VERMONT YANKEE
NUCLEAR POWER CORPORATION
185 OLD FERRY ROAD, PO BOX 7002, BRATTLEBORO, VT 05302-7002
(802) 257-5271

August 24, 2000
BVY 00-75

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Reference: (a) Letter, VYNPC to USNRC, "Request for Relief from the American Society of Mechanical Engineers Code for Repair of a Reactor Building Recirculation Unit," BVY 00-50, dated June 1, 2000.

(b) Letter VYNPC to USNRC, "Supplement to Request for Relief from the American Society of Mechanical Engineers Code for Repair of a Reactor Building Recirculation Unit," BVY 00-69, dated August 11, 2000.

Subject: **Vermont Yankee Nuclear Power Station**
License No. DPR-28 (Docket No. 50-271)
Supplement Number 2 to Request for Relief from the American Society of Mechanical Engineers Code for Repair of a Reactor Building Recirculation Unit

In reference (a), Vermont Yankee (VY) requested, pursuant to 10 CFR 50.55a(g)(5)(iii), approval to delay the repair of an intermittent pin-hole leak on Reactor Building Recirculation Unit No. 8 (RRU-8) until the scheduled 2001 refuel outage. Reference (b) provided a summary of the structural analysis that was performed to support the request. Based on additional discussions with NRC staff, the attached calculation is provided for your review. The calculation is current as of the date of this submittal and it is not VY's intent to maintain the docket current with regard to future revisions to this calculation.

We trust that this information is adequate to support the requested action, however; should you need additional information please contact Mr. Jim DeVincentis at (802) 258-4236.

Sincerely,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Gautam Sen
Licensing Manager

Attachment
cc: USNRC Region 1 Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS
Vermont Department of Public Service

A047

Docket No. 50-271
BVY 00-75

Attachment 1

Vermont Yankee Nuclear Power Station

VYC-2134 "Structural Assessment of Reactor Recirculation Unit Number 8 (RRU-8)

Cooling Coil Pin Hole Leak"

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VY CALCULATION TITLE PAGE

VYC-2134	0	N/A	N/A
VY Calculation Number	Revision Number	Vendor Calculation Number	Revision Number

Title: Structural Assessment of Reactor Recirculation Unit Number 8 (RRU-8) Cooling Coil Pin Hole Leak

QA Status: X SC ☐ NNS ☐ OQA _____ Operating Cycle Number 22

Calculation Supports A Design Change/Specification? ☐ Yes X No N/A
VYDC/MM/TM/Spec No.

Calculation Supports An Independent Analysis? ☐ Yes X No _____ N/A _____
Reference

Calculation Done as a Study Only? ☐ Yes X No

FOR INFORMATION ONLY

Safety Evaluation Number: N/A

Superseded Calculation Number, Title and Revision: N/A

Computer Code(s) N/A

Review and Approval: (Print and Sign Name)

Preparer: KF BEARDSLEY / KF Beardsley Date: 7/27/00

Interdiscipline Reviewer(s): N/A Date: —

Independent Reviewers(s): JAMES C. FITZPATRICK Date: 7/27/00

Approved: SD Goodwin SD Goodwin Date: 7.31.00

Open Items Associated with Calculation? ☐ Yes X No ☐ Closed _____ Total No. Pages in Package (including all attachments)
TOTAL = 22 PAGES

Installation Verification N/A

X Calculation accurately reflects plant as-built configuration, OR
☐ N/A, calculation does not affect plant configuration

KF BEARDSLEY / KF Beardsley / 7/27/00
Printed Name / Signature / Date

VY CALCULATION DATABASE INPUT FORM

VYC- 2134 | 0 | N/A | N/A
VY Calculation/CCN Number | Revision Number | Vendor Calculation Number | Revision Number

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

Originating Department: VY MECHANICAL / STRUCTURAL DESIGN ENGINEERING

Implementation Required? ☐ Yes X No

FOR INFORMATION ONLY

Asset/Equipment ID Number(s): RRU-8

Asset/System ID Number(s): HVAC

Keywords: Reactor Recirculation Unit, RRU-8, Leak, Service Water

General References

Reference #	Reference Title (including Rev. No. and Date, if applicable) (See App. A, Section 3.2.7 for Guidance)	Critical Reference (_)
1	Event Report (ER)2000-0221	
2	Drawing 5920-11864, RRU-7 and 8 Coil Replacement, Revision 1, shts 1 and 2	
3	VY Drawing VYI-SW-Part-10A, Piping Isometric Drawing Service Water South East Corner Rooms (SW), Part 10A, Revision 2	
4	VYM 00/046, Structural Assessment of Reactor Recirculation Unit Number 8 (RRU-8) Cooling Coil Pin Hole Leak	
5	Power Piping Code , B31.1 – 1977 Edition	
6	EES / CYGNA Piping Stress reanalysis, Problem 120, Calculation Set No. PI-120, VY Microfilm Roll 441 (Revision 1)	

Design Input Documents - The following documents provide design input to this calculation. (Refer to Appendix A, section 4)

Document #	Document Title (including Rev. No. and Date, if applicable)	Critical Reference (_)
1	EES / CYGNA Piping Stress reanalysis, Problem 120, Calculation Set No. PI-120, VY Microfilm Roll 441 (Revision 1)	

Design Output Documents - This calculation provides output to the following documents. (Refer to Appendix A, section 5)

Document #	Document Title	Critical Reference (_)
	N/A	

TABLE OF CONTENTS

SECTION	PAGE NO.
Cover Sheet	1
VY Calculation Database Input Form (VYAPF 0017.07)	2
List of Affected Pages (if required)	N/A
Table of Contents	3
Calculation Objectives	4
Summary of Results	4
Method of Solution	4
Assumptions	4
Calculation	5-12
Conclusion	13
VYAPF 0017.05, Calculation Review Form	14

Attachments (including Compact Disc (CD) computer files)

1.	Anchor Load Summary at RRU-8 (From EES/ CYGNA Piping Stress Reanalysis, Problem 120)	1 Page
2.	Stress Intensification Factor for use with brazed copper connections, (Memorandum dated June 6, 1983, From EES/ CYGNA Piping Stress Reanalysis, Problem 120)	2 Pages
3.	Event Report ER-2000-0221	5 Pages

FOR INFORMATION ONLY

OBJECTIVE – Provide a brief description of the purpose or objective of the calculation. (See Appendix A, Section 3.2.1)

The VY Operations Department identified a pin hole leak at an internal joint of Reactor Recirculation Unit No. 8 (RRU-8). This calculation will assess / evaluate the structural stability of the RRU-8 inlet stub connection with the identified flaw / pin-hole, in support of a code relief request deferring repair of the unit until RFO-22. This calculation represents the as found field condition of the plant and as such a 50.59 evaluation is not required.

SUMMARY OF RESULTS – Provide a summary of the results of the calculation with respect to the stated objective. (See Appendix A, Section 3.2.2)

The calculation demonstrates that the identified defect / pin hole does not compromise the overall structural integrity of the brazed copper tubing joint.

METHOD OF SOLUTION – Provide a summary description of the calculation's overall approach and methodology. (See Appendix A, Section 3.2.3)

Standard hand calculation techniques are utilized to assess the structural stability of the joint. See page 5 of this calculation for additional discussion.

FOR INFORMATION ONLY

ASSUMPTIONS – Identify all assumptions used in the calculation. Document the bases for any engineering judgements made. Any unvalidated assumptions shall be listed on VYAPF 0017.05. (See Appendix A, Section 3.2.4)

None

CALCULATION – Perform the calculation showing adequate detail to enable a reviewer to understand the calculation without discussion with the preparer. All Design Inputs, Outputs, and References shall be identified as required by the procedure and listed on VYAPF 0017.07. (See Appendix A, Section 3.2.5)

See the evaluation contained on pages 5 thru 12 of this calculation.

CONCLUSIONS – Summarize the calculation's results and simply state how the objective of the calculation has been met. State any interactions with precursor/successor calculations. State any impacts to plant documentation or hardware, referencing VYAPF 0017.07 as applicable. (See Appendix A, Section 3.2.6)

See Page 13 of this calculation.

ATTACHMENTS – Attach all required procedure forms and any necessary supporting documentation. (See Appendix A, Section 3.2.8)

Calculation:

During a routine plant tour, the VY Operations Department identified a "pin-hole" leak at an internal joint of Reactor Building Recirculation Unit No. 8 (RRU-8). The leak is located on the inlet stub connection for the cooling coil where it joins the cooling coil's inlet header manifold. The inlet stub connection is a 2 ½ inch diameter class M copper tube (i.e., 2.625 inch OD, 0.065-inch wall thickness – Reference 2). The leak rate at the time of discovery was approximately 20 ml/minute. Since that time, the leakage has stopped and the VY Operations Department continues to monitor the location.

The identified deficiency is a localized defect, associated with the brazed joint (see Attachment 3). The deficiency, caused by an original construction defect, is not a crack type flaw subjected to future growth under load. The 2.625 inch diameter brazed joint is intact with the exception of the pin hole area at the top of the joint. The design flow rate through the coil is 146 gpm. (Reference 1 and 2). Reference 1 documents that the "pin hole is < 1/16" in diameter" and at the time of discovery, the identified leakage was "approximately 20 ml / minute" (0.005 gpm).

This calculation will evaluate the joint for dead weight and seismic (OBE, SSE), and dead weight and thermal loading conditions. Bounding calculations considering circumferential flaw lengths of 1" and 2" will be evaluated. In doing so the structural integrity of the as found joint configuration will be demonstrated as the actual flaw length is < 1/16" (Reference 1). The analysis will evaluate the copper tubing in accordance with Reference 5.

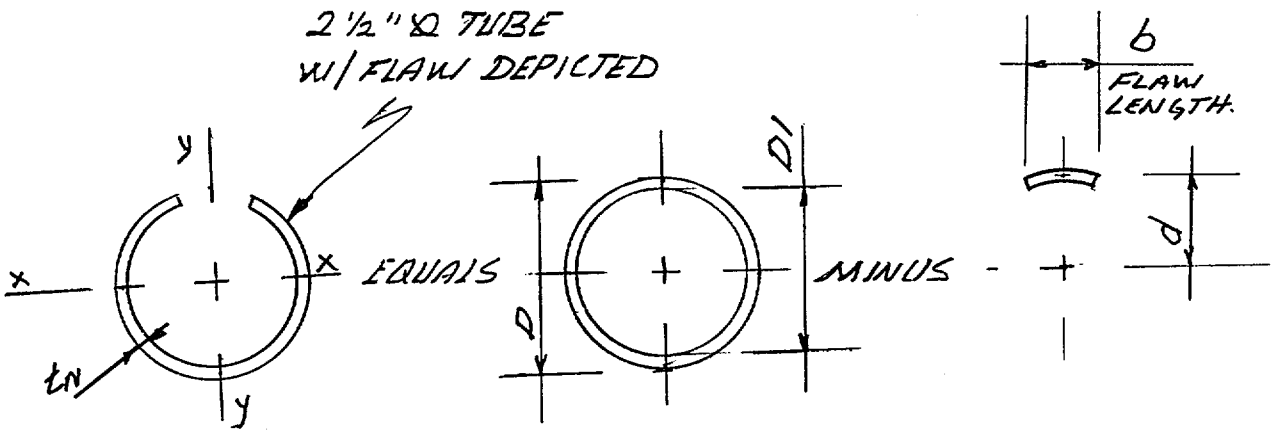
The analysis will calculate the resultant cross sectional properties of the tubing taking into account appropriate reductions for the flaw sizes discussed above. This will be accomplished by calculating the moment of inertia for an intact tubing cross section. The moment of inertia of a 1" and 2 " long portion of the tubing with respect to the tubing's centroidal axes will then be subtracted from the intact tubing moment of inertia. The section modulus will then be derived and resultant stresses calculated. This approach, while an approximation, provides sufficient accuracy with regards to calculation of the flawed tubing cross sectional properties.

FOR INFORMATION ONLY

Design Pressure $P := 125 \cdot \frac{lb}{in^2}$ Wall thickness $tn := 0.065 \cdot in$

(REF 6) Ref. 2

Design Temperature $T := 32$ to 150 degrees $D := 2.625 \cdot in$



$I_{Gx,y}$ (EQUALS) $I_{1x,y}$ (MINUS) $I_{2x,y}$

- NOTE: IN CALCULATING I FLAW IS CONSIDERED AS A FLAT RECTANGULAR SECTION.

Calculate IGx

$D1 := D - 2 \cdot tn$ $D1 = 2.495 \cdot in$

$I_{1x} := \frac{\pi}{64} \cdot (D^4 - D1^4)$ $I_{1x} = 0.4285 \cdot in^4$

$b := 1 \cdot in$ $A := b \cdot tn$ $d := \frac{D1}{2} + \frac{tn}{2}$

FOR INFORMATION ONLY

$I_{2x} := \frac{b \cdot tn^3}{12} + A \cdot d^2$ $I_{2x} = 0.1065 \cdot in^4$

$I_{Gx} := I_{1x} - I_{2x}$ $I_{Gx} = 0.322 \cdot in^4$

Calculate IGy

$b := 0.065 \cdot in$ $\qquad$ $y := 1 \cdot in$

$I_{1y} := I_{1x}$ $\qquad$ $I_{1y} = 0.4285 \cdot in^4$

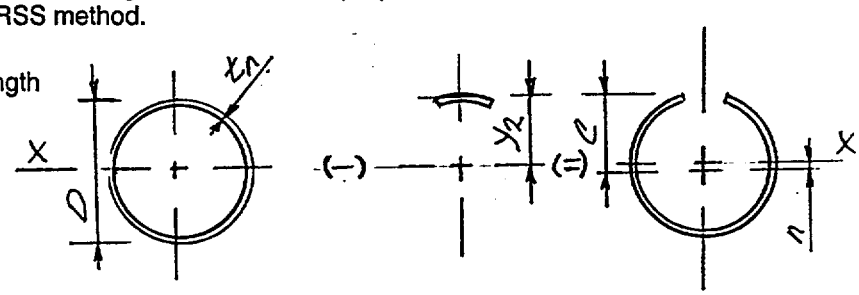
$I_{2y} := \frac{b \cdot y^3}{12}$ $\qquad$ $I_{2y} = 5.4167 \cdot 10^{-3} \cdot in^4$

$I_{Gy} := I_{1y} - I_{2y}$ $\qquad$ $I_{Gy} = 0.4231 \cdot in^4$

FOR INFORMATION ONLY

IGx is the limiting case therefore, use IGx when calculating overall sectional properties and resulting moments will be determined by the SRSS method.

Calculate shift in centroidal axis due 1" flaw length



$b := 1 \cdot in$ $\qquad$ $tn := 0.065 \cdot in$

$A1 := \pi \cdot D \cdot tn$ $\qquad$ $A2 := b \cdot tn$

$y1 := 0 \cdot in$ $\qquad$ $y2 := \frac{D}{2} - \frac{tn}{2}$ $\qquad$ $y2 = 1.28 \cdot in$ $\qquad$ $n := \frac{A1 \cdot y1 - A2 \cdot y2}{A1 - A2}$

$n = -0.1766 \cdot in$ $\qquad$ $c := \frac{D}{2} - n$ $\qquad$ $c = 1.4891 \cdot in$ $\qquad$ $S := \frac{I_{Gx}}{c}$

Calculate the resultant stress in the tubing for normal plus seismic loading conditions. Use equation 11 and 12 from Ref. 5, Section 104.8.1 and 104.8.2

$Mx := 11 \cdot lb \cdot ft$ $\qquad$ $My := 1 \cdot lb \cdot ft$ $\qquad$ $Mz := 39 \cdot lb \cdot ft$ $\qquad$ **Dead Weight Loading (Attachment 1)**

$i := 1.3$ $\qquad$ **Attachment 2** $\qquad$ $D1 := D - 2\,(tn)$ $\qquad$ $Z := S$

$Ma := \left(Mx^2 + My^2 + Mz^2\right)^{0.5}$ $\qquad$ $D1 = 2.495 \cdot in$ $\qquad$ $Z = 0.2162 \cdot in^3$

$Ma = 40.5339 \cdot lb \cdot ft$ $\qquad$ $Ma \cdot 12 \cdot \frac{in}{ft} = 486.4072 \cdot lb \cdot in$

Cross sectional area reduction due to the 1" flaw length

$Ar := \frac{\pi \cdot D \cdot tn}{\pi \cdot D \cdot tn - b \cdot tn}$ $b := 1 \cdot in$ $Ar = 1.138$

Therefore increase P(D)/4(tn) term by 14%

$.75 \cdot i = 0.975$ Therefore use 1.0 in piping stress equation

$fnorm := \frac{P \cdot D \cdot Ar}{4 \cdot tn} + \frac{1.0 \cdot Ma}{Z}$ **Ref. 5 - Eq. 11**

$fnorm = 3.6856 \cdot 10^3 \cdot \frac{lb}{in^2}$

$Mx1 := 9 \cdot ft \cdot lb$ $My1 := 29 \cdot ft \cdot lb$ $Mz1 := 11 \cdot ft \cdot lb$ **SSE Loading Attachment 1**

$Mb := \left(Mx1^2 + My1^2 + Mz1^2\right)^{0.5}$

$Mb = 32.2955 \cdot ft \cdot lb$ $Mb \cdot 12 \cdot \frac{in}{ft} = 387.5461 \cdot in \cdot lb$

FOR INFORMATION ONLY

$fsse := \frac{1.0 \cdot Mb}{Z}$ **Ref. 5 - Eq. 12**

$fsse = 1.7922 \cdot 10^3 \cdot \frac{lb}{in^2}$

$ftotal := fnorm + fsse$ **Ref 5 - Eq. 12**

$ftotal = 5.4778 \cdot 10^3 \cdot \frac{lb}{in^2}$ $f_{allow} := 6000 \cdot \frac{lb}{in^2}$ **Ref. 5**

Note allowable increase for occasional (OBE,SSE) loading conditions are not considered (conservative)

ftotal < fallow therefore OK

Note the evaluation above envelopes both the OBE and SSE load case as SSE moments were used in calculating ftotal with the resultant stress compared to the normal allowable limit.

Calculate the resultant stress in the tubing for normal plus thermal loading conditions. Use equation 11 and 14 from Ref. 5, Section 104.8.1 and 104.8.3

13 JCR

$Mx2 := 41 \cdot ft \cdot lb$ $My2 := 8 \cdot ft \cdot lb$ $Mz2 := 25 \cdot ft \cdot lb$ **Thermal Loading Attachment 1**

$Mc := \left(Mx2^2 + My2^2 + Mz2^2\right)^{0.5}$ $Z = 0.2162 \cdot in^3$

$Mc = 48.6826 \cdot ft \cdot lb$ $Mc \cdot 12 \cdot \frac{in}{ft} = 584.1917 \cdot in \cdot lb$ **Thermal Load Case**

$ftherm := \frac{i \cdot Mc}{Z}$ **Ref 5 - Eq. 13** $ftotal := fnorm + ftherm$ **Ref. 5 - Eq. 14**

$ftherm = 3.5121 \cdot 10^3 \cdot \frac{lb}{in^2}$ $ftotal = 7.1977 \cdot 10^3 \cdot \frac{lb}{in^2}$

$Sh := 6000 \cdot \frac{lb}{in^2}$ $Sc := 6000 \cdot \frac{lb}{in^2}$ $f := 1.0$ Ref. 5

FOR INFORMATION ONLY

$Sa := f \cdot (1.25 \cdot Sc + 0.25 \cdot Sh)$ Ref 5 $Sa = 9 \cdot 10^3 \cdot \frac{lb}{in^2}$

$fallow := Sh + Sa$ Ref 5 $fallow = 1.5 \cdot 10^4 \cdot \frac{lb}{in^2}$

ftotal < fallow therefore OK

Check for 2.0" flaw considering allowable increase of 1.8 SSE and applicable thermal load case allowable stress limit.

$D := 2.625 \cdot in$ Reference 2 $D1 := D - 2 \cdot tn$ $D1 = 2.495 \cdot in$

Calculate IGx

$I_{1x} := \frac{\pi}{64} \cdot (D^4 - D1^4)$ $I_{1x} = 0.4285 \cdot in^4$

$b := 2.0 \cdot in$ $A := b \cdot tn$ $d := \frac{D1}{2} + \frac{tn}{2}$

$I_{2x} := \frac{b \cdot tn^3}{12} + A \cdot d^2$ $I_{2x} = 0.213 \cdot in^4$

$I_{Gx} := I_{1x} - I_{2x}$ $I_{Gx} = 0.2155 \cdot in^4$

$b := 0.065 \cdot in$ $y := 2.0 \cdot in$

$I_{1y} := I_{1x}$ $I_{1y} = 0.4285 \cdot in^4$

$I_{2y} := \frac{b \cdot y^3}{12}$ $I_{2y} = 0.0433 \cdot in^4$

$I_{Gy} := I_{1y} - I_{2y}$ $I_{Gy} = 0.3852 \cdot in^4$

FOR INFORMATION ONLY

IGx is the limiting case therefore, use IGx when calculating overall sectional properties and resulting moments will be determined by the SRSS method.

Calculate shift in centroidal axis due to 2" flaw length

$b := 2 \cdot in$ $tn := 0.065 \cdot in$ $A1 := \pi \cdot D \cdot tn$ $A2 := b \cdot tn$

$y1 := 0 \cdot in$ $y2 := \frac{D}{2} - \frac{tn}{2}$ $y2 = 1.28 \cdot in$ $n := \frac{A1 \cdot y1 - A2 \cdot y2}{A1 - A2}$

$n = -0.4098 \cdot in$ $c := \frac{D}{2} - n$ $c = 1.7223 \cdot in$ $S := \frac{I_{Gx}}{c}$

Calculate resultant stress in the tubing for normal plus seismic loading conditions. Use equation 11 and 12 from Ref. 5, Section 104.8.1 and 104.8.2

$Mx := 11 \cdot lb \cdot ft$ $\quad My := 1 \cdot lb \cdot ft$ $\quad Mz := 39 \cdot lb \cdot ft$ **Dead Weight loading Attachment 1**

$Ma := \left(Mx^2 + My^2 + Mz^2\right)^{0.5}$ $\quad D1 := D - 2\ (tn)$ $\quad Z := S$

$Ma = 40.5339 \cdot ft \cdot lb$ $\quad D1 = 2.495 \cdot in$ $\quad Z = 0.1251 \cdot in^3$

$Ma \cdot 12 \cdot \frac{in}{ft} = 486.4072 \cdot in \cdot lb$ $\quad b := 2 \cdot in$ $\quad Ar := \frac{\pi \cdot D \cdot tn}{\pi \cdot D \cdot tn - b \cdot tn}$

$Ar = 1.3202$

$fnorm := \frac{P \cdot D \cdot Ar}{4 \cdot tn} + \frac{1.0 \cdot Ma}{Z}$ **Ref. 5 - Eq. 11** $\quad fnorm = 5.5538 \cdot 10^3 \cdot \frac{lb}{in^2}$

$Mx1 := 9 \cdot ft \cdot lb$ $\quad My1 := 29 \cdot ft \cdot lb$ $\quad Mz1 := 11 \cdot ft \cdot lb$ **SSE Loading Attachment 1**

$Mb := \left(Mx1^2 + My1^2 + Mz1^2\right)^{0.5}$

FOR INFORMATION ONLY

$Mb = 32.2955 \cdot lb \cdot ft$ $\quad Mb \cdot 12 \cdot \frac{in}{ft} = 387.5461 \cdot in \cdot lb$

$fsse := \frac{1.0 \cdot Mb}{Z}$ **Ref 5** $\quad fsse = 3.0976 \cdot 10^3 \cdot \frac{lb}{in^2}$

$ftotal := fnorm + fsse$ **Ref. 5 Eq. 12** $\quad f_{allow} := 6000 \cdot \frac{lb}{in^2} \cdot 1.8$

$ftotal = 8.6514 \cdot 10^3 \cdot \frac{lb}{in^2}$ $\quad f_{allow} = 1.08 \cdot 10^4 \cdot \frac{lb}{in^2}$

ftotal < fallow therefore OK

Calculate resultant stress in the tubing for normal plus thermal loading conditions. Use equation 11, 13 and 14 from Ref. 5, Section 104.8.1 and 104.8.3

$Mx2 := 41 \cdot ft \cdot lb$ $\quad My2 := 8 \cdot ft \cdot lb$ $\quad Mz2 := 25 \cdot ft \cdot lb$ **Thermal Loading Attachment 1**

$Mc := \left(Mx2^2 + My2^2 + Mz2^2\right)^{0.5}$ $\quad Z = 0.1251 \cdot in^3$

$Mc = 48.6826 \cdot ft \cdot lb$ $\quad Mc \cdot 12 \cdot \frac{in}{ft} = 584.1917 \cdot lb \cdot in$

$ftherm := \frac{i \cdot Mc}{Z}$ **Ref 5 - Eq. 13** $\quad ftherm = 6.0701 \cdot 10^3 \cdot \frac{lb}{in^2}$

$ftotal := fnorm + ftherm$ **Ref 5 - Eq. 14** $\quad ftotal = 1.1624 \cdot 10^4 \cdot \frac{lb}{in^2}$

FOR INFORMATION ONLY

Calculate allowable stress limit

$Sh := 6000 \cdot \frac{lb}{in^2}$ $\quad Sc := 6000 \cdot \frac{lb}{in^2}$ $\quad f := 1.0$ Ref. 5

$Sa := f \cdot (1.25 \cdot Sc + 0.25 \cdot Sh)$ **Ref 5** $\quad Sa = 9 \cdot 10^3 \cdot \frac{lb}{in^2}$

$fallow := Sh + Sa$ **Ref 5** $\quad fallow = 1.5 \cdot 10^4 \cdot \frac{lb}{in^2}$

ftotal < fallow therefore OK

CONCLUSION

The evaluation contained in this calculation demonstrates that the RRU-8 copper stub inlet connection is structurally stable when consider a 1" length flaw (Normal Allowables) and a 2" flaw when considering faulted allowables. The as found defect was visually identified as being less than 1/16" long. The as found configuration of the stub tube is therefore deemed structurally adequate to perform its intended design function. No further evaluation is required.

FOR INFORMATION ONLY

VY CALCULATION REVIEW FORM

Calculation Number: VYC-2134 Revision Number: 0 CCN Number: N/A

Title: Structural Assessment of Reactor Recirculation Unit No. RRU–8 Cooling Coil Pin Hole Leak

Reviewer Assigned: James C.Fitzpatrick Required Date:

☐ Interdiscipline Review ☑ Independent Review

FOR INFORMATION ONLY

Comments*	Resolution
1. Reviewed in accordance with AP0017. The problem is properly constructed, the calculation method is reasonable and defensible, and the calculations are mathematically accurate within appropriate tolerances typically used in piping /component design.	1. None Required
2 In discussion of "Method of Solution" on Page 5 (2nd PP): Clarify/ Expand your statement on the type and cause of the existing flaw (caused by an original construction defect and not a crack-like flaw subject to future crack growth under load).	2. COMMENT RESOLVED JCF 7/27/00
3 In discussion of "Method of Solution" on Page 5 (3rd PP): Clarify/ expand that the large size flaws evaluated significantly bound/ envelope the existing conditions.	3. COMMENT RESOLVED. JCF 7/27/00
4 For stress totals for normal ,upset and thermal conditions shown on pages 8,9,11,&12: Identify the corresponding ANSI B31.1 equation number next to the results/allowable stress comparison.	4. COMMENT RESOLVED. JCF 7/27/00

Reviewer Signature, 7/27/00 Date

Calculation Preparer (Comments Resolved), 7/27/00 Date

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

Reviewer Signature (Comments Resolved), 7/27/00 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.

JOB NO.	PREP. BY	DATE	CHECK BY	DATE
82005	R.J. Bertuzzi	6/7/83	R. Ramos	6/7/83
FILE NO.	CALC. SET NO.	SHEET NO.	REV.	
17/F	120	PI-120-26	1	

VERMONT YANKEE JO-82005 PIPING REANALYSIS
SERVICE WATER (SW) PART 10A PROB. NO. 120
EES ISO.DWG.NO.PI-1189, SH. 1 OF 1, REV. 2 A. W. CHOCK

****
* POINT NO. 660 *
****

ANCHOR LOAD SUMMARY SUPPORT TYPE = ANCH

SUPPORT I.D. = RRU-8

COND.	DESCRIPTION	FORCES (LBF) FX	FY	FZ	MOMENTS (FT-LBF) MX	MY	MZ
1	DEADWGHT	1.	-34.	-1.	11.	1.	39.
2	THERMAL	7.	-36.	-7.	41.	8.	25.
6 *	OBEI	8.	1.	4.	4.	14.	5.
7 *	SSEI	16.	4.	9.	9.	29.	11.
9 *	SAM	1.	1.	1.	1.	1.	1.

CALC VYC-2134 REV 0
ATTACHMENT 1
SHT 1 OF 1

FOR INFORMATION ONLY

DESCRIPTION	TITLE
DEADWGHT	DEADLOAD ANALYSIS
THERMAL	THERMAL ANALYSIS @ 95 F
OBEI	SEISMIC INERTIA LOADING ARS FILE OBE-EL252.5-RB (FSAR-6/3/
SSEI	SEISMIC INERTIA LOADING ARS FILE SSE-EL252.5-RB (FSAR 6/3/83
SAM	SRSS SUMMATION - X,Y,Z SSE SEISMIC ANCHOR MOVEMENT

NOTES:

1.) X, Y AND Z ARE ALONG GLOBAL AXES

2.) AN "*" MEANS NUMBERS ARE ABSOLUTE VALUES

CYGNA

Memorandum

To: Distribution

Date: June 6, 1983

From: J. G. Dyckman

Job No: 82005

Subject: Structural Design Criteria
Service Water Piping and Supports
Cygna Problem Nos. 120, 122, 130, 133 and 171
EES Drawing Nos. 82005-PI-1174, 1184, 1186, 1187 and 1189

Copies: Project File
Central File

The analysis of the subject piping shall be performed to the design input and acceptance criteria consistent with FSAR requirements and as-built drawings, as directed by YAEC as follows:

1. System Operating Temperatures

Problem No.	°F
120	32 to 95
122	32 to 138
130	32 to 95
133	32 to 95
171	32 to 138

CYGNA
ATTACHMENT #9
JOB NO. 82005
FILE NO. 17/F
SHEET NO. PI-120 -75
REV. 1

2. Seismic Input

Spectra published in the FSAR (Amendment 27) is to be used for dynamic analysis of the piping. Horizontal spectra for the design earthquake (OBE) were generated at 0.5% damping. The vertical spectra for the design earthquake (OBE) are taken as 2/3 of the horizontal ground spectra at 0.5% damping. The maximum hypothetical earthquake (SSE) spectra was taken as 2 times the design earthquake spectra.

3. Piping Acceptance Criteria

ANSI B31.1 Power Piping Code (1977 Edition)

4. Pipe Support Acceptance Criteria

Cygna DC-82005-2

VYC-2134
REV 0
ATTACHMENT 2
SHT 1 OF 2

FOR INFORMATION ONLY

5. Seismic Anchor Movement

Combine OBE Seismic Anchor Movement (SAM) from the existing enveloped spectra (R.G. 1.60 + FSAR) with the Dead Load plus Thermal Load case. If this case does not pass, investigate reducing the SAM's to approximate the FSAR spectra alone. This judgment will be made by reviewing the two ARS sets and the dynamics of the piping.

6. Nozzles, Valves and Equipment Components

Qualification of nozzles, valves and equipment such as pumps, heat exchangers, etc. are excluded from the scope of the qualification effort.

7. Brazed Fittings

YAEC has advised that their analysis confirms that brazed connections have a higher capacity than the tubing itself (ref Cygna Telecon notes dated 3/30/83).

8. Socket Stress Intensification Factors

* Sockets use a 1.3 SIF on the basis that brazing will not undercut the copper tube. Threaded connections use a 2.3 SIF in accordance with ANSI B31.1. *

Distribution: J. L. White
A. M. Abrahamovich
R. J. Robicheau
R. A. Riemer
D. Antonopoulos

C. L. Child (YAEC)
A. Roudenko (YAEC)
R. O'Regan (YAEC)

CYGNA
ATTACHMENT
JOB NO. 82005
FILE NO. 17/F
SHEET NO. PI-120-76
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VERMONT YANKEE
EVENT REPORT

Event Level (Circle One) (complete at screening meeting) 1 2 (3)

ER No. ER-2000-0221

PART 1: IDENTIFICATION OF EVENT (Originator) (Fill in all known data)

A) Initiated By (Print) Pete Rose Date 2-11-00 Phone # 5373 Department Operations

B) Event/Discovery (Date) 2-11-00 Occurred (Time) 1640 Equip No(s). RRU-8 System(s) affected SW, RHR

C) Event Title: Service Water Leak at RRU-8 inlet.

D) Activity Event detected during (e.g., Corrective/Preventative Maintenance, QA Audit/Surveillance, Self Assessment, Switching/Tagging, Surveillance Testing, (AO Rounds), Rework, Operating Experience Review, etc.), other: N/A

E) Reference Document (WO, Procedure, Calculation, Drawing, Audit/Surveillance No., etc.): P.ID 4191159 sheet 2 WOR 00-044090

F) Event Description (Describe the event and suspected cause, if known) AO on plant tour noticed a 50-60 drop per minute leak from tagging near RRU-8. Leak is downstream of SW-318A in southeast corner room.

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G) Immediate Action Taken - Recommendations, if any (WOR)/WO No. 00-044090 Nonconformance Tags Installed: ☒ NO ☐ YES (if segregation required)

Increased monitoring. SS/SCRO informed.

PART 2: REVIEW OF EVENT (Department Head)

A) Department Head Review

1. SS Review Required (operability concern/degraded equipment AP 0156, LCO, TS)?	☐ NO	☒ YES (deliver to SS)
2. Security-Related Event?	☒ NO	☐ YES (immediately notify SSS/SS)
3. Personnel Injury/Accident? Accident Type (Discuss with Safety Coord.)____	☒ NO	☐ YES (FAX ER to Treasury/Risk Mgr. VY personnel)
4. Recommended Event Level 3 (for Level 3 ERs, AP 0028 Required?)	☒ NO	☐ YES
5. Nuclear Network entry required?	☒ NO	☐ YES
6. Bulletin 80-10 issue?	☒ NO	☐ YES
7. Recommended Responsible Department? Mech Maint		

B) If degraded or nonconforming SSC's will remain operable then record and attach Operability Basis/Justification, refer to AP 0167.

C) Additional Comments/Actions Taken:

Department Head Signature/Date Edward Haas for KHB 2/14/00 (assess need to discuss/NRC)

PART 3: REPORTABILITY AND OPERABILITY (SS/SE)

A) Event reportable per AP 0156? ☒ Not Reportable ☐ Reportable. Attach copy of VYAPF 0156.01 if reportable or if additional notifications requir

B) Per AP 0167 degraded or nonconforming SSCs will remain operable? ☒ N/A ☐ NO ☐ YES

C) Documentation for Operability Determination attached? ☐ N/A ☒ YES If YES: ☐ Form attached (VYAPF 0167.01) and/or ☒ Evaluation attached or included in ER

Shift Supervisor/Date/Time [signature] 2/11/00 1800

PART 4: EVENT SCREENING MEETING

A) Additional Initial Notifications and Reviews Required? ☑ NO ☐ YES

B) BMO Required? ☑ NO ☐ YES (Processing Time _____ Resp. Dept._____ BMO #_____)

C) Reportable? ☑ NO ☐ YES ☐ Further Evaluation Required (Assigned To _____)

D) Potential 10CFR50.65 Maintenance Rule Issue? ☑ NO ☐ YES

E) Potential Reactivity Management Event? ☑ NO ☐ YES (If YES, assign RE review in Part 6.A, below)

F) Human Performance Related? ☑ NO ☐ YES

G) Event Level Determined 3

H) Responsibility for ER Investigation and Recommending Corrective Action Assigned To (Dept.): Mech. Maint.

I) Additional Considerations Consider if there is an adverse trend on safety class RRU's

J) Completed by/Date [illegible] 12/14/00

PART 5: EVENT INVESTIGATION (Assigned Department)

A) Investigation Type: (RCA required for Level 1; Optional for Level 2)

☐ RCA ☐ ACE ☐ MPC (DH check one)

C) MRFF: ☐ NO ☐ YES

D) Event Reportable: ☐ NO ☐ YES (LER No._____).

E) Estimated hours to perform investigation_____.

F) Actions Taken (Level 3 ER Disposition):

B) Investigation Results:

1. Attach report for Level 1 and 2 ERs (see PP 7017 for details).
2. Note Most Probable Cause Codes (Level 3 ERs)_____.

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Qualified Investigator (RCA or ACE):_____/_____ DH Review:_____/_____

PART 6: REVIEWS

A) Additional Reviews: _____

B) _____/_____ QAD (Level 1) _____/_____ Design Eng. (Design Deficiency, "Use-As-Is" dispositions)

Comments:

PART 7: APPROVALS (Forward to the TSM after final approval)

A) _____/_____ Department Head (Level 1,2,3 ERs) _____/_____ Supt/Dir designee (Level 1 & 2 ERs) _____/_____ PORC (Level 1 ERs)

B) _____/_____ Plant Mgr (Level 1 ERs) _____/_____ Dir. of Operations (Level 1 ERs)

PART 8: CANCELLATION/CLOSEOUT

A) Repair/rework complete _____/_____ Nonconformance Tags removed _____/_____

B) ER Canceled By (Supt/Dir/designee) _____/_____

Basis/Approval Comments:

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C) Technical Support (ER Database Updated, Copies Distributed, Commitments Initiated)

ERC/Date _____/_____

Operability Assessment for the RRU-8 Cooling Coil Leak

BACKGROUND

On 2/11/2000, service water was found to be leaking from the RRU-8 cooling coil. The leak, pinhole in size (< 1/16th inch diameter), is located on the inlet stub connection for the cooling coil where it joins the cooling coil's inlet header manifold. The inlet stub connection is a 2½-inch diameter class M copper water tube (i.e., 2.625 inch OD, 0.065-inch wall thickness). The leak rate is approximately 20 ml/minute.

RRU-8 Safety Design Bases

RRU-8 is a SC3 component, which is supplied with cooling water from the Service Water system. RRU-8 will auto-start whenever a Core Spray or RHR pump in the Southeast ECCS Corner Room is operating, thus ensuring the Core Spray, RHR and RHRSW system components within the pump spaces are maintained within their EQ temperature limits.

DISCUSSION

The leak is located at the toe of a brazed connection joint. More specifically, the leak is at the top where the horizontal 2.625" diameter copper inlet stub connection joins the vertical inlet header manifold of the cooling coil. However, because the leakage rate is small (~ 0.005 gpm) compared to the design flow rate of RRU-8 (146 gpm), the leak will not compromise the cooling capacity of RRU-8.

The through-wall failure is limited to RRU-8, thus the affected RRU could be isolated without impairment of other Service Water system functions by closing the inlet and outlet valves V70-318A and V70-318B.

The inlet stub connection is attached the cooling coil's inlet header manifold using a brazed butt joint configuration. The manifold is connected to individual tubes that run through the tube sheet via 5/8-inch stub tubes. The leak is due to a very localized defect associated with the brazed butt joint. Per Scott Goodwin (Sr. Mechanical Design Engineer), the structural integrity of the coil unit is unaffected by this leak, and the integrity of the connecting Service Water piping is similarly unaffected. It can therefore be concluded that the RRU unit is not structurally degraded and remains seismically qualified. The NRC Generic letter 90-05 is not applicable to the leakage in the RRU coil unit, as the RRU and the individual tubes are not classified as piping but are considered to be a component. In GL 90-05, Section B.1, "Scope", it states that only ASME Code Class 3 piping fabricated from ferritic or austenitic stainless steel are within the scope of the generic letter. It states further that pumps, valves, heat exchangers, and components other than piping are excluded.

Although there are no operability concerns relative to structural integrity of the cooling coil, leakage from the inlet stub connection does present concerns associated with flooding, spraying of water on equipment, and loss of Service Water flow to vital components.

Total inventory loss due to the through-wall failure on RRU-8 is estimated to be approximately 0.005 gpm, which is insignificant in terms of any single Service Water pump's capacity (~ 3000 gpm), or with respect to cooling water flow design requirements as determined in VYC-1279, "Service Water System Hydraulic Analysis". Furthermore, it was determined that there is a remaining deep basin inventory of ~30,000 gallons after 7 days of ACS operation. This would permit leakage of 3 gpm (e.g., ~ 600 × the estimated RRU-8 leakage) over the 7 day period before depletion of the remaining inventory would challenge ACS operability. Therefore, issues relative to loss of Service Water flow to vital components is not of concern.

In the event that power to the corner room sump is not available post-LOCA, the leakage would begin accumulating in the lower elevation. Assuming access to the Reactor building was prevented for 30 days following the event, water would accumulate to a depth of approximately ½ inch in the NE corner

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room before remedial action can commence[1]. However, the corner rooms have a maximum allowable flood level of 1 foot per the emergency operating procedures. Therefore, issues relative to flooding of vital safety components is not of concern.

There are no instrumentation or electrical components in the immediate vicinity of the leak, and the leak is extremely small with no significant fluid jet streaming. Therefore, issues relative to spray impingement on safety related equipment are not of concern.

In order to monitor the leakage, the jacket insulation was removed from the copper tube where the tube penetrates the cooling coil steel enclosure. This created a small area (~ 8 in2) through which the fan may draw air that will bypass the cooling coil. However, based upon results from RRU-8 thermal performance testing conducted in October 1999, it is concluded that this does not represent a significant impairment of the functional capability of RRU-8.

CONCLUSION

Based on the above assessments, operation with the identified leakage from the RRU-8 cooling coil will not compromise the ability of any systems to perform their safety functions.

RECOMMENDATIONS

1. Initiate a Work Order to document this condition. (*done – WOR # 4409*)
2. Operations should initiate periodic monitoring of the leakage rate, to be performed at least once-per-shift. If leakage exceeds 200 ml/min, the Service Water System Engineer should be contacted for further assessment.

Prepared by: Mark E. Palmer / Feb 11, 2000

System Engineer Date

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REFERENCES

1. AP 0167, Rev.0, "Operability Determinations"
2. Generic Letter 90-05, "Guidance for Performing Temporary Non-code Repairs of ASME Code Class 1, 2, and 3 Piping", dated 6/15/90
3. Calculation VYC-1279, Rev.0, Service Water System Hydraulic Analysis
4. Calculation VYC-1279C, Rev.3, "Determine Maximum Allowable RHRSW Pump Degradation & Maximum Cooling Tower Flows"
5. Memo, Bill Sherbin to J. Lynch, VYS-99/66, "Results of ACS Calculation VYC-1803A, Rev.1, Thermal Performance of Alternate Cooling System Using Cooling Tower Test Data, Supplement A", dated 6/1/99
6. Dwg. 5920-11864, sh 1&2, RRU 7 & 8 Coil Replacement

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[1] The reactor building SE corner room is an equilateral triangle of ~40 feet on each side. The floodable surface area is conservatively assumed equal to 90% of this, to account for area taken up by pipe an pump supports, etc.: 40'×40'× ½ ×0.9 = 720 ft^2. The flood capacity per inch of depth is 720×7.4805÷12 = 448.83 gallons/inch. Water accumulation from the RRU-8 leak for 30 days: 30×24×60×0.005 = 216 gallons, or 216÷448.83 = 0.48 inches deep in the NE corner room.

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SUMMARY OF VERMONT YANKEE COMMITMENTS

BVY NO.: 00-75

The following table identifies commitments made in this document by Vermont Yankee. Any other actions discussed in the submittal represent intended or planned actions by Vermont Yankee. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager of any questions regarding this document or any associated commitments.

COMMITMENT	COMMITTED DATE OR "OUTAGE"
None	N/A