel to fail such that a leak greater than 10 gpm (condensate), but less than the 300% high flow trip flow rate suddenly develops.)

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For the above postulated breaks the steam tunnel temperature reached the 200°F high temperature trip isolation set point. For the double ended break steam tunnel temperature reached the high temperature trip point almost instantaneously. For the 10 gpm break the high temperature isolation trip value was reached in less than 15 minutes.

In all cases the resultant peak temperatures in affected areas outside the steam tunnel were less than for the MSLB but elevated temperature durations were longer.

Existing instrumentation located in the steam tunnel together with operator surveillance is sufficient to detect and isolate a small leak (less than 10 gpm condensate) and take steps to isolate the leak before it could develop into a large break.

Note: The temperature detectors will automatically close the main steam isolation valves immediately upon reaching the 200°F trip point and the HPCI/RCIC isolation valves after a 30 minute time delay if operator action does not isolate the break earlier.

Based on the above there are three limiting cases to be considered:

1) Large sudden break greater than 300% HPCI flow with high flow isolation. (Run ABGQADMJ)

2) Small leak (HPCI/RCIC) at a maximum flow equivalent to 10 gpm condensate with 30 minute delayed isolation. (Run ABGQAFVR)

3) A small leak (HPCI/RCIC/MS) that raises temperature to just below the high temperature trip and may not be discovered by operator surveillance for up to 16 hours (See SB-ST-41).

7.5.3.3 Feedwater Line Break in Steam Tunnel

A feedwater line break in the steam tunnel will create a harsh environment. However, unlike the main steam system, there is no automatic leak isolation feature (except pump runout protection) in the Feedwater System. In fact, should a leak occur in any pipe in the steam tunnel, it is the task of the operators to evaluate the plant symptoms and take steps to isolate the leak while maintaining the plant in a safe condition.

1) The feedwater leak can be isolated by components located in a mild environment.

2) If the steam tunnel temperature reaches 200°F, the MSIVs will close and a reactor scram will occur.

3) Although not required to be environmentally qualified for this event, HPCI and RCIC, if available, would be utilized for shutdown purposes. Alternatively, the ADS and core spray systems are relied upon as the qualified redundant path available for safe shutdown.

Note: Analysis of the more restrictive MS HELB with only ADS and core spray shows that no fuel failure will occur (Reference 53).

4) The steam tunnel is well isolated from other areas of the plant with vital equipment. With a timely diagnosis and isolation of a leak, areas of the Reactor Building where vital components are located should not become significantly more severe than normal for small leaks or cracks (see Section 7.5.3.4 for further discussion of the mitigation of small leaks in the steam tunnel).

5) For the design bases double-ended rupture of a feedwater line in the Steam Tunnel, the resulting environmental conditions are judged to be enveloped by the Main Steam Line Break environments analyzed in Reference 28. This judgement is based on the analysis done for the 1973/74 pipe whip study (Reference 2) which concludes that a single Main Steam Line Break in the Tunnel is more limiting than either the single Feedwater Line Break or the Combined Feedwater and Main Steam Line Break Cases.

7.5.3.4 Small Leaks in Steam Tunnel

The steam tunnel is a relatively small space and any high energy release into it will significantly raise its temperature. A major leak would increase the space temperature above 200°F almost instantly causing MSIV closure and resultant reactor scram. Small leaks do not have the significance of a major leak but they have the potential of becoming a major leak. Therefore, operator evaluation and action is mandatory. Small leaks from any source can be classified and detected as follows:

1) A small leak that initiates the high space temperature alarm of 160°F and a short time later initiates the MSIV close/scram signal at 200°F. The operator would be immediately alerted by these events. The HPCI/RCIC 30-minute delay signal is also set at 200°F. If HPCI or RCIC are being utilized post-scram, the operators would have 30 minutes to evaluate plant status, isolate leak, and assure a core cooling and decay heat removal path is maintained.

2) A small leak that initiates the high space temperature alarm of 160°F, or is detected by the operator readings, but may not reach the 200°F signal. Such a leak would be detected and isolated within 16 hours allowing for operator evaluation and leak isolation. All the steam tunnel equipment required to initiate a safe shutdown is environmentally qualified for this scenario.

3) A small leak that raises the steam tunnel temperature slowly, but may not initiate the 160°F space temperature alarm. This type of leak would be detected by the operators due to increasing space temperature readings. Sufficient time is available for the operators to evaluate and repair or isolate since operator action for plant safety is not immediately required and essential electrical equipment is environmentally qualified and available for plant safety action.

7.5.4 High Energy Line Break in the Turbine Building

Turbine, turbine auxiliary, and feedwater and heating steam piping in the Turbine Building is routed in many areas. If a reactor safety action is

needed, all emergency systems required to safely shut down the plant, given a loss of off-site power and a single failure, are located in the Reactor Building and Diesel Generator Rooms. For a Turbine Building HELB, a mild environment would exist in the Reactor Building. A harsh environment would exist in the Diesel Generator Room only for a HHS HELB in the room, however, a loss of off-site power is not anticipated for this break.

The only components located in the Turbine Building that warrant environmental qualification for this event are those associated with the Reactor Protection System (RPS) and Main Steam Isolation. These components are not required for the direct mitigation of a Turbine Building HELB, but they are important to reactor fuel integrity during certain plant transients combined with worst case single failures.

Although specific HELB analyses have not been performed for the Turbine Building, RPS and Main Steam Isolation components in the Turbine Building should be qualified to the bounding Turbine Building environmental profile (Appendix C, Figure TB-39) unless otherwise documented as an exception. This profile envelopes, with a margin, a large Main Steam line break in the steam tunnel which is quickly isolated and small leaks that are isolated approximately 30 minutes after detection. Because the steam tunnel is a significantly smaller and more confined volume in comparison to the turbine building environmental conditions following a HELB in the steam tunnel are expected to be more severe than conditions in the turbine building, therefore this profile should envelope all open areas in the turbine building.

In accordance with Reference 34, certain RPS/MS isolation components in the Turbine Building were further reviewed and, on a case-by-case basis, it was determined that a specified environment of 212°F and 100% relative humidity was appropriate.

Since the Turbine Building is easily accessible, small leaks would be detected by plant personnel due to changes in the usual Turbine Building humidity, temperature, and noise levels.

7.5.5 Small Leaks in Reactor Building

Other than the primary containment, the Reactor Building has five basic areas (steam tunnel, torus area, RCIC Room, HPCI Room, RWCU Rooms) that are somewhat confined and contain high energy lines which could produce a small leak. In addition, the north side of Elevation 252' contains the RWCU return line which must also be considered.

All of the above areas have temperature sensors that provide indication to the Control Room. This temperature data is logged daily. Also, all of the above areas except the primary containment and steam tunnel are visually inspected by operators at least once per shift. A small leak in the steam tunnel was discussed in 7.5.3.4.

The RWCU areas (except Elevation 252') are termed high radiation areas requiring radiation work permits for personnel access. Qualified temperature switches were installed by Reference 33 to provide automatic RWCU isolation on high space temperature. This temperature switch, set at 125°F, will provide isolation of a small leak in the RWCU piping which results in a leak below the high flow isolation setpoint. Also, as discussed above, the operators can

obtain the actual cubicle temperature remotely, from other temperature detectors which also have an alarm setpoint of 110°F or 115°F (nominal).

The HPCI cubicle and torus area are low radiation areas with unrestricted personnel access. As discussed above, these areas are readily accessible having continuous remote temperature indication, with an alarm set at 175°F. Operator detection of small leaks is most likely well before the space high temperature detector HPCI/RCIC alarm/isolation signal setpoint of 200°F. The HPCI cubicle is well ventilated with a large door opening near the SW stairwell where steam could escape in to contiguous areas of the Reactor Building. The torus area is a large space with several hatchways and many pipe chase openings where steam could escape. This lowers the probability that a small leak would raise the local space temperatures, to the trip setpoint of 200°F and increases the probability that the operators would discover a leak.

The RCIC cubicle is a low radiation, high security, locked room used by an operator to control the cooling of the reactor in the event of a terrorist attack. Leak detection is by operator surveillance and remote temperature indication, including an alarm at 175°F, in the control room. The space high temperature detector HPCI/RCIC alarm/isolation signal is set at 200°F for automatic isolation.

7.5.6 Other Design Basis Accidents

The control rod drop and refueling accidents, as described in FSAR Sections 14.6.2 and 14.6.4, respectively, have been reviewed for environmental qualification concerns. In both cases, the environmental consequences are not harsh from an equipment degradation standpoint. The only environmental parameter that will change is radiation. Per Reference 6, the cumulative radiation dose for any area of the plant will not exceed 1×10^4R due to either of these accidents. Since this level of radiation is considered mild for most materials, and all components qualified for the DB LOCA environment would also be qualified for these accidents, all electrical equipment relied upon to mitigate these accidents and achieve a safe shutdown are qualified since the qualification requirements for a LOCA are satisfied.

7.6 ENVELOPE ACCIDENT ENVIRONMENTAL DESIGN DATA

The following accident environmental conditions are recommended for procurement of new equipment important to safety. These conditions envelope worst case accidents and should be specified for new and replacement components, as well as spare parts.

7.6.1 Reactor Building (Excluding Primary Containment, Steam Tunnel, and CRD Repair Room)

Temperature Profile: Figure TE-1 - Appendix C

Pressure: 2 psig maximum for 70 seconds

Humidity: Above 212°F: Superheated Steam
Below 212°F: 100% RH Saturated Steam/Air Mixture

Rev. 3

Radiation: See Table 7.6.1 - Appendix C

Submergence: Not applicable, large area and timely leak isolation preclude significant flooding concerns.

7.6.2 Primary Containment (Drywell and Torus)

Temperature Profile: Above El. 264'-2": Figure DWH-T1 - Appendix C
Below El. 264'-2": Figure DWL-T1 - Appendix C

Pressure Profile: Figure DW-P1 - Appendix C

Humidity: Drywell
Above El. 239'-8" 100% (saturated steam and spray)
Below El. 239'-8" Submerged (Reference 1)
Torus
Above El. 228' 100% (saturated steam, splashing, and spray)
Below El. 227' Submerged (turbulence)

Note: Torus water level is maintained between approximately 228' and 227'. Components near this interface range could be exposed to both conditions of submergence or saturated steam during course of event. In addition, subsequent long-term recovery activities (e.g., removing fuel from reactor vessel) may involve flooding of the entire torus and drywell to above the top of core level, but such recovery activities are not within the scope of 10CFR50.49.

Radiation: See Table 7.6.1 - Appendix C

Submergence: See Humidity

7.6.3 Steam Tunnel

Temperature Profile: STE-41 - Appendix C

Pressure: STE-41 - Appendix C

Humidity: Above 212°F : Superheated Steam
Below 212°F : Saturated Steam / Air Mixture

Radiation: See Table 7.6.1 - Appendix C

Submergence: Any flooding in the Steam Tunnel will be confined to below steam lines (approximately Elevation 253'-6"). See Section 7.5.3.

7.6.4 CRD Repair Room, and Turbine Building

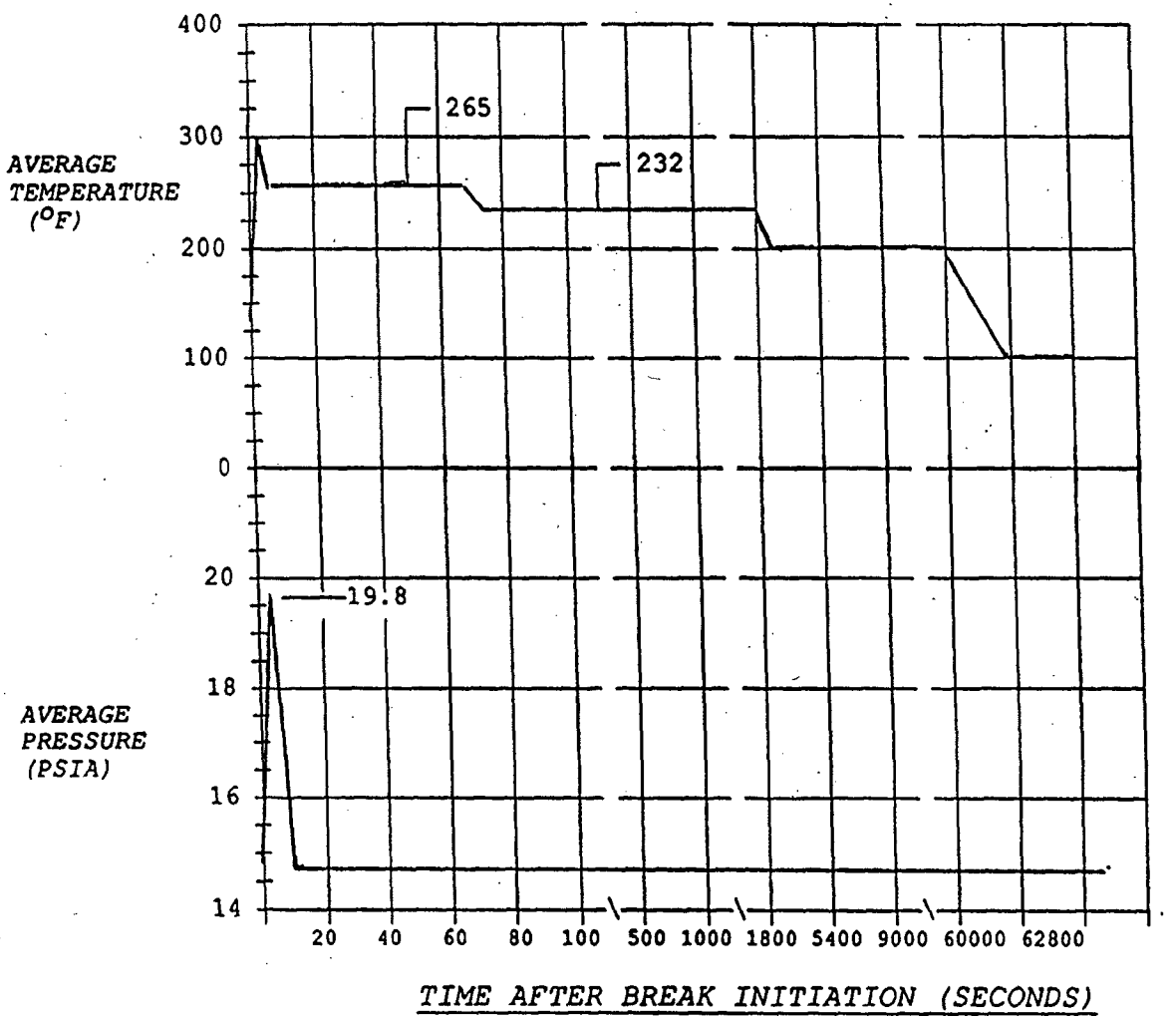
Temperature Profile: TB-39 - Appendix C

Pressure: STE-41 - Appendix C

Humidity: Above 212°F : Superheated Steam
Below 212°F : Saturated Steam / Air Mixture

Radiation: See Table 7.6.1 - Appendix C

Submergence: In the Turbine Building the large area and timely leak detection preclude significant flooding concerns.



VERMONT YANKEE NUCLEAR POWER STATION

TIME HISTORY FOR LIMITING BREAKS IN THE STEAM TUNNEL

ELEVATION 252'-6"
VOLUME NO. 41
STEAM TUNNEL

SEE SECTION 7.5.3.2 and TABLE 7.5.1 in Appendix B (This curve is bounding for Steam Tunnel.)

Note: The 70-1800 second portion of this curve which represents the 10gpm break contribution has a 20 °F added margin to account for uncertainties such as break size, time to isolate & condensation.

FIGURE STE-41

REV. 3

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. YYC-462C
Rev 0
ATTACHMENT C PAGE 20 OF 30

DT1

FACILITY: Vermont Yankee TYPE: BWR

QDR NO.:	COMPONENT:	DESCRIPTION AND SERVICES:
9.4, Revision 7	Temperature Switch	See Section B
MANUFACTURER: Fenwal, Inc.	MODEL/SERIAL NO.: See Section B	
PARAMETER: Temperature	QUALIFICATION STATUS: Qualified	

REMARKS:

REVIEW

Normal Ambient Temperature

The worksheets (Tab B) of this QDR indicate that the subject switches are located in various areas outside of primary containment, including nonoccupied areas of the plant. As specified in Volume I, Section 7.0, of the Environmental Qualification Program Manual, the maximum normal ambient temperature of these switch locations does not exceed 40°C (104.0°F) for various areas in the Reactor Building and 60°C (140.0°F) for steam tunnel and Turbine Building Heater Bay general area locations. These average temperatures will be used as the basis of the aging analysis in Tab DA.

Accident Temperature

The worst case temperature profile for any area in the Reactor Building, excluding the steam tunnel and CRD Repair Room, is shown on Figure TE-1 which is reproduced on QDR Page DT3. The worst case temperature profile for the CRD Repair Room, the steam tunnel, and the Turbine Building is shown on Figure STE-41 which is reproduced on QDR Page DT4. Only the first hour of the accident needs to be enveloped; however, a 24-hour post-accident operability requirement has been assumed for conservatism (refer to Tab DO).

As indicated in Section X of Report PEI-TR-831200-1 (QDR Page G1-286), the switches were LOCA/HELB tested to the profile shown in Figure 1 (QDR Page G1-299). This profile (reproduced on QDR Page DT5) indicates a test duration of 2 days with a peak temperature in excess of 355°F.

As indicated in the Rockbestos LOCA profile reproduced as QDR Page DT6, the wire was subjected to peak temperatures of 346°F. This profile indicates a test duration of 30 days.

The required temperature profiles STE-41 and TE-1 have been redrawn onto the Patel and Rockbestos test profiles (QDR DT5 and DT6). It illustrates that the test profiles exceed the required profiles, with margin, in both severity and duration.

E1

QDR NO. 9.4
REVISION 5

Installation and Maintenance Requirements
Fenwal Temperature Switch

1. Maintenance Requirements/Intervals

This equipment does not require special maintenance/surveillance as the basis for qualification. The manufacturer recommends that a calibration schedule with a maximum 5-year interval be instituted (see QDR Page G1-23, Paragraph I-3.3.1).

2. Replacement Requirements

Not applicable.

3. Storage Requirements

Not applicable.

4. Installation Requirements

Per manufacturer's instructions. Equipment installed under QA program assuring installation meets requirements.

DP1

FACILITY: Vermont Yankee TYPE: BWR

QDR NO.:	COMPONENT:	DESCRIPTION AND SERVICES:
9.4, Revision 5	Temperature Switch	See Section B
MANUFACTURER: Fenwal, Inc.	MODEL/SERIAL NO.: See Section B	
PARAMETER: Pressure	QUALIFICATION STATUS: Qualified	

REMARKS:

REVIEW

As indicated in the worksheets and the EQ matrix, this equipment need only function through the first hour of a HELB (a 24-hour post-accident duration has been used for conservatism).

As indicated in the Summary Report of Plant Environmental Conditions (EQ Program Manual, Volume 1), the envelope accident pressure design data is 2 psig (70 seconds) for the Reactor Building and 5.1 psig (10 seconds) for the steam tunnel.

Testing by the Vendor indicates that the switches were tested to the pressure profiles described in Appendix X-B of Report PEI-TR-831200-1 (QDR Pages G1-297 to G1-298). These profiles (summarized on QDR Page DP3) show that the maximum test pressure of 26 psig and the test duration envelop the pressure conditions for all areas outside primary containment.

DR2

QDR NO. 9.4
REVISION 4

The basis of the radiation value required is the 40-year operating doses as indicated in Appendix A of the Vermont Yankee EQ Program Manual. The one-hour post-accident operating time requirements are for HELBs in the Reactor Building only. The accident radiation increases caused by a primary containment LOCA are not applicable to these switches.

Conclusion

Qualified with margin.

DH1

FACILITY: Vermont Yankee TYPE: BWR

QDR NO.:	COMPONENT:	DESCRIPTION AND SERVICES:
9.4, Revision 2	Temperature Switch	See Section B
MANUFACTURER: Fenwal, Inc.	MODEL/SERIAL NO.: See Section B	
PARAMETER: Relative Humidity	QUALIFICATION STATUS: Qualified	

REMARKS:

REVIEW

A 100% worst case relative humidity condition is assumed due to saturated steam conditions following an accident for the areas in which these switches are located (see worksheet, Tab B).

Vendor testing included a humidity/cycling test where the switches were cycled under rated load by subjecting them to 100% relative humidity in a controlled humidity chamber. Refer to Report PEI-TR-831200-1, Paragraph I-3.10 (QDR Page G1-31), and Report Section XI (QDR Page G1-305).

The Vendor also performed the LOCA/HELB test under both superheated steam conditions and saturated steam conditions. Refer to Report PEI-TR-831200-1, Paragraph X-1.0 (QDR Page G1-286).

In addition, the NRC has recently reached the same conclusion as industry that, "... it has not been demonstrated that the time-dependent variation in humidity will produce any differences in degradation of electric equipment as stated in comments to 10CFR50.49" (Federal Register, Volume 48, No. 15, Page 2732, Comments). Furthermore, the rule itself [10CFR50.49(e)(2)] states, "... humidity during design basis accidents must be considered." As indicated above, the accident simulation profiles include a steam environment that meets the new rule requirements.

Conclusion

Qualified for 100% relative humidity.

DC1

FACILITY: Vermont Yankee TYPE: BWR

QDR NO.:	COMPONENT:	DESCRIPTION AND SERVICES:
9.4, Revision 2	Temperature Switch	See Section B
MANUFACTURER: Fenwal, Inc.	MODEL/SERIAL NO.: See Section B	
PARAMETER: Chemical Spray	QUALIFICATION STATUS: Not Applicable	

REMARKS:

REVIEW

The switches are located outside of primary containment and are not subject to chemical spray or demineralized water spray. This parameter is therefore not applicable.

Conclusion

Not applicable.

DR1

FACILITY: Vermont Yankee TYPE: BWR

QDR NO.:	COMPONENT:	DESCRIPTION AND SERVICES:
9.4, Revision 4	Temperature Switch	See Section B
MANUFACTURER: Fenwal, Inc.	MODEL/SERIAL NO.: See Section B	
PARAMETER: Radiation	QUALIFICATION STATUS: Qualified	

REMARKS:

REVIEW

As indicated in the worksheets, the required worst case integrated radiation dose for these temperature switches must be 3.5×10^6 rads. The Vendor's test documentation includes qualification for accident conditions to 5.0×10^7 rads (refer to Report PEI-TR-831200-1, Paragraph I-3.8 (QDR Page G1-29); and Paragraph IX-3.0 (QDR Page G1-277); and certification by Georgia Institute of Technology, QDR Page G1-283.

The metallic outer shell of the switches (see Paragraph I-1.3 of Vendor's report, QDR Page G1-11) protects them from degradation due to beta radiation.

Therefore, the qualification margin is:

$$\text{Margin} = (\text{Capability} - \text{Requirement})/\text{Requirement} \times 100\%$$

$$= (5.0 \times 10^7 - 3.5 \times 10^6)/3.5 \times 10^6 \times 100\%$$

$$= 1{,}328\%$$

DP2

QDR NO. 9.4
REVISION 4

(Note: Only the first hour of the accident conditions need to be enveloped.) Therefore, the switches are qualified with significant margin.

Conclusion

Qualified for this parameter.

E2

QDR NO. 9.4
REVISION 5

Review of Equipment Cable/Racewy
Interface Sealing Requirements

PROJECT:	Vermont Yankee Nuclear Power Plant
QDR NO.:	9.4
COMPONENT:	Temperature Switch
MANUFACTURER:	Fenwal, Inc.
MODEL/SERIAL NO:	01-170020-090 (NC) and 01-170230-090 (NO)

SPECIAL SEALING REQUIRED: ___ Yes X No

REMARKS

These switches are specifically procured and designed for detection of high energy line breaks outside containment. The switches come complete with seals and pigtails and have been tested and qualified to peak temperatures (e.g., 355°F) and pressures (e.g., 26 psig) which far exceed the Vermont Yankee requirements.

DT2

QDR NO. 9.4
REVISION 5

A close review of the vendor tests indicate that the temperature rise times to not envelop the rise times indicated in Figures STE-41 and TE-1. However, due to the severity and duration of the vendor tests, the effects of heat rise time is considered negligible.

Conclusion

Qualified with significant margin for post-accident temperatures and duration.

As indicated in the Rockbestos LOCA profile reproduced as QDR Page DT6, the wire was subjected to peak temperatures of 346°F. This profile indicates a test duration of 30 days.

Interoffice Memorandum

TO: FILE

FROM: John Lewis

RE: Changes to VYC-1599 Rev. 0 (Drift Calculation for Fenwal Temperature Switches Models 01-170020(230))

DATE: September 8, 1997

VYC-1599 Was reviewed to determine the impact of the non-conservative method used to eliminate outliers from the sample pool(s). The changes are as follows:

1. **Replace page 12 of 20 in the body of the calculation due to additional sample sizes in Table 3 - Critical Values For t-Test.**
2. **Replace pages 1, 5, 6 & 7 of Attachment 2 to reflect the OP-4358 re-run of outlier tests on the statistics.**

The changes do not affect the outcome of the calculation due to the data being combined with data from OP-4370 in Attachment 4. The combination of OP-4358 and 4370 exceeded 150 points that kept the original outlier test of Attachment 4 conservative.

The changes in Attachment 2 of VYC-1599 do warrant an immediate revision to the calculation. VYC-1599 Is used as the software validation baseline for the use of Microsoft Excel in the drift calculations. Manual verification of the outliers or lack there of will eliminate the need to re-run the base line.

CC: George Hengerle

From the desk of :
John H. Lewis
I&C Engineer
Yankee (CSI)
(802) 258-5734

Rev. No.	Approval Date	Reason & Description of Change
0		Initial Issue.
1		VYC-1599 was reviewed to determine the impact of the non-conservative method used to eliminate outliers from the sample pool(s). The changes are as follows: 1. Update Table 3 - Critical Values For t-Test, page 12 of 20 in the body of the calculation. 2. Replace pages 1, 5, 6 & 7 of Attachment 2 to reflect the OP-4358 re-run of outlier tests on the statistics.

2.4.7 Outlier tests were performed on the data until either 5% of the original sample was expelled or no other outliers were detected.

Table 3 - Critical Values For t-Test

Sample Size	Upper 5% Significance Level	Sample Size	Upper 5% Significance Level	Sample Size	Upper 5% Significance Level
3	1.15	16	2.44	45	2.92
4	1.46	17	2.47	50	2.96
5	1.67	18	2.5	60	3.03
6	1.82	19	2.53	70	3.09
7	1.94	20	2.56	75	3.1
8	2.03	21	2.58	80	3.14
9	2.11	22	2.6	90	3.18
10	2.18	23	2.62	100	3.21
11	2.23	24	2.64	125	3.28
12	2.29	25	2.66	150	3.33
13	2.33	30	2.75	>150	4.00
14	2.37	35	2.82		
15	2.41	40	2.87		

2.4 Pooling the Drift Data

Note: Refer to the "Vermont Yankee Instrument Drift Analysis Design Guide" for methodology used in this section. [Ref. 6.1]

2.4.1 The standard deviations and variances of the various sub-groups were evaluated to determine the data's suitability for combining. [Att. 2]

2.4.2 The model numbers, spans and setpoints listed in Table 1 (Equipment Summary) were evaluated to determine the suitability for combining the data.

2.4.3 A t-Test assuming unequal variances was performed on all potential groupings using the following equation in Microsoft Excel: [Att. 3]

$$t' = \frac{\bar{x}_1 - \bar{x}_2 - \Delta_0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_1^2}{n_2}}}$$

Where ; [Ref. 6.1 & 6.6]

t' - test statistic
n - Total number of data points.
x - Mean of the samples.
s^2 - Pooled variance
Δ_0 - Hypothesized mean difference.

2.4.3.1 The test performs a two-sample student's t-test which assumes that the variances of both ranges of data are unequal and is referred to as a heteroscedastic t-test. This t-test is used to determine whether two sample means are equal and when the groups under study are distinct.

ATTACHMENTS
7.1 23 Pages
7.2 11
7.3 1
7.4 11
7.5 15
7.6 15
7.7 11
TOTAL PAGES 20 + 87 = 107

ORIGINAL: PAGE 1 OF 20 PAGES
Rev 1: PAGE 1 OF ____ PAGES
Rev 2: PAGE 1 OF ____ PAGES
Rev 3: PAGE 1 OF ____ PAGES

QA RECORD?
X YES
___ NO

IMS NO. 09.016.004

RECORD TYPE H02.01.05

W.O. / P.O. NO. 4894

YANKEE NUCLEAR SERVICES DIVISION
CALCULATION/ANALYSIS FOR

TITLE DRIFT CALCULATION FOR FENWAL TEMP SW MODELS 01-170020-090 & 01-170230-090

PLANT VERMONT YANKEE CYCLE 20/19

CALCULATION NUMBER VYC-1599

	PREPARED BY /DATE	REVIEWED BY /DATE	APPROVED BY /DATE	SUPERSEDES CALC. /REV. NO.
ORIGINAL	J. H. Lewis 2/7/97	G.J. Hengerle 2/13/97	R.T. Vibert 2/17/97	
REVISION 1				
REVISION 2				
REVISION 3				

KEYWORDS: RWCU/MS/HPCI/RCIC/Steam/Leak/Detection/Calculation/Temperature/Switch
INSTRUMENTS: TS-12-101-103A, B, 106-112A, B; TS-13-79-82A-D; TS-2-121-124A-D
DESIGN DOCS: None
MODELS: Fenwal 01-170020-090 & 01-170230-090
T/S or FSAR: TS Table 3.2.2, FSAR 7.3.4.7.3, 7.3.4.7.15, 7.4
PROCEDURES: OP-4322, OP-4358, OP-4366 and OP-4370

FORM WE-103-1
Revision 2

1 CALCULATION OBJECTIVES

This calculation documents the drift analysis performed on the Fenwal Temperature Switches at Vermont Yankee for the Steam Leak Detection System of the Main Steam Lines, HPCI Steam Lines, RCIC Steam Lines and RWCU Areas. This calculation has been developed in support of the Vermont Yankee Improved Technical Specifications Project with the following major objectives:

- Determine the drift characteristics for the Fenwal Model 01-170020-090 & 01-170230-090 temperature switches listed in Table 1(Equipment Summary).
- Document the analyses performed on the components in accordance with the "Vermont Yankee Instrument Drift Analysis Design Guide." [Ref. 6.1]
- Provide the standard deviation, variance, 95%/95% Tolerance Interval Factors (TIF) for the device groups covered.
- Evaluate the data for normality, time dependency and provide the 95%/95% Analyzed Drift Term (ADR) for the components covered in this calculation.

1.1 Systems & Components

This calculation applies to the Main Steam Line, HPCI Steam Line, RCIC Steam Line and RWCU Space steam leak detection temperature switches. The specific components addressed are listed below in the equipment summary table.

TABLE 1 - Equipment Summary

TAG NO.	SYSTEM	DESCRIPTION	S/C	MANUF	MODEL	SPAN	SETPOINT	TOL	PROC
TS-12-101A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-101B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-102A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-102B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-103A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-103B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-106A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-106B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-107A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-107B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-108A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-108B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-109A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-109B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-110A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-110B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-111A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-111B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-112A	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-12-112B	RWCU	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	120°F INC	± 5°F	OP-4370
TS-13-79A	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-79B	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-79C	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366

TAG NO.	SYSTEM	DESCRIPTION	S/C	MANUF	MODEL	SPAN	SETPOINT	TOL	PROC
TS-13-79D	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-80A	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-80B	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-80C	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-80D	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-81A	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-81B	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-81C	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-81D	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-82A	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-82B	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-82C	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-13-82D	RCIC	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4366
TS-2-121A	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-121B	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-121C	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-121D	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-122A	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-122B	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-122C	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-122D	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-123A	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-123B	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-123C	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-123D	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-124A	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-124B	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-124C	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-2-124D	MS	Stm Leak Detection	SCE	Fenwal	01-170020-090	(-)100-600°F	185°F INC	± 5°F	OP-4322
TS-23-101A	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-101B	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-101C	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-101D	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-102A	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-102B	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-102C	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-102D	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-103A	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-103B	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-103C	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-103D	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-104A	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-104B	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-104C	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358
TS-23-104D	HPCI	Stm Leak Detection	SCE	Fenwal	01-170230-090	(-)100-600°F	185°F INC	± 5°F	OP-4358

1.2 Instrument Loop Function (Abbreviated)

1.2.1 The temperature switches covered by OP-4322 monitor the Main Steam Line Areas for high temperatures caused by steam leaks (Setpoint 185°F Increasing). High temperature in the Main Steam Line Areas provides inputs into the Primary Containment Group 1 Isolation circuitry.

1.2.2 The temperature switches covered by OP-4358 monitor the HPCI Steam Line Areas for high temperature caused by steam leaks (Setpoint 185°F Increasing). High temperature in the HPCI Steam Line Areas provides an automatic isolation signal to the HPCI Steam Line Isolation Valves.

1.2.3 The temperature switches covered by OP-4366 monitor the RCIC Steam Line Areas for high temperature caused by steam leaks (Setpoint 185°F Increasing). High temperature in the RCIC Steam Line Areas provides an automatic isolation signal to the RCIC Steam Line Isolation Valves.

1.2.4 The temperature switches covered by OP-4370 monitor the RWCU Steam Line Areas for high temperature caused by steam leaks (Setpoint 120°F Increasing). High temperature in the RWCU Steam Line Areas provides an automatic isolation signal to the RWCU Steam Line Isolation Valves.

1.3 Governing Procedures And Programs

1.3.1 Vermont Yankee Instrument Drift Analysis Design Guide, Rev. 0. [Ref. 6.1]

1.3.2 Vermont Yankee Instrument Uncertainty and Setpoints Design Guide, Rev. 0. [Ref. 6.2]

1.3.3 Yankee Nuclear Services Engineering Instruction, WE-103, Rev. 15, Analyses and Calculations. [Ref. 6.3]

1.3.4 Vermont Yankee Engineering Procedure, AP-0017, Rev. 4, Calculations and Analyses. [Ref. 6.4]

1.3.5 Yankee Nuclear Services Engineering Instruction, WE-108, Rev. 5, Computer Codes. [Ref. 6.5]

2 METHOD OF SOLUTION

This calculation has been prepared in accordance with the Governing Procedures and Programs listed in step 1.3. Standard methods employed in this calculation are explained in the "Vermont Yankee Instrument Drift Analysis Design Guide", an overview of the methodology is explained below. [Ref. 6.1]

2.1 Data Entry and Determination of Drift Values

2.1.1 Calibration data was collected from the applicable Surveillance Test for the components listed in Table 1 (Equipment Summary).

2.1.2 The data was then entered into Microsoft Excel Spreadsheets titled after the Surveillance Test (e.g. OP4322.XLS) noting any discrepancies found with the data (e.g. As Found out of tolerance, illegible data, etc.). [Att. 1]

4.1.2 A change in setpoint was made in OP-4370 between 1987-1989 and the calibration data for all components in that time frame was expelled from the pool. [Att. 1]

4.2 Statistics Calculations

4.2.1 The statistics calculation for each surveillance test and the grouped components is documented in Attachments 2 and 4. [Att. 2 & 4]

4.2.2 The TIF used in this analysis is for a 95%/95% level of confidence and is listed in Table 4 (Statistical Summary) for each surveillance test and the grouped data.

4.2.3 The Analyzed Drift value is listed in Table 4 (Statistical Summary) for each surveillance test and the grouped data.

4.2.4 The statistics summary for each surveillance test and the two groupings can be found in Table 4 (Statistical Summary) and at the beginning of Attachments 2 and 4. [Att. 2 & 4]

4.3 Plots

4.3.1 The XY scatter plots, Regression lines, Histograms and Probability plots used for determining the characteristics of the data are contained in Attachment 5 for Group OP-4322 & 66 and Attachment 6 for Group OP-4358 & 70 [Att. 5 & 6]

4.3.2 The plot statistics are located at the end of the plot groups in Attachments 5 & 6. [Att. 5 & 6]

5 RESULTS AND CONCLUSIONS

5.1 Groupings

5.1.1 Refer to Table 4 (Statistical Summary) for the summary of the statistical analysis for each surveillance and the resulting groupings.

5.1.2 The data from OP-4322 and OP-4366 was able to be pooled into one group due to the components passing the t-Test performed in step 2.4.3, having the same ranges, similar model numbers, same setpoints and essentially equal standard deviations and variances. Refer to Table 1 (Equipment Summary) for component information and Table 4 (Statistical Summary) for statistical information. [Att. 3]

5.1.2.1 The pooled data provides a group of 209 sample points with a standard deviation of 0.502% of span with an average time interval of 544 days. As discussed in Section 3 of this calculation a 95%/95% TIF will be applied to the standard deviation for the group which equates to an ADR term of **1.077% of span (7.54°F)**. Refer to Table 4 (Statistical Summary).

5.1.3 The data from OP-4358 and OP-4370 was able to be pooled into one group due to the components passing the t-Test performed in step 2.4.3, having the same ranges, same model numbers, similar setpoints and essentially equal standard deviations and variances. Refer to Table 1 (Equipment Summary) for component information and Table 2 (Statistical Summary) for statistical information. [Att. 3]

5.1.3.1 The pooled data provides a group of 199 sample points with a standard deviation of 0.648% of span with an average time interval of 775 days. As discussed in Section 3 of this calculation a 95%/95% TIF will be applied to the standard deviation for the group which equates to an ADR term of 1.391% of span (9.74°F). Refer to Table 4 (Statistical Summary).

5.2 Time Dependency

5.2.1 Group OP-4322 and OP-4366

As seen from the XY Scatter plots, Regression lines and Regression statistics in Attachment 5 it can be concluded that the data is evenly distributed about zero with a slope on the time dependency line equivalent to < 0.2 % / ~550 days. [Att. 5]

5.2.2 Group OP-4358 and OP-4370

As seen from the XY Scatter plots, Regression lines and Regression statistics in Attachment 6 it can be concluded that the data is evenly distributed about zero with a slope on the time dependency line equivalent to < 0.3 % / ~2000 days. [Att. 6]

5.3 Normality

5.3.1 Group OP-4322 and OP-4366

As seen from the Probability plots, Probability statistics and Histogram in Attachment 5 it can be concluded that the data is normally distributed with a highly peaked narrow distribution. [Att. 5]

5.3.2 Group OP-4358 and OP-4370

As seen from the Probability plots, Probability statistics and Histogram in Attachment 6 it can be concluded that the data is normally distributed with a highly peaked narrow distribution. [Att. 6]

5.4 Summary

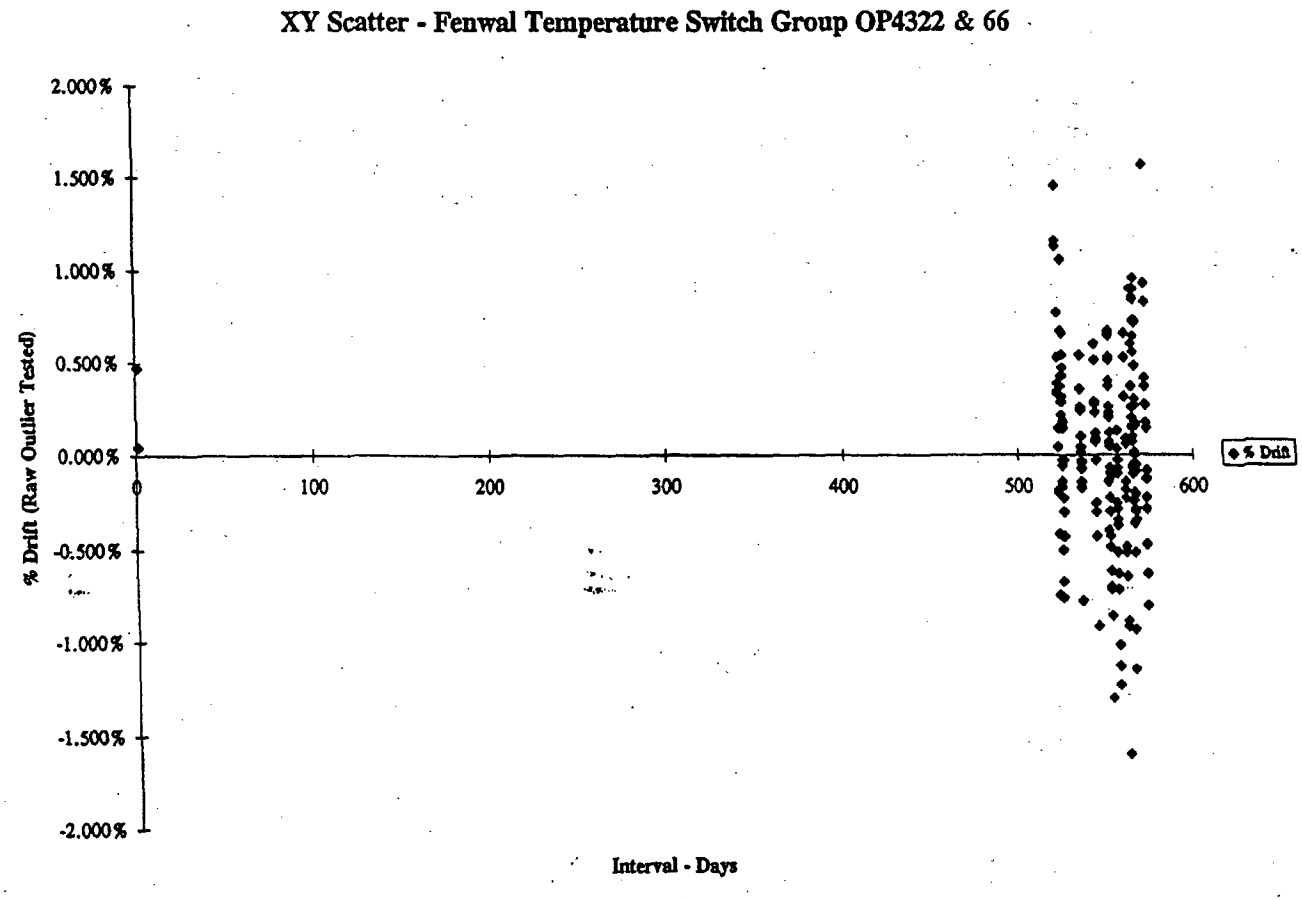
The data contained is normally distributed, showing little time dependency and is acceptable for use in Setpoint/Uncertainty calculations. The 95%/95% ADR value is:

5.4.1 Group OP-4322 and OP-4366 = 1.077% of Span (7.54°F).

5.4.2 Group OP-4358 and OP-4370 = 1.391% of Span (9.74°F).

TABLE 4 - Statistical Summary

	OP4322	OP4358	OP4366	OP4370 Setpoint	OP4370 Reset	Group OP4322 & 66	Group OP4358 & 70
COUNT	113	110	95	44	43	209	199
AVERAGE	-0.014%	-0.065%	0.017%	-0.078%	-0.021%	0.008%	-0.081%
STDEV	0.543%	0.607%	0.425%	0.640%	0.605%	0.502%	0.648%
VARIANCE	0.003%	0.004%	0.002%	0.004%	0.004%	0.003%	0.004%
KURTOSIS	0.347	1.658	0.173	0.758	0.221	0.627	1.599
SKEWNESS	-0.118	-0.248	-0.150	0.072	0.381	-0.038	-0.349
MAXIMUM	1.457%	1.957%	0.929%	1.400%	1.571%	1.571%	1.957%
MINIMUM	-1.600%	-2.100%	-1.143%	-1.786%	-1.357%	-1.600%	-2.400%
95%/95% TIF	2.218	2.218	2.241	2.445	2.445	2.143	2.148
STDEV x 95/95 TIF	1.204%	1.347%	0.953%	1.565%	1.478%	1.077%	1.391%
CAL UNITS °F	8.43	9.43	6.67	10.95	10.35	7.54	9.74
% OF ORIGINAL COUNT	99.12%	99.10%	98.96%	100.00%	97.73%	99.52%	100.00%


XY Scatter - Fenwal Temperature Switch Group OP4322 & 66
2.000%
1.500%
1.000%
0.500%
0.000%
-0.500%
-1.000%
-1.500%
-2.000%
% Drift (Raw Outlier Tested)
0
100
200
300
400
500
600
Interval - Days
% Drift

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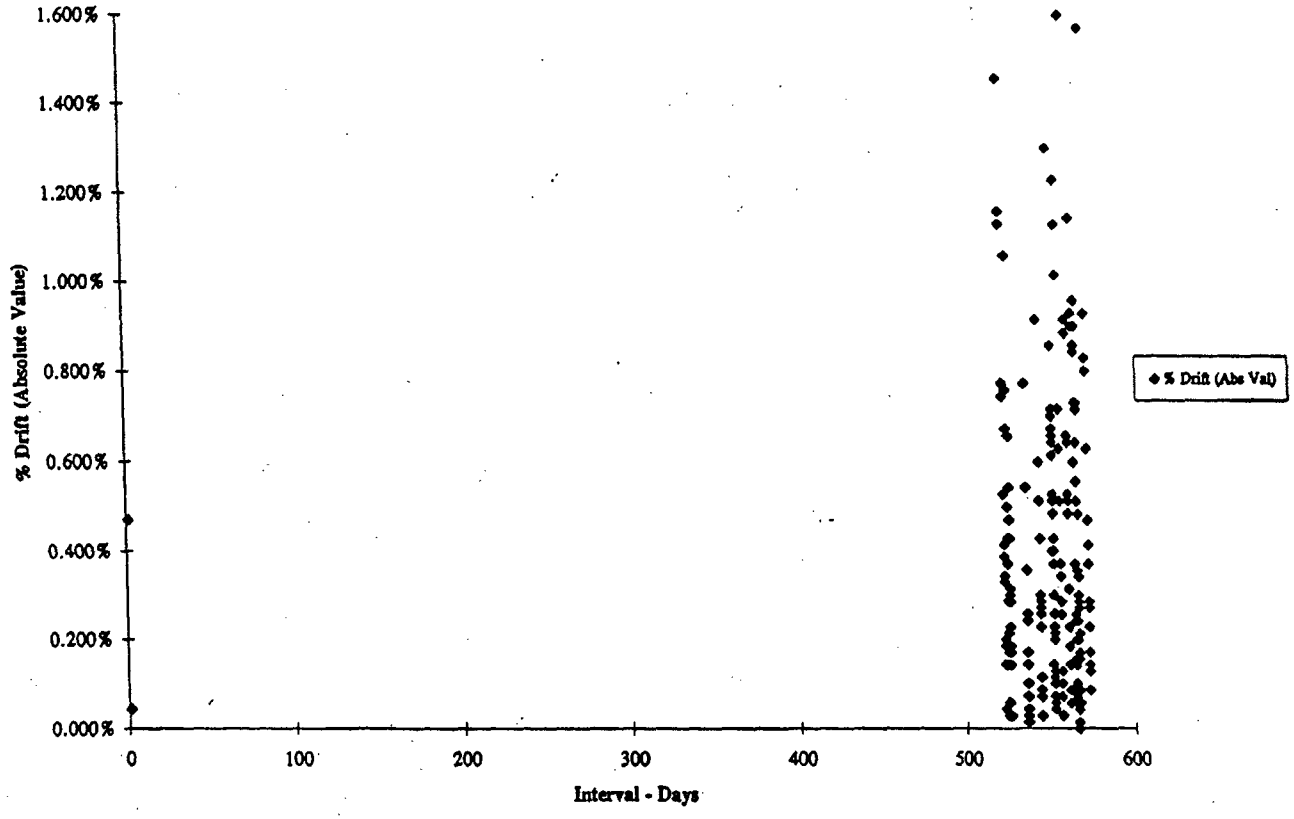
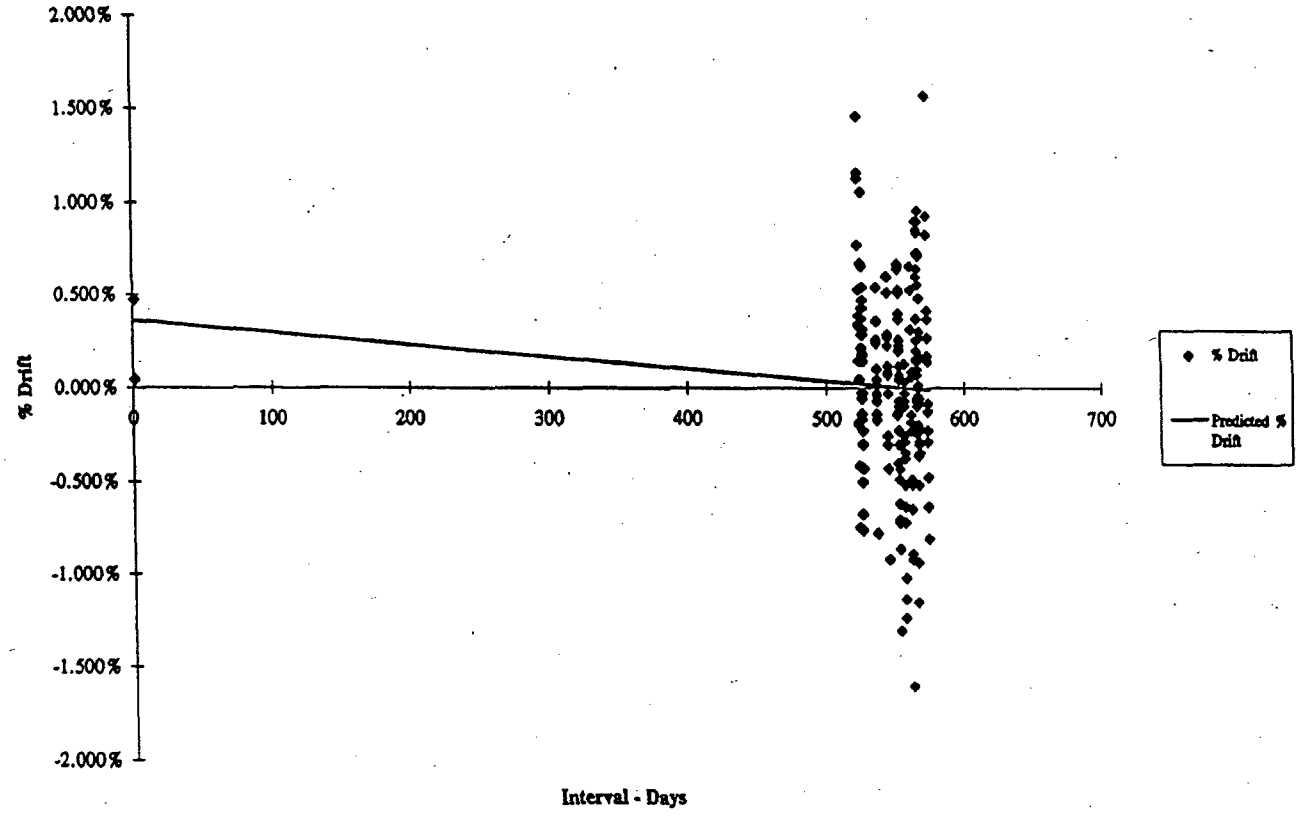
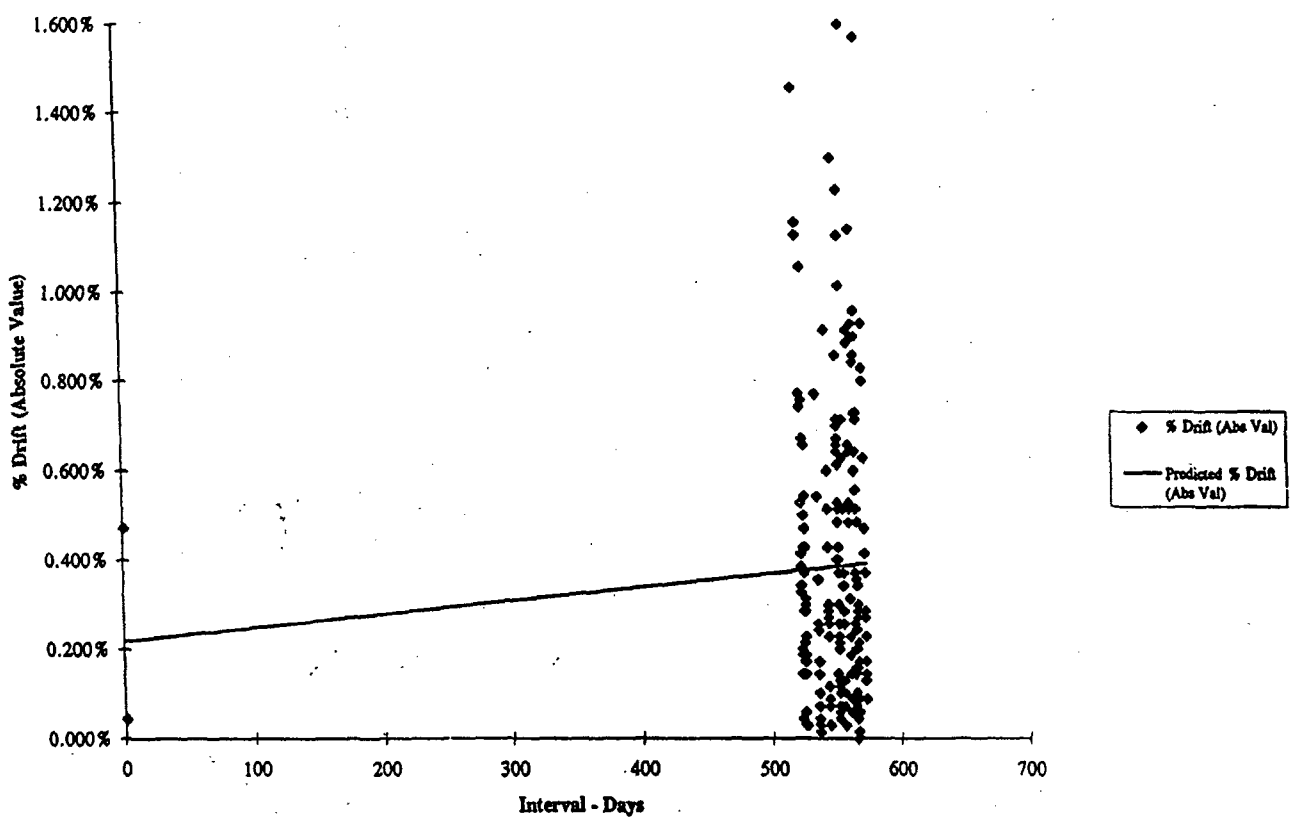
XY Scatter (Absolute Value) - Fenwall Temperature Switch Group OP4322 & 66



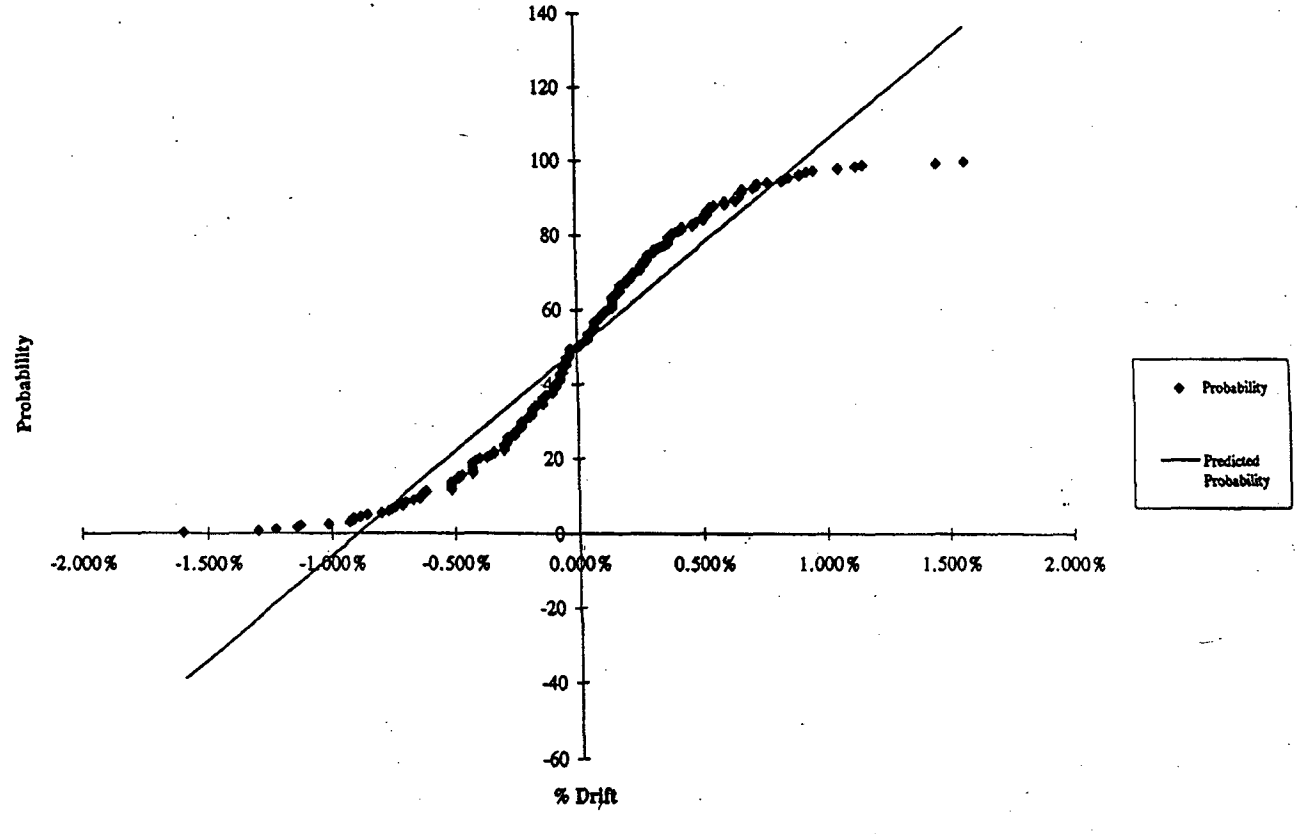
Regression Line (Raw Data) - Fenwal Temperature Switch Group OP4322 & 66



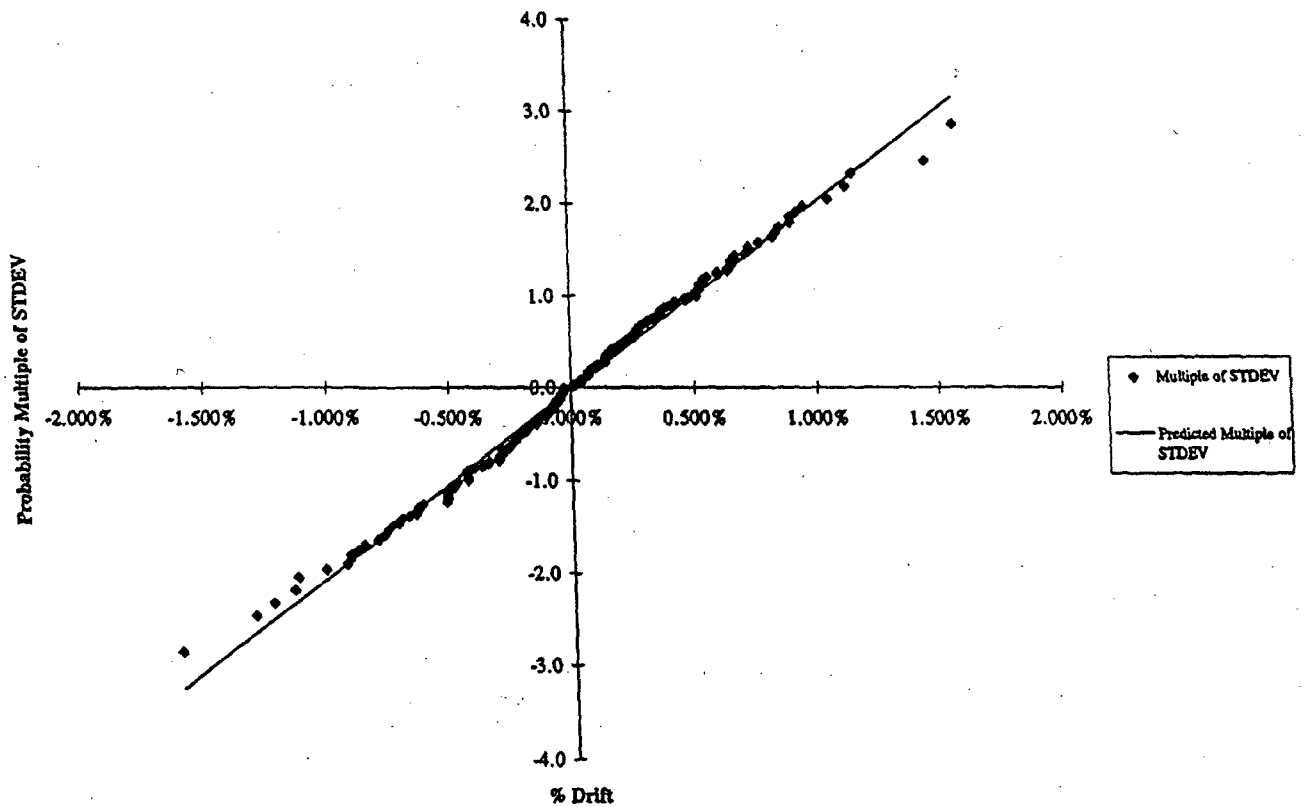
Regression Line (Asolute Value) - Fenwal Temperature Switch Group OP4322 & 66



Cumulative Probability Plot - Fenwal Temperature Switch Group OP4322 & 66



Normalized Probabilty Plot - Fenwal Temperature Switch Group OP4322 & 66



Histogram - Fenwal Temperature Switch Group OP4322 & 66

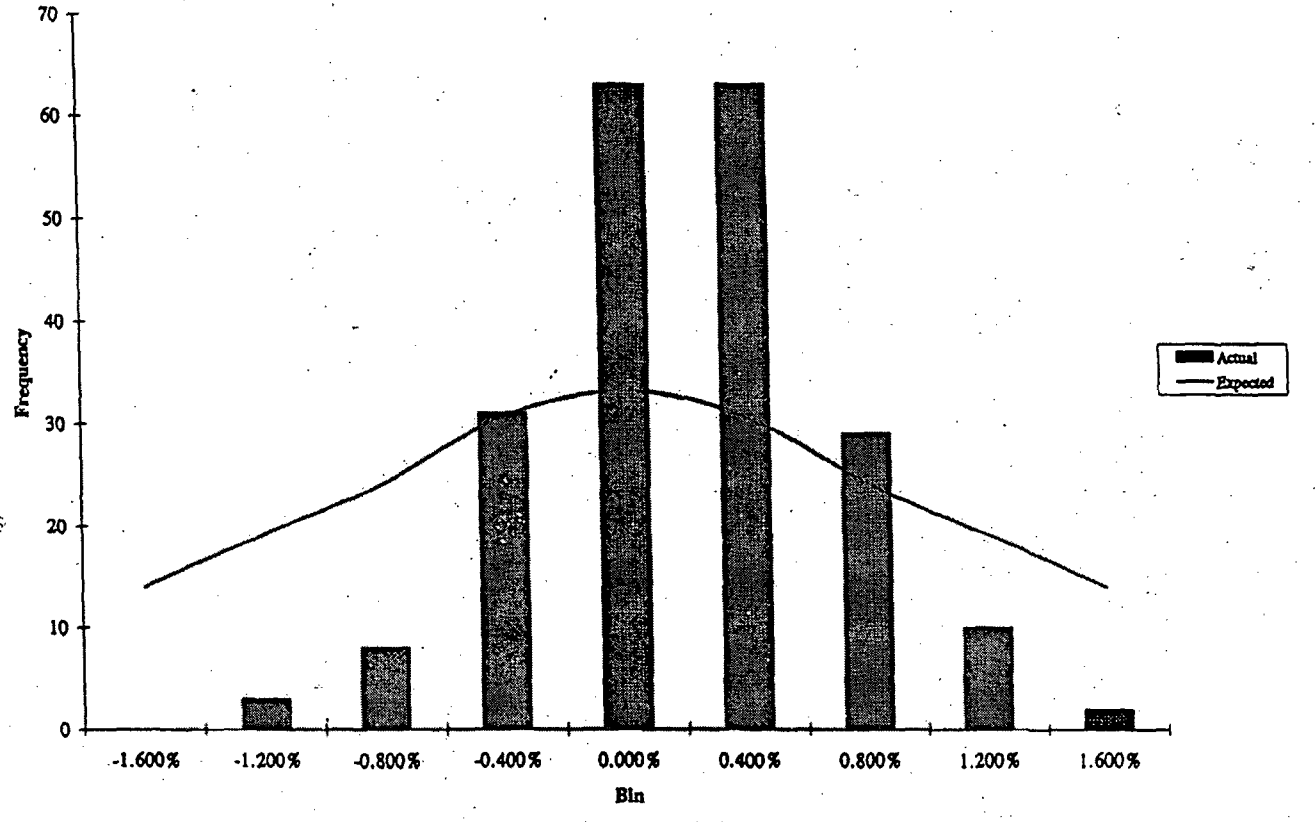


TABLE 3.2.2
(Cont'd)

REACTOR CORE ISOLATION COOLING SYSTEM ISOLATION INSTRUMENTATION

Minimum Number of Operable Instrument Channels per Trip System	Trip Function	Trip Level Setting	Required Action When Minimum Conditions for Operation are not Satisfied (Note 2)
2	Main Steam Line Tunnel Temperature	≤212°F	Note 3
1	Time Delay (13A-K41) (13A-K42)	≤35 minutes	Note 3
2 per set of 4	High Steam Line Space Temperature	≤212°F	Note 3
1	High Steam Line d/p (Steam Line Break)	≤195 inches of water	Note 3
4 (Note 5)	Low Steam Supply Pressure	≥50 psig	Note 3
1	Bus Power Monitor	--	Note 3
1	Trip System Logic	--	Note 3
1	Time Delay (13A-K7) (13A-K31)	3≤ t ≤7 seconds	Note 3

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TABLE 4.2.2
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MINIMUM TEST AND CALIBRATION FREQUENCIES

REACTOR CORE ISOLATION COOLING SYSTEM ISOLATION INSTRUMENTATION

Trip Function	Functional Test(8)	Calibration(8)	Instrument Check
Main Steam Line Tunnel Temperature	(Note 1)	Each refueling outage	--
High Steam Line Space Temperature	(Note 1)	Each refueling outage	--
High Steam Line d/p including time delay relays (Steam Line Break)	(Note 1)	Every three months	--
Low RCIC Steam Supply Pressure	(Note 1)	Every three months	--
Bus Power Monitor	(Note 1)	None	Once each day
Trip System Logic	Once/operating cycle	Once/operating cycle (Note 3)	--

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RHRS reactor shutdown cooling supply
Drywell equipment drain discharge
Drywell floor drain discharge
Traversing incore probe tubes
Drywell purge inlet
Drywell and suppression chamber purge supply
RHR drywell spray
Suppression chamber spray
Suppression chamber cooling and spray
Containment air compressor suction
Containment Air Sample System
Drywell purge and vent outlet
Suppression chamber purge and vent outlet
Drywell and suppression chamber main exhaust
Drywell makeup
Drywell and suppression chamber makeup
Suppression chamber exhaust valve bypass
Suppression chamber purge inlet
Suppression chamber makeup
Drywell exhaust valve bypass
Exhaust to Standby Gas Treatment System
Reactor Building ventilation inlet and exhaust
RHR discharge to radwaste

The primary containment high pressure isolation setting was selected to be as low as possible without inducing spurious isolation trips.

7. RCIC Equipment High Temperature (Table 7.3.1, Signal K)

High temperature in the vicinity of the RCIC equipment could indicate a break in the RCIC steam line. The automatic closure of the RCIC steam line valves prevents the excessive loss of reactor coolant and the release of significant amounts of radioactive material from the nuclear system process barrier. When high temperature occurs near the RCIC equipment, the RCIC turbine steam line is isolated. The high temperature isolating setting was selected far enough above anticipated normal RCIC System operational levels to avoid spurious operation, but low enough to provide timely detection of an RCIC turbine steam line break. This

signal has nonfail-safe logic. The high temperature isolation initiation circuitry is designed to meet the intent of IEEE 279 criteria.

8. RCIC Turbine High Steam Flow (Table 7.3.1, Signal K)

RCIC turbine high steam flow could indicate a break in the RCIC turbine steam line. The automatic closure of the RCIC steam line valves prevents the excessive loss of reactor coolant and the release of significant amounts of radioactive materials from the nuclear system process barrier. Upon detection of RCIC turbine high steam flow, the RCIC turbine steam line is isolated. The high steam flow trip setting was selected high enough to avoid spurious isolation yet low enough to provide timely detection of a RCIC turbine steam line break. A time delay is introduced in the isolation logic to prevent isolation due to differential pressure spikes that occur during startup.

The logic arrangement used for this function is shown in Figure 7.3-5b and is an exception to the usual logic requirement because high steam flow is the second method of detecting an RCIC turbine steam line break.

9. RCIC Turbine Steam Line Low Pressure (Table 7.3.1, Signal K)

RCIC turbine steam line low pressure is used to automatically close the two steam supply isolation valves in the RCIC turbine steam line so that steam and radioactive gases will not escape from the RCIC turbine shaft seals into the Reactor Building after steam pressure has decreased to such a low value that the turbine cannot be operated. The isolation setpoint is chosen at a pressure below that at which the RCIC turbine can operate effectively.

10. HPCI Equipment Space High Temperature (Table 7.3.1, Signal L)

High temperature in the vicinity of the HPCI equipment could indicate a break in the HPCI turbine steam line. The automatic closure of certain Class A valves prevents the excessive loss of reactor coolant and the release of significant amounts of radioactive material from the nuclear system process barrier. When high temperature occurs near the HPCI equipment, the HPCI turbine steam supply line is isolated. The high temperature isolation setting was selected far enough above anticipated

provides the input signal for the 40% rated flow PCIS input whenever the Reactor Mode Switch (RMS) is out of RUN.

5. Main steam line low pressure is sensed by four pressure switches which sense pressure downstream of the outboard main steam isolation valves. The sensing point is located at the header that connects the four steam lines upstream to the turbine stop valves. Each switch is part of an independent channel. Each channel provides a signal to one isolation logic. The MSL low pressure trip signals are bypassed with the reactor mode switch out of the "RUN" mode.

6. Primary containment pressure is monitored by four pressure transmitters which are mounted on instrument racks outside the drywell. Pipes that terminate in the Reactor Building connect the transmitters with the drywell interior. Each transmitter is connected to an electronic trip unit which provides the trip. Cables are routed from the trip unit to the Main Control Room. The instruments are electrically grouped in pairs, physically separated, and electrically connected to the Isolation Control System so that no single event will prevent isolation due to primary containment high pressure.

7. High temperature in the vicinity of the RCIC equipment is sensed by four sets of four bimetallic temperature switches. Each set is arranged as two trip systems. Each trip system receives input signals from two temperature trip channels. Both trip systems must trip to initiate isolation. Figure 7.3-6 illustrates the arrangement.

8. High flow in the RCIC turbine steam line is sensed by two differential pressure switches which monitor the differential pressure across elbow taps installed in the RCIC turbine steam supply pipeline. The arrangement is illustrated in Figure 7.3-10. The tripping of either trip channel initiates isolation of the RCIC turbine steam line. This is an exception to the usual channel arrangement. The reason for the exception was given in the discussion of the RCIC turbine high steam flow isolation function. Keylock test switches are provided to block operation of the isolation valves as a result of testing the differential pressure switches.

9. Low pressure in the RCIC turbine steam line is sensed by four pressure switches from the RCIC turbine steam line upstream of the isolation

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TABLE 7.3.2

PRIMARY CONTAINMENT AND REACTOR VESSEL ISOLATION CONTROL SYSTEM

INSTRUMENT SPECIFICATIONS

ITS ALLOWABLE VALUE

Isolation Function	Sensor	Required Accuracy	Trip Setting
Reactor Vessel Low Water Level	Level Transmitter	±3.3% in.	≥127 inches above top of enriched fuel
Reactor Vessel Low-Low Water Level	Level Transmitter	±3.3% in.	≥82.5 inches above top of enriched fuel
Main Steam Line High Radiation	Radiation Monitor	Not Applicable	≤3 times normal background at rated power
Main Steam Line Space High Temperature	Temperature Switch	±12°F	212°F
Main Steam Line High Flow	Differential Pressure Transmitter/ Electronic Trip Unit	±2.4 psid ±1.2 psid	≤140% in RUN mode and ≤40% in all modes but RUN
Main Steam Line Low Pressure	Pressure Switch	±20 psig	≥800 psig
Primary Containment High Pressure	Pressure Transmitter/ Electronic Trip Unit	±.05 psig	≤2.5 psig
RCIC Turbine Steam Line Space High Temperature	Temperature Switch	±12°F ±5°F	≤212°F 198°F INSIDE STEAM TUNNEL 194°F OUTSIDE STEAM TUNNEL
RCIC Turbine Steam Line High Flow	Differential Pressure Switch	±9 in. W.C.	≤195 inches* W.C.
RCIC Turbine Steam Line Low Pressure	Pressure Switch	±1 psig	≥50 psig

*519,000 lb/hr

MEMORANDUM

YANKEE ATOMIC - BOLTON

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
REV 0
ATTACHMENT L PAGE 1 OF 4

To: File

From: G.J. Hengerle

Date: April 25, 1997
Group #: VYI 37/97 # NOTE: CHANGED FROM VYI 42/97
WO #: 4894

Subject: Improved Setpoint Program/CTS v.s. ITS Setpoint Evaluation

IMS #:
File #: SETPOINTMEMO-12489

References:

a. Vermont Yankee Setpoint Design Guide (Draft)

Background:

The Vermont Yankee Setpoint Design Guide (reference a) addresses the manner in which setpoints should be determined. However, additional guidance is needed to clarify the manner in which the Custom Technical Specification (CTS) evaluation and Improved Technical Specification evaluations should be conducted. The manner in which this issue should be addressed is discussed below.

Discussion:

The setpoints being determined have two goals; to identify the Allowable Value for use in the ITS and to determine the acceptability of the existing setpoints in regards the CTS limits. Sketches are attached for clarification.

ITS

The starting point in the ITS setpoint determination is the Analytical Limit. The Analytical Limit is identified as a "proposed" limit, provided to YNSD Nuclear Engineering, for use in their reload and safety analysis. The Analytical Limit is available from the Setpoint Matrix. A copy of the matrix from where the Analytical Limit was obtained should be attached to the calculation (as the Analytical Limit is still "proposed" and is subject to change).

The Limiting Setpoint (LSP) is established by calculating the Total Loop Uncertainty (TLU). The LSP is determined by adding the TLU to the Analytical Limit. The Allowable Value is then determined by adding the testable (observable) uncertainties to the LSP.

There are two ITS evaluations associated with each evaluation; a monthly surveillance cycle and a quarterly surveillance cycle. The Analyzed Drift (DA) is typically based on monthly surveillances. The calculation extends the DA for an equivalent quarterly surveillance. As such, the TLU and the testable uncertainties will be larger. However, the Analytical Limit remains unchanged.

CTS

The starting point for the CTS evaluation is the trip setting identified in the CTS. The Limiting Setpoint (LSP) is established by first calculating the Total Loop Uncertainty (TLU) for the normal operating environment and adding it to the Technical Specification Limit. There is no Allowable Value term. The actual setpoint must be ≤LSP or a change to the setpoint will be required.

The next step is to identify the impact of harsh environments (if applicable). A TLU for harsh environments must be calculated and added to the actual setpoint. The potential trip point is then established and must be less than the Analytical Limit used in current safety analysis.

Conclusion:

The above discussion provides general guidance for ITS and CTS evaluations.

The guidance provided in this memorandum will be incorporated into a future revision of the Vermont Yankee Setpoint Design Guide (as appropriate). Until then, this memorandum is an interim change to the design guide.

George J. Hengerle
Senior I&C Engineer
Vermont Yankee Design Engineering

Interim Design Guide References

1. Memo VYI 31/97, "Improved Setpoint Program/Application of Analyzed Drift Values in Setpoint Determination", April 2, 1997.
2. Memo VYI 32/97, "Improved Setpoint Program/Relationship of HELB Environments to RPS Setpoints", DRAFT
3. Memo VYI 41/97, "Improved Setpoint Program/FSAR Table Revisions and M&TE Accuracy", April 23, 1997.
4. Memo VYI 37/97, "Improved Setpoint Program/CTS v.s. ITS Setpoint Evaluation", April 25, 1997.

MEMORANDUM

Vermont Yankee Design Engineering - BOLTON

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
Rev 0
ATTACHMENT L PAGE 3 OF 4

To: Distribution

From: G.J. Hengerle/R.T. Vibert

Date: June 26, 1998
Group #: VYI 92/97 Rev 1
WO #: 4894

Subject: Application of CT, CE and A for Single Point Devices **IMS #:**
File #: SETPOINT\MEMO-20R1.489

Background:

Currently the Vermont Yankee Instrument Uncertainty and Setpoint Design Guide states:

- **Section 3.6.2 Calibration Effect (CE) and Calibration Tolerance (CT)**

  Section 3.6.2.A Analog Loop Components:

  CE = CT+A, Where A is taken as a dependent term when, during calibration testing, less than a full traverse is performed

  Section 3.6.2.B Bistables/Switches:

  CE = CT+A, Where A is taken as a dependent term when during calibration testing, actuation is only tested once.

For bistable components this has been viewed as overly conservative, especially where drift data over numerous calibrations would imply that repeatability in a single direction of interest is addressed. The following discussion provides additional guidance in this area.

Revision 1 addresses the inclusion of calibration tolerance.

Discussion:

ISA S67.04 Section 6.2.6.2 States,

> "If the method of calibration or performance verification does not verify all attributes of the reference accuracy, the potential exists to introduce an offset in the instrument channels performance characteristics that is not identified in the calibration or performance verification of the instrument channel".

Reference Accuracy is normally assumed to consist of vendor stated accuracy, linearity, hysteresis, and repeatability. Since the timer operates in only one direction hysteresis is not a consideration. The linearity of the measurement is not a concern since the point of interest remains constant. Therefore only repeatability and accuracy are considered. A single calibration will not confirm the accuracy or repeatability of the instrument. However, each of several different calibrations occurring within the limits of vendor defined performance does verify the accuracy and repeatability.

Where Vermont Yankee has performed a drift analysis for a given component type the multiple calibrations evaluated for this analysis verifies performance within assumed values assuming that this historical value is compared to expected values for performance. Additionally, it may be inappropriate to perform multiple setpoint checks for the time delay relays.

For single point devices (i.e. bistables/switches/time delays relays) used in a single direction, where repeatability is the primary contributor to RA, and where drift analysis has been performed, determine if the value for analyzed drift is within expected performance characteristics. To simplify verification within performance characteristics , combine (via SRSS) the vendor's published reference accuracy term, the vendor's stated drift term, calibration tolerance, and the M&TE terms. This value will be compared to the plant specific drift. Where plant specific drift is less than the expected performance, CE = CT will be used for Calibration Effect. In other words:

If Plant Specific Drift $< (RA^2+DA^2+CT^2+M\&TE^2)^{1/2}$; CE = CT

If Plant Specific Drift $\geq (RA^2+DA^2+CT^2+M\&TE^2)^{1/2}$; CE = CT + A

Conclusion:

The intent of the design guide is adequately addressed with the guidance provided in this correspondence. It will be incorporated in a future revision of the design guide.

George J. Hengerle
Principal Engineer
Vermont Yankee Design Engineering

Roger T. Vibert
Lead Electrical/I&C Engineer
Vermont Yankee Design Engineering

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
Rev 0
ATTACHMENT L PAGE 4 OF 4

C: Setpoint Team

M. Anderson
D. Dauzat
D. Clinton
J. Voss

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
REV 0
ATTACHMENT M PAGE 1 OF 1

GENERAL ELECTRIC

225A5600
CONT ON SHEET 99 SH NO. 98

REV NO. 0
225A5600
CONT ON SHEET 99 SH NO. 98

TITLE INSTRUMENT DATA SHEET

FIRST MADE FOR TEMPERATURE SWITCH (VERMONT YANKEE)

* ITEM (TAG) NO	12-139		13-79A-D		13-80A-D		REVISIONS
* QUANTITY	8		4		4		
* SERVICE	CL-UP LEAK DET		ST LEAK DET		ST LEAK DET		
SCALE RANGE/UNITS	—		—		—		
CONTACT: TYPE	1-RELAY SPDT		1-DIFF EXP SPST		1-DIFF EXP SPST		
FORM/RATING	2A @ 120VAC		5A @ 115VAC		5A @ 115 VAC		
* REQD RANGE (ADJ)	0-200°F		0-300°F		0-300°F		
* CONTACT #1 OPER AT	100°-110°F		200°F		200°F		
* CONTACT #2 OPER AT	—		—		—		
PURCHASE RANGE(ADJ)	100°-400°F		-10°F to 600°F		-10°F to 600°F		
RESET SPAN DIFF							
* PROCESS FLUID							
* DESIGN TEMP							
* DESIGN PRESS							
* NORMAL TEMP			0-150°F		0-150°F		
* NORMAL PRESS							
* LINE SIZE/SCH/MATL	—		—		—		
WELL: MATERIAL							
LG BELOW CONN NIPPLE LG MTG SIZE & TYPE							
CONN TO ITEM NO	12-117		—		—		
* REQD ACCURACY	±2% FSD		2%		2%		
RATED ACCURACY	±1.5% SPAN						
PURCHASE SPEC	158B7001P001		136B1921P001		136B1921P001		
VENDOR	SCLY		[illegible]		[illegible] INC		
CAT NO	11-PX2		[illegible]-6		17033-[illegible]		
LOCATION	9-21		LOCAL		LOCAL		
P&ID	728E940		728E941		728E941		
NOTES:							
* TO BE FILLED IN BY APED							PRINTS TO

MADE BY K. GOTO
DATE 24 Mar. Sep 25-69
APPROVED K.J. Allen 8/27/69
DIV OR DEPT NID
LOCATION SAN JOSE, CALIF
225A5600
CONT ON SHEET 99 SH NO. 98

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
Rev 0
ATTACHMENT N PAGE 1 OF 1

Table 4.2—Range of Applicability and Limits of Error* for Commercially Available Thermocouples and Extension Wire†

Type	Thermocouples: Temperature range, °F	Limits of error: Standard	Limits of error: Special	Extension wire: Temperature range, °F	Limits of error, °F: Standard	Limits of error, °F: Special
Copper—constantan	−300 to −75		±1%			
	−150 to −75	±2%	±1%			
	−75 to +200	±1½°F	±¾°F	−75 to +200	±1½	±¾
	200 to 700	±¾%	±¾%			
Iron—constantan	0 to 530	±4°F	±2°F	0 to 400	±4	±2
	530 to 1400	±¾%	±¾%			
Chromel—alumel	0 to 530	±4°F		0 to 400	±6	
	530 to 2300	±¾%				
Platinum—platinum + 10% rhodium or platinum + 13% rhodium	0 to 1000	±5°F		75 to 400	±12	
	1000 to 2700	±0.5%				

*Does not include use or installation errors.
†From American Society of Mechanical Engineers, Power Test Code 19.3, p. 23, 1961.

Table 4.3—Electromotive Force vs. Temperature (°F) for Thermocouples*

°F	Chromel—alumel (type K)	Iron—constantan (type J)	Copper—constantan (type T)	Chromel—constantan (type E)	Platinum—platinum + 10% rhodium (type S)	Platinum—platinum + 13% rhodium (type R)
0	0.00	0.00	0.000	0.00		
50	1.08	1.39	1.059	1.61	0.156	0.154
100	2.20	2.83	2.187	3.29	0.321	0.319
150	3.34	4.30	3.381	5.06	0.501	0.499
200	4.50	5.80	4.637	6.89	0.695	0.695
250	5.65	7.31	5.950	8.78	0.900	0.906
300	6.77	8.83	7.317	10.73	1.117	1.129
350	7.88	0.37	8.734	12.73	1.342	1.360
400	8.99	11.92	10.195	14.77	1.574	1.603
450	10.11	13.46	11.700	16.86	1.812	1.853
500	11.25	15.01	13.245	18.97	2.056	2.111
550	12.39	16.54	14.827	21.11	2.305	2.376
600	13.54	18.07	16.443	23.27	2.558	2.646
650	14.70	19.61	18.091	25.46	2.816	2.922
700	15.86	21.15	19.770	27.67	3.077	3.202
750	17.03	22.68	21.475	29.88	3.340	3.486
800	18.21	24.21		32.11	3.606	3.776
850	19.38	25.74		34.34	3.875	4.069
900	20.57	27.29		36.59	4.146	4.363
950	21.75	28.84		38.84	4.419	4.662
1000	22.94	30.41		41.08	4.696	4.967
1050	24.12	32.01		43.33	4.974	5.275
1100	25.31	33.61		45.58	5.256	5.587
1150	26.49	35.25		47.83	5.540	5.904
1200	27.66	36.90		50.06	5.826	6.224
1250	28.83	38.60		52.29	6.115	6.545
1300	30.00	40.32		54.52	6.407	6.872
1350	31.17	42.08		56.73	6.701	7.202
1400	32.33	43.85		58.94	6.997	7.535
1450	33.48	45.64		61.13	7.269	7.873
1500	34.61	47.42		63.32	7.598	8.215
1550	35.75	49.20		65.49	7.903	8.559

*From Instrument Society of America, Recommended Practices 1.7, Aug. 1, 1954.

CALCULATION/ANALYSIS REVIEW

CALCULATION NO. VYC-462C REVISION NO. 0

COMMENTS	RESOLUTION
This calculation has been reviewed IAW WE-103. Non-technical comments have been made to a mark-up copy and do not require formal resolution.	RESOLVED PER REVIEW 8/24/98 [illegible]
NO TECHNICAL COMMENTS	
[illegible] 8/10/98	

Identify method(s) of review:

- ☒ Calculation/analysis review
- ☐ Alternative calculational method
- ☐ Qualification testing

Resolution By: N/A
Preparer/Date

Comments Continued on Page: N/A

Concurrence with Resolution N/A Reviewer/Date

FORM WE-103-3
Revision 5

VERMONT YANKEE SETPOINT CONTROL PROGRAM
INTERDEPARTMENTAL REVIEW OF CALCULATION: VYC-462C Revision 0 ATT O

VYC- 462C Revision 0 has been prepared and independently reviewed. The Departments impacted by this calculation are requested to review the results of this calculation, concur with the results and/or recommendations, and document the department's acceptance prior to the calculation being approved.

1. Summary: This calculation evaluates the uncertainty & setpoint for *RCIC Steam Line High Temperature (HELB Detection).*

2. Calculation Open Items: AP-0028 to be Assigned

   2.1. *None* N/A

3. Department Review - contact the Setpoint Program Manager (G. Hengerle) if not in agreement with the conclusions/statements.

   3.1. Vermont Yankee E&C

   3.1.a. Procedure *OP-4366* Revision 12 will require the following (based on *Custom Technical Specifications /standard* surveillance cycle):

   1. Add the following in the procedure discussion:

      a. Limiting Setpoint:
         TS-13-79A-D/80A-D/81A-D/82A-D 187 °F for B, C, & D 191 for A

      b. As Found values:
         TS-13-79A-D/80A-D/81A-D/82A-D ~~±11 °F~~ 8°F

      fwA 10/14/99 ER 99-0733

      c. Revise Head to reflect: *NA*

      d. Insert the following M&TE requirements:
         Omega Omnical 4A, 8A, or CL-505A, or
         T/C reader

   2. In the body of the procedure and the data sheet revise as follows:

	From	To
a. Calibration Tolerance *TS-13-79A-D/80A-D/81A-D/82A-D*	±5 °F	±5 °F
b. Trip Setpoint *TS-13-79A-D/80A-D/81A-D/82A-D*	185 °F	185 °F

      c. Revise calibration data to reflect head correction of: *NA*

ATT. O

d. Insert a 9-point calibration for all analog instruments: NA

Transmitter [Equipment ID] Input	Output	Recorder [Equipment ID] Input	Output	Indicator [Equipment ID] Input	Output	Square Root Converter [Equipment ID] Input	Output	Other [Equipment ID] Input	Output
0%	mA								
25%	mA								
50%	mA								
75%	mA								
100%	mA								

3.1.b. The following comments/recommendations apply:

Concur

1. *Incorporate the above changes.* ☑

Sign & Date Roy D Gregor / 9/8/98
Vermont Yankee E&C Representative

3.2. Vermont Yankee Reactor Engineering

Concur

3.2.a. *None* ☒

Sign & Date MPBenoit for DJMANNAI / 9/24/98
Vermont Yankee RE Representative

3.3. Vermont Yankee Operations

PLACE A NIGHT ORDER DISCUSSING

Concur

3.3.a. Operations should ~~administratively limit (standing orders)~~ B ☒ the maximum acceptable setpoint to 196° F in lieu of the 212° F presently allowed by the Vermont Yankee Technical Specifications. An ER has been generated to address this issue.

Sign & Date / 9/24/98
Vermont Yankee Operations Representative

3.4. Vermont Yankee Systems Manager

	Concur	Comments
3.4.a. This analysis supports the design bases for the RCIC System.	☑	None

Sign & Date Ralph Barfield / 10/1/98
Vermont Yankee System Engineering Representative

3.5. YNSD Nuclear Engineering

		Concur	Comments
3.5.a. Custom Technical Specifications			
1. Analytical Limit used in setpoint determination:	196° F*	☑	
2. Potential accident trip (LOCA):	NA	☑	
3. Potential accident trip (HELB):	196° F*	☑	
3.5.b. Improved Technical Specifications			
1. Analytical Limit used in setpoint determination:	196° F	☑	
2. Potential accident trip (LOCA):	NA	☑	
3. Potential accident trip (HELB):	196° F	☑	

* See Section 3.1 and comment 1 (200°F used for switches inside steam tunnel)

Sign & Date Mark LeFrancois / 10/29/98
YNSD NED Representative

3.6. Vermont Yankee DBD Manager

		Yes	No
3.6.a.	The RCIC DBD should reference this analysis.		
	The DBD is complete (an AP-0028 to follow)	☐	☑
	The DBD is not complete. Incorporate reference to this analysis as appropriate.	☑	☐

Sign & Date [signature] / 10-29-98
ISP Program Manager

3.7. Vermont Yankee Licensing

		Impact	Yes	No
3.7.a.	FSAR Changes (AP-0028 to follow)	Table 7.3.2	☑	☐
3.7.b.	Other impact on licensing basis:		☑	☐

The CTS has a limit of ≤212°F. The Analytical Limit is 196°F. It is not acceptable to have an AL < CTS as this would allow the instrument setpoint to be above 196°F (outside the analysis limits). Either the NED analysis needs to be revised to use a value of ≥212°F or the CTS Limit needs to be lowered to 196°F. An ER has been generated to address this condition. AN AP0028 WAS PREVIOUSLY ISSUED TO LICENSING TO INVESTIGATE THIS ISSUE.

Sign & Date [signature] / 10-29-98
ISP Program Manager

3.8. Vermont Yankee ITS Manager

		Yes	No
3.8.a.	This analysis provides an input to the ITS. An Allowable Value applies.	☑	☐
	Allowable Value = 194°F (OUTSIDE STEAM TUNNEL) 198°F (INSIDE STEAM TUNNEL)		
3.8.b.	This analysis provides an input to Technical Requirements Manual. Incorporate as appropriate.	☐	☑

Sign & Date [signature] / 10-29-98
ISP Program Manager

3.9. Other Department(s)/Program(s) (None)

		Concur
3.9.a.	Impact assessment/recommendations: NA	☐

Sign & Date [signature] / 10-29-98
ISP Program Manager

4. Setpoint Program Manager

	Completed
4.1. Concurs with above.	☑
4.2. Interdepartmental Review form (copy/steps 1 through 3) incorporated into calculation.	☑
4.3. Calculation has been approved.	☑ Approved on 11-5-98
4.4. AP-0028 commitments have been assigned and forwarded for incorporation into the Commitment Tracking System.	☑

Sign & Date [signature] / 11-9-98
ISP Program Manager

ATT 0

5. *Post-Approval Requirements*

a. E&C (perform as appropriate):
- Initiate AP0022 Setpoint Change Request — AP0028 VYC0462CR0-01
- Update MPAC
- Revise calibration/functional/logic test procedure
- Inform the following after changes are implemented:
  - Setpoint Coordinator
  - Setpoint Program Manager
  - Training (notified via AP-0022 if initiated)
  - Operations (notified via AP-0022 if initiated)
  - Design Engineering

b. Setpoint Program Manager: Update Program Manual (after step 5.a). — AP0028 VYC0462CR0-02

c. Setpoint Coordinator: Update Setpoint Data Base (after step 5.a) — AP0028 VYC0462CR0-03

d. Design Engineering: Initiate FSAR/DBD changes, as appropriate (if DBD has been completed — AP0028 VYC0462CR0-04

Comments:

1) An ER has been generated to address the condition where AL<CTS

e. Design Engineering: Investigate need to revise EQ Program Manual temperature limits (200° F applies inside steam tunnel, 196° F applies outside steam tunnel) for HPCI, RCIC & MS small break HELBs. — AP0028 VYC0462CR0-05

SYSTEM ENGINEERING REVIEW FORM

Document VYC-463 Revision 3
Turbine Control Valve Fast Closure / Load Reject System

Comment	Resolution
No Comments	

Ralph Banfield 10/1/93
Reviewer Signature Date

Document Originator Date

Reviewer Signature Date

G1-289
YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. YYC-462C
REV 0
ATTACHMENT P PAGE 1 OF 3

QDR 9.4
REV.5

X-2.3 Post-Accident Functional Tests

X-2.3.1 Visual Inspection

The test items were visually inspected per Paragraph X-1.3.1. The only noted observation was a slight discoloration on one of the Amphenol connectors (surface tarnish through protective coating). The discoloration does not affect the operation of the test item. The inspection sheets are presented in Appendix X-A.

X-2.3.2 Functional Tests

The following functional tests were performed per Paragraph X-1.3.2 on items #2 and #5 (the items that were subjected to the LOCA/HELB simulation).

X-2.3.2.1 Set Point Determination

The set points of items #2 and #5 were measured and found to be within the original specified $\pm 6^{\circ}F$ acceptance criterion. This is especially noteworthy in that the set points changed by $+2.2^{\circ}F$ (item #2) and $-0.2^{\circ}F$ (item #5) when comparing the functional test values before and after the LOCA/HELB simulation. In fact, the switches remained in calibration throughout the entire test program without any adjustments (calibrations). This performance also continued through the tests of Section XI, Humidity/Cycling.

Data is presented in Appendix X-A.

X-2.3.2.2 Contact Resistance

The contact resistance of items #2 and #5 was measured at 0.039 and 0.037 ohm, respectively. These are acceptable values. Data is presented in Appendix X-A.

X-2.3.2.3 Insulation Resistors

The insulation resistance of both test items was 2×10^{12} ohms (wire to case and wire to wire with open contacts). These are acceptable values. Data is presented in Appendix X-A.

X-3.0 SUMMARY

The test items (#2 and #5) were subjected to environmental conditions as described in the test report in Appendix X-B. The test items were powered and monitored as required with no problems experienced. The functional tests following the accident simulation were satisfied (all acceptance criteria were met).

Report No. 50-3668-1

G1-188

Customer Patel Engineering
Customer P.O.# 255
MEDTHERM Job No. 50-3668

QDR 9.4
REV 5

Test Date 9/2/83

FENWAL TEMPERATURE SWITCH P/N 01-83001
FUNCTIONAL TEST: Post Seismic Simulation

Tag No.	S/N	Target Set Point, °F
1	1	135 ±5
2	2	135 ±5
3	3	180 ±5
4	4	180 ±5
5	5	212 ±5

Tag No.	Pre-Test Room Temp. Contact Res., ohms	°F at Break 1st	2nd	3rd	Avg.
1					
2	.036	137.1	137.0	137.0	137.0
3					
4	See Note (a)	177.0	176.9	176.8	176.9
5	.041	216.2	216.1	216.2	216.2

Isolation Resistance @500 VDC, Megohms, 10°F above Breakpoint

Tag No.	Between Wires	One Wire to Case	Other Wire to Case
1			
2	2000K	2000K	2000K
3			
4	2000K	2000K	2000K
5	2000K	2000K	2000K

NOTES:
a) No. 4 lead wire into switch has intermittent contact. Received at MEDTHERM in damaged condition after seismic test, apparently pulled from seismic test fixture by lead wires.

F. J. Bekett
Tested by

9/2/83
Date

MEDTHERM CORPORATION
POST OFFICE BOX 412
HUNTSVILLE, ALABAMA 35804

CODE IDENT NO 55103 | DWG SIZE A | SHEET

A8
QDR 9.4
Rev.5

-100 to 600° F/-73 to 316° C

TEMPERATURE RANGE	CONTACT OPERATION ON TEMP. RISE	SHELL AND HEAD MATERIAL	STANDARD LEAD WIRE LENGTH	APPROX. DEGREES CHANGE PER FULL TURN OF ADJUSTING SLEEVE	EXTREME TEMPERATURE EXPOSURE	CURRENT RATING	FACTORY TEMPERATURE SETTING TOLERANCE (MOD.#3)	APPLICABLE MODIFICATIONS (Modifications and Special Features listed on Page 7 & 8)	APPLICABLE SPECIAL FEATURES
-100 to 400°F/ -73 to 204°C UL CSA	Opens	Brass	8" to 10"	90°F/50°C	Unless otherwise specified, all ratings apply to noninductive loads such as heaters or resistors. Tungsten filament lamps have an inrush ten to 15 times the steady state current. Do not exceed ratings....			1 2 3 4 14	31 34 35
	Closes			80°F/44°C					
-100 to 600°F/ -73 to 316°C	Opens	Type 321 S.S. Shell		110°F/61°C					
	Closes			100°F/56°C					
-100 to 400°F/ -73 to 204°C UL CSA	Opens	Brass	8" to 10"	80°F/44°C	Units that open on temperature rise: -100°F/-73°C indefinitely and 100°F/38°C above Set Point for one hour maximum	* AC 10 amps 120 volts 5 amps 240 volts (non-inductive) DC ratings consult factory	UNITS THAT OPEN ON TEMPERATURE RISE (Indicated by the 4th and 5th digits of Catalog Number, i.e. 00 or 02) ±5°F from -100 to 100°F ±3°F or 2% of Setting Value (whichever is greater) From 100° to 600°F	1 thru 14, 27	3 34 35
	Closes			75°F/42°C					
-100 to 600°F/ -73 to 316°C	Open	Type 321 S.S. Shell Brass Head		100°F/56°C					
	Closes			90°F/50°C					
-100 to 400°F/ -73 to 204°C UL CSA	Opens	Brass	8" to 10"	80°F/44°C	Units that close on temperature rise: -100 to 400°F/-73 to 204°C -100°F/-73°C indefinitely and 500°F/260°C for one hour maximum			1 thru 14, 27	31 34
	Closes			70°F/39°C					
-100 to 600°F/ -73 to 316°C	Opens	Type 321 S.S. Shell Brass Head		100°F/56°C					
	Closes			90°F/50°C					
-100 to 400°F/ -73 to 204°C UL CSA	Opens	Brass	8" to 10"	80°F/44°C	-100 to 600°F/ -73 to 316°C -100°F/-73°C indefinitely and 700°F/371°C for one hour maximum		UNITS THAT CLOSE ON TEMPERATURE RISE (Indicated by the 4th and 5th digits of Catalog Number, i.e. 21 or 23) ±5°F or 3% of Setting Value (whichever is greater)	1 thru 14, 27	31 34
	Closes			70°F/39°C					
-100 to 600°F/ -73 to 316°C	Opens	Type 321 S.S. Shell Brass Head		100°F/56°C					
	Closes			90°F/50°C					
-100 to 400°F/ -73 to 204°C CSA	Opens	Brass	Terminal Block	125°F/69°C				1 3 16	31 34
	Closes			75°F/42°C					
-100 to 600°F/ -73 to 316°C	Opens	Type 321 S.S. Shell Brass Head		160°F/89°C					
	Closes			90°F/50°C					
-100 to 400°F/ -73 to 204°C UL CSA	Opens	Brass	6" to 8"	80°F/44°C				1 2 3 4 14 27	31 34 35
	Closes			75°F/42°C					
-100 to 600°F/ -73 to 316°C	Opens	Type 321 S.S. Shell Brass Head	6" to 8"	100°F/56°C					
	Closes			90°F/50°C					

Temperature Offsets due to pressure (approx. only)	
Pressure psi	Setpoint Offset
100	+3°F/2°C
200	+6°F/3°C
300	+9°F/5°C
400	+12°F/7°C
500	+15°F/8°C
Collapsing pressure (brass shell) 1400 psi at room temp.	
Collapsing pressure (S.S. shell) 3000 psi at room temp.	

U.L. File No. 18974
UL Recognized under the Component Program of Underwriters Laboratories, Inc. (XAPX2)
Underwriters Laboratories Listed (XAPX)
CSA File No. LR7378
Certified by Canadian Standards Association (Guide No. 400-E-0)

* UL, U.L. and CSA units rated for AC operation only.

YANKEE ATOMIC ELECTRIC COMPANY
CALCULATION NO. VYC-462C
Rev 0
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Telecon Record

Date: 8/24/98
Purpose: E&C Review of Preliminary Calc Inputs
From: Michael Anderson 518-251-2559/978-779-6711 x2639
To: Roy Gregor
Calculation: VYC-462C

Discussion:
To facilitate timely calculation preparation, the following calculation sections regarding design input have been provided to VY E&C for review and comment:

Section	Subject
1.2	Systems / Components
1.3	Loop Function
2.2	Assumptions
3.1	Process & Loop Data
4.1.4	M&TE

PROCEDURE REVIEW PORC MEMORANDUM VYC-462

To PORC From R. A. Barfield Date 5/20/96

Procedure No.: OP4366 Rev: 12 [X]Biennial Review [ ]Partial Review

Title: RCIC STEAM LINE TUNNEL/SPACE HIGH TEMPERATURE FUNCTIONAL CALIBRATION TEST

The procedure was reviewed against Technical Specification section(s) 3.2/4.: for applicability, with no concerns noted.

The procedure was reviewed against FSAR section(s) 4.7 & 7.3 for applicability with no concerns noted.

Review of YOQAP-1A is not required. Procedure is written to AP 031(requirements, with AP 0310 reviewed to YOQAP requirements.

These changes do not require a 10CFR50.59(a)(2) based upon the 10CFR50.59(a)(1) screening criteria in AP 6002.02.

VERMONT YANKEE DESIGN ENGINEERING
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Summary of changes:

In the Surveillance Setpoint Criteria table, changed TS-13-81A,B,C,D in the bottom row to TS-13-82A,B,C,D.

Changed Reference g. from AP-0021 to AP-0047 (Work Order Request). Same change ade for Precaution #3.

Added "Associated Relays" to step 2 of VYOPF 4366.01 to match procedure step.

Added to VYOPF 4366.02 "M/TE (VY SN/Due Date)" for recording of M/TE used for calibration. None needed for Functional Test.

Added a paragraph at the end of the Discussion section to discuss how the functional and calibration are performed. Also added why the temperature switch is preheated when performing the calibration. Tech Spec Procedure review project comment PC-2 and PC-5.

Added Acceptance Criteria #3, "All applicable EQ requirements satisfied". Tech Spec Procedure Review Project comment PC-4. Other procedures include this requirement when working on EQ related components.

The following addition Tech Spec Procedure Review comments did not result in any procedure changes and are documented here.

Comment PC-1 concerning influences of test conditions. The procedure contains a note to alert the performer to be as consistent with his testing as possible. The calibration is performed by installation of a test heater that is prefabricated. This minimizes the effect of any external influences since the heater is placed directly over the temperature switch and the thermocouple is already attached to the temperature switch. The speed of temperature change is omewhat limited since the voltage to the heater is controlled. No new procedure nhancements are made due to this comment.

Comment PC-3 concerning calculation VYC-462 and the calibration equipment error of .5% versus up to 4 Deg F for type K thermocouple is a valid concern. This additional error will not affect the actual trip point since the trip point is set conservative in relation to the tech spec value. The total error is also below the FSAR accuracy limit if the 4 Deg is added to the present total loop error. Calculation VYC-462 will need revision by YNSD to incorporate thermocouple errors different from that presently stated in the error analysis. No procedure change is made by this comment and the present setpoints satisfy the Tech Spec setpoint. A copy of this PORC memo sent to Roger Vibert (YNSD)

Resolved per VYC-462C
9/10/98

Training required: Formal [ ] Departmental [ ] None [x]

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ıbmitted By Ralph A. Bonfiglio Date 5/22/96

MEMORANDUM

VERMONT YANKEE DESIGN ENGINEERING - BOLTON

VERMONT YANKEE DESIGN ENGINEERING
CALCULATION NO. VYC-462C
REVISION NO. 0
ATTACHMENT S PAGE 1 OF 4

To:	R.T. Vibert	**Date:**	October 5, 1998
		Group #:	VYE 98/214
From:	G.J. Hengerle	**WO #:**	
Subject:	Assessment of VYC-462A,C & D Temperature Limits	**IMS #:**	
		File #:	MEMO-VYC-462A,C,D

Background:

VYC-462A, C & D evaluate the setpoint & uncertainty associated with the Main Steam, RCIC & HPCI steam line area high temperature switches. The Technical Specification limit associated with these switches is 212 F. DE&S THSAG used an analytical limit of 196 F in support of the EQ Program for evaluation of High Energy Line Breaks. The Appendix R/Station Blackout analysis assumes a limiting high temperature of 174 F in the Steam Tunnel. The following provides a discussion on how these limits interact.

Discussion:

The DE&S THSAG ran a small break steam line break analysis was completed to support of the EQ Program. The analytical limit used in the analysis is 196 F. The analysis assumes that when temperature reaches 196 F the steam line will isolate on high temperature by tripping the associated high temperature switches (following the appropriate time delay). VYC-462A, B & C address the high temperature trip requirements associated with the Main Steam, RCIC & HPCI steam line areas. The limiting condition for these analyses is not the existing Technical Specification limit of 212 F, but the 196 F in the small break HELB analysis.

VYC-462D (HPCI steam line area temperatures) requires a setpoint change to support the 196 F limit. However, the setpoint change must also support the lower limit of 174 F. The 174 F limit is based on the Appendix R/Station Blackout scenario where the Main Steam tunnel can heat up but HPCI & RCIC must not isolate. VYC-462D determined that the Limiting Setpoint is 183 F, with a recommended setpoint of 180 F. The two limits (≥174 F and ≤196 F) make a setpoint change that accommodate both conditions difficult.

An evaluation of the DE&S NED THSAG analysis was conducted. The following has been concluded:

1. The 196 F limit used in the analysis is relied on to isolate the HPCI & RCIC steam lines for small breaks outside the Main Steam Tunnel. These analyses were developed to directly support the EQ Program.

2. Analyses of HELBs in the Main Steam Tunnel were completed using a 196 F analytical setpoint. The results of these analyses are not directly used in the EQ Program. The EQ Program uses a enveloping temperature profile for evaluation of small steam line breaks in the Main Steam Tunnel (EQ Program Figure SB ST-41). Per the EQ Program Manual (Section 7.5.5 paragraph 5), the limiting temperature that applies is 200 F.

Conclusion:

VYC-462A, C & D will use an analytical limit of 196 F for the temperature switches located outside the steam tunnel and 200 F for the switches located within the steam tunnel.

George J. Hengerle
Principal Engineer
Vermont Yankee Design Engineering

Ed Goodwin
Project Manager II
Duke Engineering & Services

C:

R.G. January
D.E. Yasi
R.T. Vibert

COMPONENT SAFETY C ICATION WORKSHEET

Component I.D. No. TS-13-79A-D, 80A-D, 81A-D, 82A-D System: RCIC

Description: RCIC STEAM LINE AREA TEMPERATURE SWITCHES

VYSCM1, Rev. 6 Sht. 1 of 2

Does the component perform a Mechanical function? If "yes", proceed to Part I. If "no", proceed to Part IV. Yes ☐ No ☒

I. Does the component perform any of the following functions?

a. Forms part of the reactor coolant pressure boundary such that failure could result in leakage of reactor coolant greater than that from a 3/4" nominal pipe size. ☐ ☐

b. Provides mechanical support to any portion of the reactor coolant pressure boundary. ☐ ☐

If any of the items above are checked "yes", component is Safety Class 1 (SC1).

If component is Safety Class 1, check box and proceed to Part IV. ☐

If all responses are "no", proceed to Part II.

II. Does the component perform (or could its failure prevent) any of the following functions?

a. Inserting negative reactivity to shut down the reactor. ☐ ☐

b. Prevents rapid insertion of positive reactivity ☐ ☐

c. Maintains core geometry appropriate to all plant conditions. ☐ ☐

d. Provides or maintains primary or secondary containment integrit ☐ ☐

e. Removes residual heat from the reactor and reactor core. ☐ ☐

f. Stores spent fuel or prevents uncovering spent fuel. ☐ ☐

g. Piping and components which form part of the reactor coolant pressure boundary but whose rupture would not result in leakage greater than that from a 3/4" nominal pipe size. ☐ ☐

h. Provides mechanical support to any of the above. (II. a-g) ☐ ☐

If any items above are checked "yes", component is Safety Class 2 (SC2)

If component is Safety Class 2, check box and proceed to Part IV. ☐

If all responses are "no", proceed to Part III.

III. Does the component perform (or could its failure prevent) any of the following functions?

a. Processes or houses radioactive wastes where failure of that single component or structure would result in a whole body dose (or equivalent to any part of the body) to a person at the site boundary of 500 mrem or greater. ☐ ☐

b. Provides or supports any safety system function. ☐ ☐

c. Removes decay heat from the spent fuel pool. ☐ ☐

d. Provides mechanical support to any of the above (III.a-c) ☐ ☐

If any items above are checked "yes", component is Safety Class 3 (SC3)

If component is Safety Class 3, check box and proceed to Part IV. ☐

If all responses are "no", proceed to Part IV.

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IV. Is the component Electrical/I&C related? If "yes", proceed to Part V. If "no", proceed to Part VII. Yes ☒ No ☐

V. Is the component essential in performing or permitting an associated component to perform a safety function? ☒ ☐

Is the instrument used for a Post Accident Monitoring function required to be Safety Class? ☐ ☒

If above is checked "yes", then component is Safety Class Electrical (SCE)

If component is Safety Class Electrical, check box and proceed to Part VII. ☒

If response is "no", proceed to Part VI.

VI. If all of the response in Parts I, II, and III, are answered "no", the component is Non-Nuclear Safety (NNS) for Mechanical functions. Check box and proceed to Part VII. ☐

If all of the responses in Part V are answered "no", the component is Non-Nuclear Safety (NNS) for Electrical functions. Check box and proceed to Part VII. ☐

VII. Other Items Requiring QA (OQA) is an optional subset of the NNS classification category. If the component is subject to non-safety related regulatory requirements or other special requirements, check box and provide special requirements in Section IX. Proceed to Part VIII. ☐

VIII. Summary: From the above, the component has been determined to be (check one box in each section).

Mechanical Function			Electrical/I&C Function	
SC1 ☐	SC2 ☐	SC3 ☐	SCE ☒	NNS ☐
NNS ☐	No Function ☒	OQA ☐	No Function ☐	OQA ☐

IX. Basis:

SEE ATTACHED

Use Sheet 2 of 2 if necessary.

Check box if Sheet 2 of 2 is used ☒

Originator: [signature] Reviewer: [signature]

Date: 10-20-98 Date: 10-21-98

Entered into MPAC Database: TP ERC Date

Safety Class Worksheet
RCIC Steam Line Area High Temperature Trip Switches
TS-33-79A-D/80A-D/81A-D/82A-D

These switches monitor the temperature in the vicinity of the RCIC steam lines (including the RCIC lines in the Main Steam Tunnel). On a high temperature, associated with a small break RCIC HELB, the switches will sense high temperature and cause the RCIC isolation valves to close. This function is necessary to support the RCIC HELB temperature profiles in the VY EQ Program and also isolates a radiological release path. In addition, the VY Technical Specification bases describe the ability to isolate a 5 to 10 gpm leak in the Main Steam Tunnel. These functions are Safety Class Electrical (SCE).

Appendix R/Station Blackout relies on RCIC availability. Analysis indicates that the Main Steam Tunnel heats up during this scenario. The temperature switches cannot be set to trip such that RCIC reliability is challenged. Appendix R/Station Blackout support is Non-Nuclear Safety related (NNS).