



# THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

P.O. BOX 5000 - CLEVELAND, OHIO 44101 - TELEPHONE (216) 622-9800 - ILLUMINATING BLDG. - 55 PUBLIC SQUARE

*Serving The Best Location in the Nation*

MURRAY R. EDELMAN

VICE PRESIDENT  
NUCLEAR

May 22, 1985  
PY-CEI/NRR-0250L

Mr. B. J. Youngblood, Chief  
Licensing Branch No. 1  
Division of Licensing  
U.S. Nuclear Regulatory Commission  
Washington, D. C. 20555

Perry Nuclear Power Plant  
Docket Nos. 50-440; 50-441  
PNPP Environmental Qualification  
Of Harsh Environment Mechanical  
Equipment - SER Outstanding Issue 4

Dear Mr. Youngblood:

This letter is provided to update two of the three mechanical equipment qualification files submitted by letter of April 3, 1985 (PY-CEI/NRR-0228L). As part of our ongoing qualification program, the qualification files included as Attachments 1 and 2 to this letter have been updated. File No. SP810-20-005 is now Revision 3, File No. SP810-20-010 is now Revision 2. File No. SP810-20-022 has not changed, and remains at Revision 1.

If there are any questions, please feel free to call.

Very truly yours,

Murray R. Edelman  
Vice President  
Nuclear Group

MRE:dlp

cc: Jay Silberg, Esq.  
John Stefano (2)  
J. Grobe  
Harold Walker, NRC  
U.S. NRC Document Control Desk  
INPO Records Center

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ATTACHMENT 1

Project Number: 20070

File Number: SP810-20-005

File Revision: 3

Date: 05/07/85

R3

R3

MECHANICAL EQUIPMENT  
QUALIFICATION REVIEW FILE  
FOR

WATER LEG PUMPS  
Manufactured by  
BINGHAM WILLAMETTE

R3

for

CLEVELAND ELECTRIC ILLUMINATING COMPANY  
PERRY NUCLEAR POWER PLANT

Cleveland Electric Illuminating - MEQ

## RECORD OF REVISIONS

REVISION NUMBER	ISSUE DATE	PREPARED BY	APPROVED BY	Q. A. BY	PAGES REVISED & DESCRIPTION
0	6/6/84	TMM	PAD	RAW	Original Issue
1	9/6/85	TMM	CRF	RAW	As marked on pages: 1, 4, 17-24
2	4/16/85	TMM	CRF	RAW	As indicated by R2's on pages: 1-7, 9
3	5/07/85	TMM	CRF	RAW	As indicated by R3's on pages: 1-9, 11, 19, 20



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Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-005  
File Revision: 3  
Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

SUMMARY CONCLUSIONS

Manufacturer: Bingham Willamette

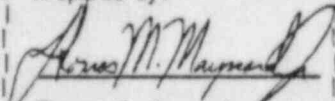
Model-Number(s): 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Qualification Restrictions: None

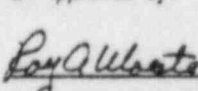
Justification for Interim Operation (if applicable): Not Applicable

Qualification Conclusion: This equipment is qualified for service as defined herein  
without restriction or exception.

Prepared by:

  
Thomas M. Maynard, Jr.  
Project Engineer

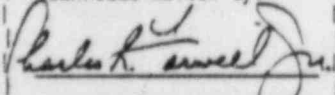
QA Approval by:

  
Roy A. Woeste  
QA Manager

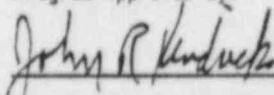
Certificate of Compliance:

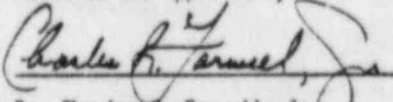
I hereby certify that the engineering  
evaluation has been performed in full  
accordance with the customer's purchase  
order as provided to Farwell & Hendricks  
Inc. The engineering evaluation has been  
reviewed and approved by me.

Technical Review by:

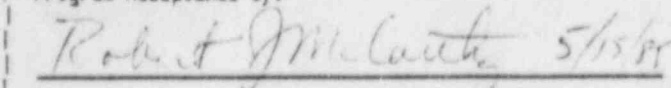
  
Dr. Charles R. Farwell, Jr.  
Program Manager

Program Approval by:

  
John R. Hendricks, P.E.  
Program Director

  
Dr. Charles R. Farwell, Jr.  
Director of Engineering and C.E.O.

Program Acceptance by:

 5/15/85  
Cleveland Electric Illuminating Company

Registration P.E. No. 10163  
State of North Carolina

Date 5/7/85 P.E. Stamp

R2

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Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-005  
File Revision: 3  
Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION SUMMARY REVIEW

Manufacturer: Bingham Willamette

Model-Number(s): 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Non-Metallic Materials: Gasket: MML #006 - Asbestos/SS (Flexitallic)  
O-Ring: MML #007 - Ethylene Propylene (incl. EPT, EPDM)  
Seal: MML #012 - Duralmetallic (Type PTO, EP)  
Gasket: MML #003 - Asbestos (Garlock)  
Gasket: MML #008 - Nitrile (Buna-N)

## ENVIRONMENTAL LIMITATIONS

PARAMETERS	REQUIRED	DEMONSTRATED	QAW PAGE NUMBER
Radiation	7.0E07 Gamma (1)	1.0E08	2, 3, 5
Temperature	185 F	225 F	5
Pressure	—	—	—
Chemical Spray	—	—	—
Humidity	100% RH	—	—
Other:	—	—	—

Notes: 1) The beta dose of 3.3E07 Rads has not been considered since all of the non-metallic materials are shielded by the metal housing of components in the pump assembly.

FTH

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Perry Nuclear Power Plant

File Number: SP810-20-005

Cleveland Electric Illuminating Company

File Revision: 3

Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

REFERENCES

1. "Flexitallic Spiral Wound Gaskets Design Criteria," Flexitallic Gasket Company, Bulletin 171, 1979 Fourth Edition
2. "Radiation Stability of Asbestos," Raybestos Manhattan Industrial Company
3. Parker Seal Company, Parker O-Ring Handbook, March, 1982
4. The Effects of Nuclear Radiation on Elastomeric & Plastic Components and Materials, Radiation Effects Information Center, REIC No. 21, September, 1961, pp. 106-108
5. Installation, Operation, Maintenance Instructions for 6 X 6 X 10-1/2 Beta, 4 Stage Type CP, RCIC Pump, Materials of Construction, Addendum #2, Procedure No. E30.70
6. Durametallic Corporation Dwg. No. 2D-159431, PTO Mechanical Seal
7. Installation, Operation, Maintenance Instructions for 2 X 2 X 7-1/2 CAP, RHR, LCPC, and HP Core Spray Water Leg Pump, Contract Specific Material List Water Leg Pump, Specification No. SP-506
8. Gilbert Associates Drawing, "Residual Heat Removal System," Drawing No. 4549 D-320-643, Revision B with DSP-E12-1-4549-00, Table 1, System Design and Operating Conditions. Data Points 59, 60 for RHR Water Leg Pump
9. Gilbert Associates Drawing, "Low Pressure Core Spray System", Drawing No. 4549 D-320-705, Revision C with DSP-E21-1-4549-00, Table 1, System Design and Operating Conditions. Data Point 1.5 for LPCS Water Leg Pump
10. Gilbert Associates Drawing, "High Pressure Core Spray System," Drawing No. 4549 D-320-701, Revision C with DSP-E22-1-4549-00, Table 1, System Design and Operating Conditions. Data Point 18.5 for LPCS Water Leg Pump
11. Gilbert Associates Drawing, "Reactor Core Isolation Cooling system," Drawing No. 4549-D-320-631, Revision A with DSP-E51-1-4549-00, Table 1, System Design and Operating Conditions. Data Points 2 and 1A for RCIC Pump and RCIC Water Leg Pump, respectively
12. "Radiation Effects on Organic Materials in Nuclear Plants" EPRI RP 1707-3, Final Report
13. "Design Guide for Reactor Cover Gas Elastomeric Seals," Atomic International Division, Rockwell International, Report AI-AEC-13145
14. "Radiation Effects on Organic Materials in Nuclear Plants," EPRI RP 1707-3, Final Report
15. "Non-Metallic Gasket and Sheet Packing Handbook," Non-Metallic Gasket and Sheet Packing Division, Fluid Sealing Association.
16. Parker Seal Company, Laboratory Report, "An Investigation Into the Radiation Resistance of Selected Compounds," Report No. K10.063A, Dated May 24, 1973

F3H

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Perry Nuclear Power Plant

File Number: SP810-20-005

Cleveland Electric Illuminating Company

File Revision: 3

Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

ENVIRONMENTAL QUALIFICATION  
MAINTENANCE AND SURVEILLANCE

QAW PAGE NUMBER (M & S ITEMS)	SCHEDULE	BASIS	
1	As required for routine maintenance	These gaskets are made of age insensitive material and are applied below their recognized temperature limits	
2, 3	>40 yrs	Arrhenius methodology applied for required service conditions (see Appendix D)	R2
4	As required for routine maintenance	These gaskets are made of age-insensitive material and are applied well below their recognized temperature limits	R2
5		Arrhenius methodology applied for required service conditions (see Appendix D)	R3
	5.46 yrs	Zone AB-4: Tag Nos. 1E12C0003 1E51C0003	44
	9.18 yrs	Zone AB-2: Tag Nos. 1E21C0002 1E22C0003	

F8H

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-005  
File Revision: 3  
Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Equipment Category : A X, B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number      \* Radiation  
302-631 Temperature

Non-Metallic Material: Gasket: MML 0006 - Asbestos/SS (Flexitallic CG-15C)

\* Values based on process radiation of 7.0E07 Gamma (see Appendix A)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE <sup>44</sup>
Temperature:	Environmental	160 F	800 F	1
	Process	185 F		
Radiation :	Environmental	4.1E07 Gamma	1.0E11 Gamma	2, 12
	Process	7.0E07 Gamma		
Pressure :	Environmental	—	—	(1)
	Process	—		—
Chemical Effects :	Environmental (Spray)	—	—	—
	Process (Internal)	—		—
Humidity :	Environmental	100% RH	—	—
Other:				

F&amp;H



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R3

Perry Nuclear Power Plant

File Number: SP810-20-005

Cleveland Electric Illuminating Company

File Revision: 3

Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Equipment Category : A X, B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number      \* Radiation  
302-631 Temperature

Non-Metallic Material: O-Ring: MML 9007 - Ethylene Propylene

\* Values based on process radiation of 7.0E07 Gamma (see Appendix A)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE <sup>44</sup>
Temperature:	Environmental	160 F	250 F	3
	Process	185 F		
Radiation :	Environmental	4.1E07 Gamma	1.0E08 Gamma	16
	Process	7.0E07 Gamma		
Pressure :	Environmental	—	—	(1)
	Process	—	—	-
Chemical Effects :	Environmental (Spray)	—	—	-
	Process (Internal)	—	—	-
Humidity :	Environmental	100% RH	—	-
Other:				

F3H



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R3

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-005  
File Revision: 3  
Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Equipment Category : A X B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number 302-631 \* Radiation Temperature

Non-Metallic Material: Seal: MM #012 Duralmetallic (Type PTO)  
(See Reference 6: Ethylene Propylene)

\* Values based on process radiation of 7.0E07 Gamma (see Appendix A)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE <sup>4*</sup>
Temperature:	Environmental	160 F	250 F	3
	Process	185 F		
Radiation :	Environmental	4.1E07 Gamma	1.0E08 Gamma	16
	Process	7.0E07 Gamma		
Pressure :	Environmental	—	—	(1)
	Process	—		—
Chemical Effects :	Environmental (Spray)	—	—	—
	Process (Internal)	—		—
Humidity :	Environmental	100% RH	—	—
Other:				

FHH

Form No. 5

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R3

Perry Nuclear Power Plant

File Number: SP810-20-005

Cleveland Electric Illuminating Company

File Revision: 3

R3

Date: 05/07/85

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : 2 X 2 X 7-1/2, 6 X 6 X 10-1/2

Equipment Category : A X B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number \* Radiation  
302-63T Temperature

Non-Metallic Material: NML #003 - Asbestos (Garlock) (Gasket)

\* Values based on process radiation of 7.0E07 Gamma (see Appendix A)

44

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE
Temperature:	Environmental	160 F	650 F	15
	Process	185 F		
Radiation :	Environmental	4.1E07 Gamma	1.0E11 Gamma	2, 12
	Process	7.0E07 Gamma		
Pressure :	Environmental	—	—	(1)
	Process	—		
Chemical Effects :	Environmental (Spray)	—	—	—
	Process (Internal)	—		
Humidity :	Environmental	100% RH	—	—
Other:				

DPH

Form No. 5

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R3

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-005  
File Revision: 3  
Date: 05/07/85

R3

R3

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : 2 X 2 X 7-1/2

Equipment Category : A X B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number \* Radiation  
302-531 Temperature

Non-Metallic Material: MML #008 - Nitrile (Buna-N) Gasket

\* Values based on process radiation of  $7.0E07$  Gamma (see Appendix A)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE
Temperature:	Environmental	160 F	225 F	3
	Process	185 F		
Radiation :	Environmental	4.1E07 Gamma	1.0E08 Gamma	4
	Process	7.0E07 Gamma		
Pressure :	Environmental	—	—	(1)
	Process	—	—	
Chemical Effects :	Environmental (Spray)	—	—	-
	Process (Internal)	—	—	-
Humidity :	Environmental	100% RH	—	-
Other:				

F&amp;H

APPENDIX A

44

Cleveland Electric Illuminating  
 ASBESTOS REMEDIATION PLANT  
 MECHANICAL EQUIPMENT DECONTAMINATION PROGRAM  
 APPENDIX A - HIGH ENVIRONMENT EQUIPMENT LIST (Page 1 of 1)

MANUFACTURER: Vaughan Williams  
 MSO FILE NUMBER: -RPS

COMPONENT DESCRIPTION	ZONE	P & ID	REV. #	VEHICLE/CONTAINER NUMBER	MODEL NUMBER	SIZE	EQUIPMENT DESCRIPTION
1E1200003	1	302-643	1	1	21217-1/2	1	1000 Water Leg Pump
1E2100002	1	302-795	1	1	21217-1/2	1	1000 Water Leg Pump
1E2200003	1	302-795	1	1	21217-1/2	1	1000 Water Leg Pump
1E3100001	1	302-631	1	1	1E310-1/2	1	1000 Water Leg Pump
1E3100003	1	302-631	1	1	21217-1/2	1	1000 Water Leg Pump

COMMENTS:

	Temperature (deg. F)	Pressure (PSIG)	Radiation (1150)
Max. Environment	150 (1)	-	4.1E07 Gamma (1)
Max. Process	575 (2)	1575 (3)	7.0E07 Gamma / 3.3E07 Beta (4)

Notes: (1) Based on 20-4  
 (2) Based on 302-631, the actual process fluid temperature for each of the pumps is provided in Appendix B.  
 (3) Based on 302-795  
 (4) Based on PY-601/021-12528

APPENDIX B

44

Cleveland Electric Illuminating - MEQ

THE UNIVERSITY OF CHICAGO PRESS

MECHANICAL EQUIPMENT AND REFRIGERATION SYSTEMS

WILLIS TOWERS WATSON ENVIRONMENTAL LIST (Page 1 of 1)

MEMBER OF THE THOMSON GROUP

UNIT FILE NUMBER	ZONE	DATE	INL B	VENDOR/DRAWING NUMBER	MODEL NUMBER	SIZE	EQUIPMENT DESCRIPTION
COMPONENT DESCRIPTION							
RENT C. ANALYSIS	1 FB-4	302-632			1 2 1 2 1 1/2		
RENT C. ANALYSIS	1 FB-4	302-632			1 2 1 2 1 1/2		



APPENDIX C

14

MASTER MATERIALS LIST  
(MML)

MML NO.	MATERIAL DESCRIPTION
001	UHMW Polyethylene
002	Viton (Fluoroelastomer)
003	Asbestos
004	Nordel
005	Kalrez
006	Asbestos/SS
007	Ethylene Propylene (incl. EPT, EPDM)
008	Nitrile (Buna-N)
009	Silicone Rubber
010	Vespel (Polyimide)
011	<sup>4</sup> Neoprene
012	Durametallic
013	Teflon
014	Kel-F
015	Nylon
016	Graphite (Grafoil)
017	Filmite 7000
018	Rubber
019	RTV
020	Dow 781
021	Grease
022	Plexiglass

APPENDIX D

44

## ETHYLENE PROPYLENE PUMP PARTS

From Reference 13 the slope and Y-intercept values for the Ethylene Propylene (EP) have been determined to be 17798 and -38.8, respectively. This results in an activation energy of 1.53eV. Applying the Arrhenius methodology to this data for the environmental profile defined below results in a determination of the expected life of the material for the defined conditions. This value can then be used to quantify a replacement interval which will assure the continued functional ability of the safety-related component.

From Appendix A, Zones AB-2, AB-3, and AB-4 provide the environmental conditions. References 8, 9, 10, and 11 provide the process parameters: See EQPM for environmental profiles for each zone.

## Composite Environmental Profile:

Normal: 123 F (From AB-3)

Accident: 160 F (From AB-4)

## Pump Composite Process Conditions

Normal: 123 F (From AB-3)

Accident: 185 F (RHR, LPCS, HPCS Accident)

By utilizing this composite, the most restrictive replacement interval can be established. For conservatism, the accident temperature has been applied for the full term post-accident condition of 180 days.

$$\ln \text{ life}_{185} = 17798 (1/358) - 38.3$$

$$= 49.7 - 38.8$$

$$\text{life}_{185} = 54176.4 \text{ Hours}$$

Since only 4320 hours have been postulated for the post-accident operation period, the residual life at 185 F can be related to an estimate of normal service life at 123 F by using the Arrhenius methodology. This results in a determination of the expected life at 123 F.

$$\text{life}_{123} = \text{residual life}_{185} e^{-17798 (1/358 - 1/323.3)}$$

life = 49856.4 (200.7)  
123

life = 1.0E07 Hours >>40 Yrs  
123

Based on the results above, no required replacement based on environmental concerns is necessary over the postulated operating life of the plant - 40 years.

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## BUNA-N (NITRILE RUBBER) PUMP PARTS

R3

From Reference 13 the slope and y-intercept values for the Buna-N have been determined to be 7825 and -14.23, respectively. This results in an Activation Energy value of 0.67 eV. Applying the Arrhenius methodology to this data for the environmental profile defined below results in a determination of the expected life of the material for the defined conditions. This value can then be used to quantify a replacement interval which will assure the continued functional ability of the safety-related component.

From Appendix A, Zone AB-4 provides the environmental conditions for Tag Numbers 1E12C0003 and 1E51C0003. References 8 and 11 provide the process parameters. See attached EQPM for environmental profile for the zone.

Process Temperature: ambient

Based on the EQRL, the pump will not experience the design basis environment.

$$\ln \text{ life}_{113} = 7825 (1/318.2) - 14.23$$

$$= 24.59 - 14.23 = 10.36$$

$$\text{life}_{113} = 31,617 \text{ hrs}$$

$$\text{residual life} = 31,617 - 8372 = 23,245 \text{ hrs}$$

$$\text{life}_{101} = 23,245 e^{-7825 (1/318.2 - 1/311.5)}$$

$$= 23,245 (1.69) = 39,450 \text{ hrs}$$

$$\text{service life} = 39,450 \text{ hrs Normal (113 F)}$$

$$8,372 \text{ hrs Normal (101 F)}$$

$$\text{-----}$$

$$47,822 \text{ hrs} = 5.46 \text{ yrs with no accident}$$

From Appendix A, Zone AB-2 provides the environmental conditions for Tag Numbers 1E21C0002 and 1E22C0003. References 9 and 10 provide the process parameters. See attached EQPM for environmental profile for the zone.

R3

Process Temperature: ambient

Based on the EQRL, the pump will not experience the design basis environment.

$$\ln \text{ life}_{106} = 7825 (1/314.3) - 14.23$$

$$= 24.89 - 14.23 = 10.66$$

$$\text{life}_{106} = 42,616 \text{ hrs}$$

$$\text{residual life} = 42,616 - 7095 = 35,521 \text{ hrs}$$

$$\text{life}_{90} = 35,521 e^{-7825 (1/314.3 - 1/305.4)}$$

$$= 35,521 (2.06) = 73,381 \text{ hrs}$$

$$\text{service life} = \begin{array}{l} 7,095 \text{ hrs Normal (106 F)} \\ 73,381 \text{ hrs Normal (90 F)} \\ \hline \end{array}$$

$$80,476 \text{ hrs} = 9.18 \text{ yrs with no accident}$$



RADIATION CONVERSION CALCULATION  
NVT-TO RADS (AIR)

From the reference, "Radiation Stability of Asbestos," Raybestos  
 Manhattan Industrial Co., asbestos shows no changes in properties

up to  $1 \times 10^{20}$  NVT. To convert to rads air use the reference,  
 "Radiation Effects Organic Materials in Nuclear Power Plants,"  
 EPRI RP 1707-3, Final Report. From this reference:

for 1 Mev neutrons

$$X \text{ neutrons/cm}^2 \times 4.17 \times 10^{-9} = Y \text{ rads (carbon)}$$

$$1.0 \text{E}20 \times 4.17 \text{E}-09 = 4.17 \text{E}11 \text{ rads (carbon)}$$

Also from this reference:

$$\text{rads (carbon)} = 0.989 \text{ rads (air)}$$

$$\text{Therefore, } 4.17 \text{E}11 \text{ rads (carbon)} / 0.989 = Z \text{ rads (air)}$$

$$\underline{4.216 \text{E}11 \text{ rads (air)}}$$

Because of the wide range of neutron energy levels and  
 uncertainties in the rads carbon to air conversion, a value of  
 $1.0 \text{E}11 \text{ rads (air)}$  [gamma equivalent] will be used.

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ATTACHMENT 2

Project Number: 20070

File Number: SP810-20-010

File Revision: 2

Date: 04/17/85

R2

R2

MECHANICAL EQUIPMENT  
QUALIFICATION REVIEW FILE  
FOR

R1

VALVES  
Manufactured by  
CONTROMATICS

for

CLEVELAND ELECTRIC ILLUMINATING COMPANY  
PERRY NUCLEAR POWER PLANT

DFH

Cleveland Electric Illuminating - MEQ

## RECORD OF REVISIONS

[illegible]

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References

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Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010  
File Revision: 2  
Date: 04/17/85

R2  
R2

## MECHANICAL EQUIPMENT QUALIFICATION

SUMMARY CONCLUSIONS

Manufacturer: Contromatics

Model-Number(s): W-2566-BB, W2566-CC, C-9922-CC, C-W2566-CC\*, C-W2566-BB\*, C-2522-8C-F5\*

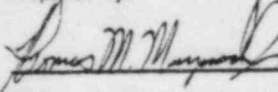
Qualification Restrictions: None

Justification for Interim Operation (if applicable): Not Applicable

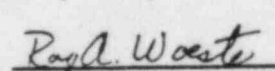
\* Mild environment only (see Appendix B)

Qualification Conclusion: These components are qualified for service in the environmental zones defined herein without exception or restriction.

Prepared by:

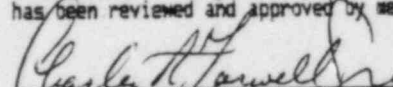
Thomas M. Maynard, Jr.  
Project Engineer

QA Approval by:

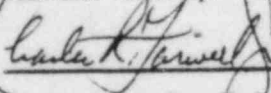
Roy A. Woeste  
QA Manager

Certificate of Compliance:

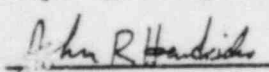
I hereby certify that the engineering evaluation has been performed in full accordance with the customer's purchase order as provided to DiBenedetto, Farwell & Hendricks. The engineering evaluation has been reviewed and approved by me.

Dr. Charles R. Farwell, Jr.  
Director of Engineering and C.E.O.

Technical Review by:

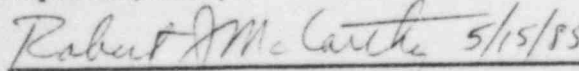
Dr. Charles R. Farwell, Jr.  
Program Manager

Program Approval by:

John R. Hendricks, P.E.  
Program Director

Registration P.E. No. 10163  
State of North Carolina

Program Acceptance by:

 5/15/85

Cleveland Electric Illuminating Company

Date 4/18/85 P.E. Stamp

R2

DFH



Form No. 2 Page 1 of 1

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010  
File Revision: 2  
Date: 04/17/85

R2  
R2

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION SUMMARY REVIEW

Manufacturer: Contromatics

Model-Number(s): W-2566-BB, W-2566-CC, C-9922-CC, C-W2566-C\*, C-W2566-BB\*, C-2522-BC-FS\*

Non-Metallic Materials: MML #001-UHMW Polyethylene Seat/Seal  
MML #002-Viton O-Ring  
MML #003-Asbestos (John Crane 5810 Packing)

\* Mild Environment Only (See Appendix B)

## ENVIRONMENTAL LIMITATIONS

PARAMETERS	REQUIRED	DEMONSTRATED	QRW PAGE NUMBER
Radiation	4.5E07 Gamma	9.0E07 Gamma	1
Temperature	189 F (1)	250 F	1
Pressure	150 PSI (1)	—	—
Chemical Spray	N/A	—	—
Humidity	100% RH	—	—
Other: (3)			
Temperature (Ball Valves)	330 F	400 F	2

Notes: 1) The Contromatics Control Seal valves are all ANSI 150# rated valves.  
2) The required values for ball valves are based on service as defined in Appendix D.

DFH



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Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010  
File Revision: 2  
Date: 04/17/85

R2

R2

### MECHANICAL EQUIPMENT QUALIFICATION

#### REFERENCES

1. Thermal Stability of Polymers, R/T Conley, ed., Marcel Dekker, Inc. New York 1970, P.171
2. MIL-HDBK-700A, March 17, 1975, P.74
3. "How Radiation Affects Engineering Materials", M/DE Manual No. 173, Columbus, Ohio: Radiation Information Effects Center, Batelle Memorial Institute, July, 1960, p. 131
4. "The Engineering Properties of Viton Fluoroelastomer", Document No. E-46315
5. Conax Electrical Penetration Report, IPS-353.1, "Design Qualification Report for a Conax Instrumentation Service Classification Conductor Module."
6. Rite Pak Packing, Crane Packing Company, Bulletin No. P-3023
7. "Radiation Stability of Asbestos", Raybestos Manhattan Industrial Co.
8. "Radiation Effects on Organic Materials in Nuclear Plants", EPRI RP 1707-3, Final Report
9. "Viton E-60-C-Long Term Compression Set Resistance", DuPont Data Sheet V-D-3-301

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Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010

File Revision: 2

Date: 04/17/85

R2

R2

## MECHANICAL EQUIPMENT QUALIFICATION

ENVIRONMENTAL QUALIFICATION  
MAINTENANCE AND SURVEILLANCE

QW PAGE NUMBER (M & S ITEMS)	SCHEDULE	BASIS
1		Arrhenius Equation evaluation of established thermal aging data
	17.8 yrs	Zone AB-2: Tag Nos. 1G42 F 0010, 1G42 F 0020
	22.1 yrs	Zone AB-4: Tag Nos. 1P45 F 0014A, 1P45 F 0014B, 1P45 F 0068A, 1P45 F 0068B
	>40 yrs	Zone AB-9: Tag Nos. 1P11 F 0060, 1P11 F 0080
	>40 yrs	Zone CT-2: Tag Nos. 1P11 F 0090, 1P43 F 0215, 1P43 F 0355, 1P43 F 0400, 1P43 F 0410, 1P50 F 0140
	21.8 yrs	Zone CT-3: Tag Nos. 1D17 F 0071B, 1G41 F 0140
	21.8 yrs	Zone CT-7: Tag Nos. 1D17 F 0081B, 1G43 F 0030B, 1G43 F 0040B
	>40 yrs	Zone CT-8: Tag Nos. 1G43 F 0030A, 1G43 F 0040A
	1.84 yrs	Zone FB-3: Tag Nos. 0G41 F 0085, 1G41 F 0090
2	>40 yrs	Arrhenius Equation evaluation of established thermal aging data
3	As required for routine maintenance	This material is a mineral and applied below its thermal limits, therefore it is considered not age sensitive

R1

DFGH

Form No. 5 Page 1 of 3

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010  
File Revision: 2  
Date: 04/17/85

R2  
R2

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers: Not Applicable

Equipment Category : A X B \_\_\_\_\_ (NUREG-0588, Appendix E)

Equipment Location : Inside Drywell \_\_\_\_\_

Outside Drywell X \_\_\_\_\_Limiting Zone or P&ID Number AB-4 Radiation  
302-655 Temperature

Non-Metallic Material: MML #001 - UHMW Polyethylene (used as a seat material and a seal material)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE
Temperature:	Environmental	189/184.6F*	250 F (Continuous)	2
	Process	185/NA		1
Radiation :	Environmental	4.1E07	9.0E07 (25% damage)	3
	Process	4.5E07		
Pressure :	Environmental	-	-	
	Process	150 PSIG	-	
Chemical Effects :	Environmental (Spray)	-	-	
	Process (Internal)	-	-	
Humidity :	Environmental	100% Rh	-	
Other:				
* Isolation/Ball Valve Values				

DF&amp;H

Form No. 5 Page 2 of 3

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010

File Revision: 2

Date: 04/17/85

R2

R2

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers: Not Applicable

Equipment Category : A X B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number AB-4 Radiation  
302-655 TemperatureNon-Metallic Material: MIL #002 - Viton (Used as an O-Ring and a Valve Seat)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE
Temperature:	Environmental	189F/184.6F*	400 F (Continuous)	4
	Process	185F/330F		
Radiation :	Environmental	4.1E07	2.0E08	5
	Process	4.5E07		
Pressure :	Environmental	—	—	—
	Process	150 PSIG	—	—
Chemical Effects :	Environmental (Spray)	—	—	—
	Process (Internal)	—	—	—
Humidity :	Environmental	100% RH	—	—
Other:				
* Isolation/Ball Valve Values				

DFH

Form No. 5 Page 3 of 3

Perry Nuclear Power Plant  
Cleveland Electric Illuminating Company

File Number: SP810-20-010  
File Revision: 2  
Date: 04/17/85

R2

R2

## MECHANICAL EQUIPMENT QUALIFICATION

QUALIFICATION REVIEW WORKSHEET

Equipment Tag Numbers: See Appendix A

Vendor Model Numbers : Not Applicable

Equipment Category : A X B      (NUREG-0588, Appendix E)Equipment Location : Inside Drywell     Outside Drywell XLimiting Zone or P&ID Number AB-4 Radiation  
302-655 TemperatureNon-Metallic Material: MML #003 - John Crane 5810 Packing (Braided Asbestos)

ENVIRONMENTAL PARAMETERS		REQUIRED	DEMONSTRATED	REFERENCE
Temperature:			500 F	6
	Environmental	189F/184.6F*		
	Process	185F/NA		
Radiation :			1.0E11	7, 8
	Environmental:	4.1E07		
	Process	4.5E07		
Pressure :				
	Environmental	—	—	—
	Process	150 PSIG	—	—
Chemical Effects :				
	Environmental (Spray)	—	—	—
	Process (Internal)	—	—	—
Humidity :				
	Environmental	—	—	—
Other:				
* Isolation/Ball Valve Values				

DFSH

APPENDIX A



PERRY NUCLEAR POWER PLANT  
MECHANICAL EQUIPMENT QUALIFICATION PROGRAM  
APPENDIX A - HARSH ENVIRONMENT EQUIPMENT LIST (Page 1 of 1)

MANUFACTURER : Contromatics  
REQ FILE NUMBER: -818

COMPONENT DESIGNATION	ZONE	P & ID	MPL #			VENDOR/DRAWING NUMBER		MODEL NUMBER	SIZE	EQUIPMENT DESCRIPTION
0041 F 0085	FB-3	382-655	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-CC	10"	Fuel Pool Cooling & Cleanup Isolation Valve
1017 F 00719	CT-3	886-004	X	X		( 298-10-66	4549-40-272-0	C- 9922-CC	1"	Radiation Monitoring DM Atmos Inboard Ball Valve
1017 F 00819	CT-7	886-007	X	X		( 298-10-66	4549-40-272-0	C- 9922-CC	1"	Radiation Monitoring DM Atmos Inboard Ball Valve
1041 F 0090	FB-3	382-651	X	X	X	(2498-00-32, Rev. A)	4549-40-928-1	C-W2566-CC	8"	FPCAC System Butterfly Valve
1041 F 0140	CT-3	382-651	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-CC	10"	FPCAC System Inboard Isolation Butterfly Valve
1042 F 0010	AB-2	382-681	X	X	X	(2498-00-26, Rev. A)	4549-40-235-1	C-W2566-BB	12"	Supp. Pool Drain & Cleanup Pump Suct. Iso. Valve
1042 F 0020	AB-2	382-681	X	X	X	(2498-00-26, Rev. A)	4549-40-235-1	C-W2566-BB	12"	Supp. Pool Drain & Cleanup Pump Suct. Iso. Valve
1043 F 0030A	CT-8	382-686	X	X	X	(2498-24-00, Rev. A)	4549-40-257-1	C-W2566-CC	24"	Supp. Pool Make-up Butterfly Valve
1043 F 0030B	CT-7	382-687	X	X	X	(2498-24-00, Rev. A)	4549-40-257-1	C-W2566-CC	24"	Supp. Pool Make-up Butterfly Valve
1043 F 0040A	CT-8	382-686	X	X	X	(2498-24-00, Rev. A)	4549-40-257-1	C-W2566-CC	24"	Supp. Pool Make-up Butterfly Valve
1043 F 0040B	CT-7	382-686	X	X	X	(2498-24-00, Rev. A)	4549-40-257-1	C-W2566-CC	24"	Supp. Pool Make-up Butterfly Valve
1011 F 0060	AB-9	382-102	X	X	X	(2498-00-26, Rev. A)	4549-40-235-1	C-W2566-BB	12"	CTIS Outboard Isolation Butterfly Valve
1011 F 0060B	AB-9	382-102	X	X	X	(2498-00-26, Rev. A)	4549-40-235-1	C-W2566-BB	12"	CTIS Cont. Pool Drain Line Isolation Valve
1011 F 0090	CT-2	382-102	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-BB	10"	CTIS Cont. Pool Drain Line Isolation Valve
1043 F 0215	CT-2	382-613	X	X	X	(2498-00-26, Rev. A)	4549-40-235-1	C-W2566-BB	12"	NCCS Inboard Containment Isolation Valve
1043 F 0355	CT-2	382-613	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-BB	10"	NCCS Outboard Drywell Isolation Valve
1043 F 0400	CT-2	382-613	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-BB	10"	NCCS Drywell Effluent Isolation Valve
1043 F 0410	CT-2	382-613	X	X	X	(2498-10-09, Rev. A)	4549-40-220-1	C-W2566-BB	10"	NCCS Drywell Effluent Isolation Valve
1045 F 0014A	AB-4	382-792	X	X	X	(2498-20-03, Rev. A)	4549-40-222-1	C-W2566-BB	20"	ESMS RHR Heat Exch. Isolation Valve
1045 F 0014B	AB-4	382-792	X	X	X	(2498-20-03, Rev. A)	4549-40-222-1	C-W2566-BB	20"	ESMS RHR Heat Exch. Isolation Valve
1045 F 0060A	AB-4	382-792	X	X	X	(2498-20-03, Rev. A)	4549-40-222-1	C-W2566-BB	20"	ESMS RHR Heat Exch. Isolation Valve
1045 F 0060B	AB-4	382-792	X	X	X	(2498-20-03, Rev. A)	4549-40-222-1	C-W2566-BB	20"	ESMS RHR Heat Exch. Isolation Valve
1050 F 0140	CT-2	913-000	X	X	X	(2498-00-23, Rev. B)	4549-40-210-3	C-W2566-BB	6"	Cont. Vessel Chilled Water Outboard Iso. Valve

## CONDITIONS

	Temperature (Deg. F)	Pressure (PSIG)	Radiation (TID)
Max. Environment	189(1)	—	4.1E07 Gamma (2)
Max. Process	212(3)	150(4)	2.6E05 Gamma/2.1E08 Beta (5), 1 Hour Beta = 2.5E07 Rads (6) 4.5E07 Gamma/3.3E07 Beta (5), 1 Hour Beta = 1.4E05 Rads (6)

- Notes: (1) Based on AB-9, see Appendix D  
(2) Based on AB-4  
(3) Based on 382-655  
(4) Based on 913-000  
(5) Based on PY-6A1/CEI-15568, G41  
(6) The 1 hour beta dose will be included for valve seats. This is a conservative estimate of the valve exposure since the normal response times are on the order of 1 minute, from EQRL.



APPENDIX B

## PERRY MIDDLE POWER PLANT

## REDUCTION EQUIPMENT QUALIFICATION PROGRAM

## APPENDIX B - WILD EQUIPMENT LIST (Page 1 of 2)

MANUFACTURER : Controlmatic  
WLS FILE NUMBER: -818

COMPONENT DESCRIPTION	ZONE	P I D	WLS #	VENDOR/WORKING NUMBER	MODEL NUMBER	SIZE	EQUIPMENT DESCRIPTION
04A17 8C208	FB-1	382-624	11111111	12438-00-25, Rev. A1	12438-00-225-1		C-402566-CC
04A17 8C209	FB-1	382-624	11111111	12438-00-25, Rev. A1	12438-00-225-1		C-402566-CC
04A17 8C210	FB-1	382-624	11111111	12438-00-25, Rev. A1	12438-00-225-1		C-402566-CC
04A17 8C211	FB-1	382-624	11111111	12438-00-25, Rev. A1	12438-00-225-1		C-402566-CC
04A17 8C212	FB-1	382-624	11111111	12438-00-23, Rev. B1	12438-00-218-3		C-402566-CC
04A17 8C213	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C214	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C215	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C216	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C217	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C218	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C219	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C220	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C221	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C222	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C223	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C224	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C225	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C226	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C227	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C228	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C229	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C230	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C231	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C232	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C233	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C234	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C235	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C236	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C237	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C238	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C239	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C240	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C241	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C242	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C243	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C244	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C245	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C246	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C247	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C248	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C249	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80
04A17 8C250	FB-1	382-621	11111111	12438-18-47, Rev. A1	12438-18-228-1		C-402566-80



APPENDIX C

MASTER MATERIALS LIST  
(MML)

MML NO.	MATERIAL DESCRIPTION
001	UHMW Polyethylene
002	Viton (Fluoroelastomer)
003	Asbestos
004	Nordel
005	Kalrez
006	Asbestos/SS
007	Ethylene Propylene (incl. EPT, EPDM)
008	Nitrile (Buna-N)
009	Silicone Rubber
010	Vespel (Polyimide)
011	Neoprene
012	Durametallic
013	Teflon
014	Kel-F
015	Nylon
016	Graphite (Grafoil)
017	Filmite 7000
018	Rubber
019	RTV
020	Dow 781
021	Grease
022	Plexiglass

APPENDIX D

## VALVE RESPONSE TIME REQUIREMENTS \*

OG41 F0085	30.0 seconds
1D17 F0071B	(not an isolation valve)
1D17 F0081B	(not an isolation valve)
1G41 F0090	30.0 seconds
1G41 F0140	30.0 seconds
1G42 F0010	30.0 seconds
1G42 F0020	30.0 seconds
1G43 F0030A	30.0 seconds
1G43 F0030B	30.0 seconds
1G43 F0040A	30.0 seconds
1G43 F0040B	30.0 seconds
1P11 F0060	30.0 seconds
1P11 F0080	30.0 seconds
1P11 F0090	30.0 seconds
1P43 F0215	30.0 seconds
1P43 F0355	10.0 seconds
1P43 F0400	10.0 seconds
1P43 F0410	10.0 seconds
1P45 F0014A	30.0 seconds
1P45 F0014B	30.0 seconds
1P45 F0068A	30.0 Seconds
1P45 F0068B	30.0 seconds
1P50 F0140	30.0 seconds

From a review of the required valve response times, the use of accident parameters corresponding to one hour is conservative. This is only true in those cases for valves that are fail-closed after the isolation signal. A review of vendor drawings and P&ID's listed in appendix A indicates that all isolation valves are fail-closed. Since no additional flow is present in the process lines, the one-hour dose is considered representative relative to beta exposure since the beta radiation will be effectively attenuated by the metallic valve seat assembly.

Based on a review of the function of these valves, the ball valves require an additional aging analysis which is provided later. The forthcoming analysis is only applicable to the isolation valves. From appendix A, all isolation valves are equipped with polyethylene seats (MML #001), viton o-rings (MML #002), and asbestos packing (MML #003). In addition, some valves are equipped with an additional valve seal of polyethylene (MML #001) which shall be treated with the valve seat calculation.

From a review of the normal and accident conditions listed on the following pages, a composite environmental condition has been developed for purposes of performing conservative estimates of replacement intervals and expected life.

\* Taken from EGRL, 10/13/83 .pa



R1

	<u>NORMAL</u>	<u>ACCIDENT</u>
<u>AB-2</u>	7093 H 106 F 2956 H 81 F 285580 H 90 F	0 to 1 H 106 F to 4320 H 138 F
<u>AB-4</u>	8372 H 113 F 3489 H 86 F 336992 H 101 F	0 to 1 H 160 F to 4320 H 129 F
<u>AB-9</u>	8404 H 107 F 3503 H 86 F 338440 H 93 F	0 to 1 H see p4 to 4320 H 115 F
<u>CT-2, -3, -7, -8</u>	7731 H 104 F 3221 H 62 F 322113 H 87 F	0 to 3 H 184.6 F 3 H to 18 H 160 F to 4320 H 90 F
<u>FB-3</u>	8408 H 130 F 3503 H 90 F 333440 H 119 F	0 to 4320 H 150 F

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R1

Zone AB-2

## Accident

$$\begin{aligned} \ln \text{ life}_{106} &= 13486 (1/314.3) - 30.9 \\ &= 42.9 - 30.9 = 12 \end{aligned}$$

$$\text{life}_{106} = 163,821 \text{ hrs}$$

$$\text{residual life} = 163,821 - 1 = 163,820 \text{ hrs}$$

$$\begin{aligned} \text{life}_{138} &= 163,820 e^{-13486 (1/314.6 - 1/332.1)} \\ &= 163,820 (0.104) = 17,114 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 17,114 - 4319 = 12,795$$

## Abnormal

49 hrs at 154°F

$$\begin{aligned} 154 &= 12,795 e^{-13,486 (1/332.1 - 1/341)} \\ 12,795 (0.346) &= 4433 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 4433 - 49 = 4384 \text{ hrs}$$

## Normal

$$\begin{aligned} \text{life}_{106} &= 4384 e^{-13486 (1/341 - 1/314.3)} \\ 4384 (28.78) &= 126,169 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 126,169 - 7095 = 119,074$$

$$\begin{aligned} \text{life}_{90} &= 119,074 e^{-13,486 (1/314.3 - 1/305.4)} \\ 119,074 (1.25) &= 148,894 \text{ hrs} \end{aligned}$$

service life	49	Abnormal
	7095	Normal 106
	<u>148,894</u>	Normal 90

$$156,038 \text{ hrs} = 17.8 \text{ yrs plus accident}$$

R1

Zone AB-4

## Accident

$$\begin{aligned} \ln \text{life}_{160} &= 13486 (1/344.3) - 30.9 \\ &= 39.17 - 30.9 = 8.27 \\ \text{life}_{160} &= 3897 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 3897 - 1 = 3896 \text{ hrs}$$

$$\text{life}_{129} = 3896 e^{-13486 (1/344.3 - 1/327.1)}$$

$$3896 (7.84) = 30557 \text{ hrs}$$

$$\text{residual life} = 30557 - 4319 = 26,238 \text{ hrs}$$

## Abnormal

49 hrs at 134°F

$$\text{life}_{134} = 26,238 e^{-13486 (1/327.1 - 1/329.9)}$$

$$26,238 (0.70) = 18,491 \text{ hrs}$$

$$\text{residual life} = 18,491 - 49 = 18,442 \text{ hrs}$$

## Normal

$$\begin{aligned} \text{life}_{113} &= 18,442 e^{-13486 (1/329.9 - 1/318.2)} \\ &18,442 (4.5) = 82,907 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 82,907 - 8372 = 74,535 \text{ hrs}$$

$$\text{life}_{101} = 74,535 e^{-13486 (1/318.2 - 1/311.5)}$$

$$74,535 (2.49) = 185,464 \text{ hrs}$$

service life	49	Abnormal
	8372	Normal 113
	185,464	Normal 101

$$\underline{193,885} \text{ hrs} = 22.1 \text{ years} \\ \text{plus accident}$$

Zone AB-9

Accident

$$\begin{aligned} \text{life}_{189} &= 13,486 (1/360.4) - 30.9 \\ &= 37.4 - 30.9 = 6.5 \end{aligned}$$

$$\text{life}_{189} = 677 \text{ hrs}$$

$$\text{residual life} = 677 - 2 = 675 \text{ hrs}$$

$$\begin{aligned} \text{life}_{115} &= 675 e^{-13486 (1/360.4 - 1/319.3)} \\ &= 675 (123.5) = 83,393 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 83,393 - 4318 = 79,075 \text{ hrs}$$

Abnormal

49 hrs at 120°F

$$\begin{aligned} \text{life}_{126} &= 79075 e^{-13486 (1/319.3 - 1/325.4)} \\ &79075 (0.45) = 35,824 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 35,824 - 49 = 35,775 \text{ hrs}$$

Normal

$$\begin{aligned} \text{life}_{107} &= 35,775 e^{-13486 (1/325.4 - 1/314.9)} \\ &35,775 (3.98) = 142,475 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 142,475 - 8,404 = 134,071 \text{ hrs}$$

$$\begin{aligned} \text{life}_{93} &= 134,071 e^{-13486 (1/314.9 - 1/307.1)} \\ &134,071 (2.96) = 397,864 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 397,864 - 338,440 = 59,424$$

service life	49	Abnormal
	8404	Normal 107
	397,864	

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$$406,317 \text{ hrs} = 46.3 \text{ yrs plus accident}$$

Zone CT-2, -3, -7, -8

Accident

$$\begin{aligned} \ln \text{ life } 184.6 &= 13486 (1/358) - 30.9 \\ &= 37.67 - 30.9 = 6.77 \\ \text{life}_{184.6} &= 873.7 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 873.7 - 3 = 870.7 \text{ hrs}$$

$$\begin{aligned} \text{life}_{160} &= 870.7 e^{-13486 (1/358 - 1/344.3)} \\ &870.7 (4.47) = 3898 \text{ hrs} \end{aligned}$$

$$\text{residual life } 3898 - 15 = 3883 \text{ hrs}$$

$$\begin{aligned} \text{life}_{90} &= 3883 e^{-13486 (1/344.3 - 1/305.4)} \\ &3883 (146.8) = 570,070 \end{aligned}$$

$$\text{residual life} = 570,070 - 4302 = 565,768 \text{ hrs}$$

Abnormal

49 hrs at 131°F

$$\begin{aligned} \text{life}_{131} &= 565,768 e^{-13486 (1/305.4 - 1/328.2)} \\ &565,768 (0.04) = 26,324 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 26,324 - 49 = 26,275 \text{ hrs}$$

R1

Normal

$$\begin{aligned} \text{life}_{104} &= 26,275 e^{-13486 (1/328.2 - 1/313.2)} \\ &26,275 (7.16) = 188,024 \text{ hrs} \end{aligned}$$

$$\text{residual life} = 188,024 - 7731 = 180,293 \text{ hrs}$$

$$\begin{aligned} \text{life}_{87} &= 180,293 e^{-13486 (1/313.2 - 1/303.8)} \\ &180,293 (3.79) = 683,264 \end{aligned}$$

service life	49	Abnormal
	7731	Normal 104
	<u>683,264</u>	Normal 87

$$691,044 \text{ hrs} = 78.9 \text{ yrs plus accident}$$

Zone FB-3

Accident

$$\begin{aligned} \ln \text{life}_{150} &= 13486 (1/338.8) - 30.9 \\ &39.8 - 30.9 = 8.9 \end{aligned}$$

$$\text{life}_{150} = 7409 \text{ hrs}$$

$$\text{residual life} = 7409 - 4320 = 3089 \text{ hrs}$$

Abnormal

$$49 \text{ hrs at } 141$$

$$\begin{aligned} \text{life}_{141} &= 3089 e^{-13486 (1/338.8 - 1/333.8)} \\ &3089 (1.81) = 5607 \end{aligned}$$

$$\text{residual life} = 5607 - 49 = 5558 \text{ hrs}$$

R1

Normal

$$\text{life}_{130} = 5558 e^{-13486 (1/333.8 - 1/327.6)}$$

$$5558 (2.15) = 11940 \text{ hrs}$$

$$\text{residual life} = 11,940 - 8408 = 3532$$

$$\text{life}_{119} = 3532 e^{-13486 (1/327.6 - 1/321.5)}$$

$$3532 (2.2) = 7713 \text{ hrs}$$

service life	49	Abnormal
	8408	Normal 130
	<u>7713</u>	Normal 119

$$16,170 \text{ hrs} = 1.84 \text{ yrs plus accident}$$

44



For Viton Valve Parts:

From reference 9 the slope and y-intercept value have been determined to be 13156 and -20.5, respectively. Applying the Arrhenius methodology to the environmental composite noted earlier, an expected life at a given temperature may be established.

$$\ln \text{ life}_{189} = 13156 (377.6) - 20.5$$

$$= 34.84 - 20.5$$

$$\text{life}_{189} = 1.689 \text{ E06 hours} \gg 40 \text{ years}$$

No further calculations are required, the viton products have an expected life in excess of the forty year operating life.

Summary Conclusion: For isolation valves the polyethylene parts have a 2.4 year replacement interval and the Viton parts have a replacement interval in excess of 40 years.

For the ball valves,

	<u>NORMAL</u>		<u>ACCIDENT</u>	
<u>CT-3, -7</u>	7731 H	104 F	0 to 3 HR	184.6 F
	3221 H	62 F	3H to 18 HR	160 F
	322113 H	87 F	to 4320 H	90 F

PROCESS CONDITIONS: 135 F DW-1 profile

Only the viton parts are exposed to process conditions. The polyethylene valve part (gland ring seal) is exposed to ambient CT-3 and CT-F conditions.

FOR POLYETHYLENE VALVE PARTS

From reference 1, as noted earlier: slope = 13486, y-intercept = -30.9

$$\ln \text{ life}_{189} = 13486 (1/377.6) - 30.9$$

$$= 35.72 - 30.9$$

$$\text{life}_{189} = 123.9 \text{ hours}$$

$$\text{life}_{160} = \text{residual life}_{189} = -13486(1/377.6 - 1/344.1)$$

$$= 120.9 (32.36)$$

$$= 3912.3 \text{ hours}$$

$$\text{life}_{104} = \text{residual life}_{160} = -13486(1/344.1 - 1/313)$$

$$= 3897.3 (49.12)$$

$$\text{life}_{104} = 191,435.4 \text{ hours} = 21.8 \text{ years}$$

FOR VITON VALVE PARTS (See profile on the last page of these calculations)

From reference 9, as noted earlier: slope = 13136, y-intercept = -20.5

In life = 13156 (1/438.5) - 20.5  
330

= 30.0 - 20.5

life = 13359.7 hours  
330

life = residual life e -13156 91/438.5 - 1/427.4)  
310 330

= 13353.7 (2.179)

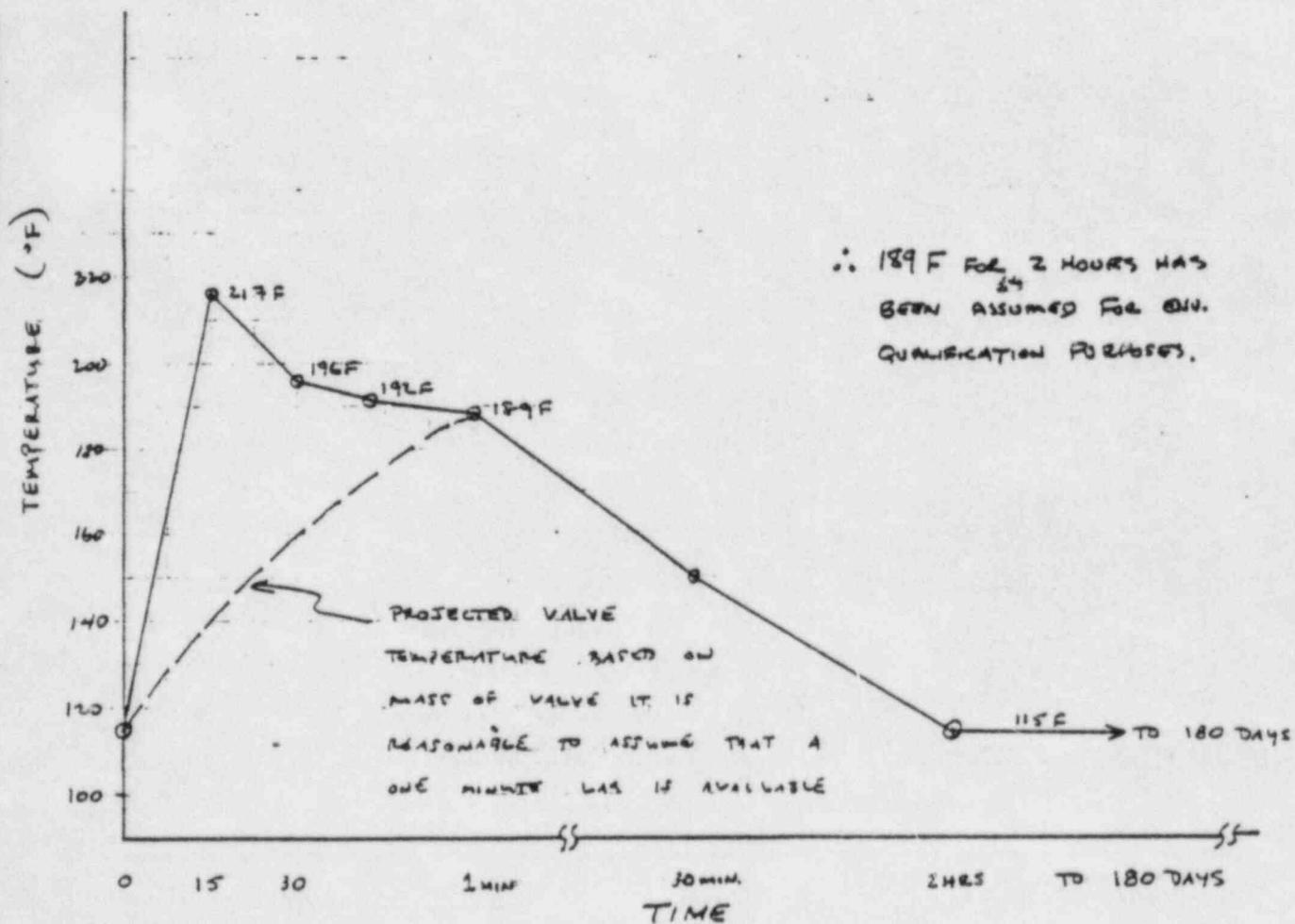
life = 29,097.7 hours  
310

life = 29073.7 (13.47)  
250

life = 391,622.7 hours >> 40 years  
250

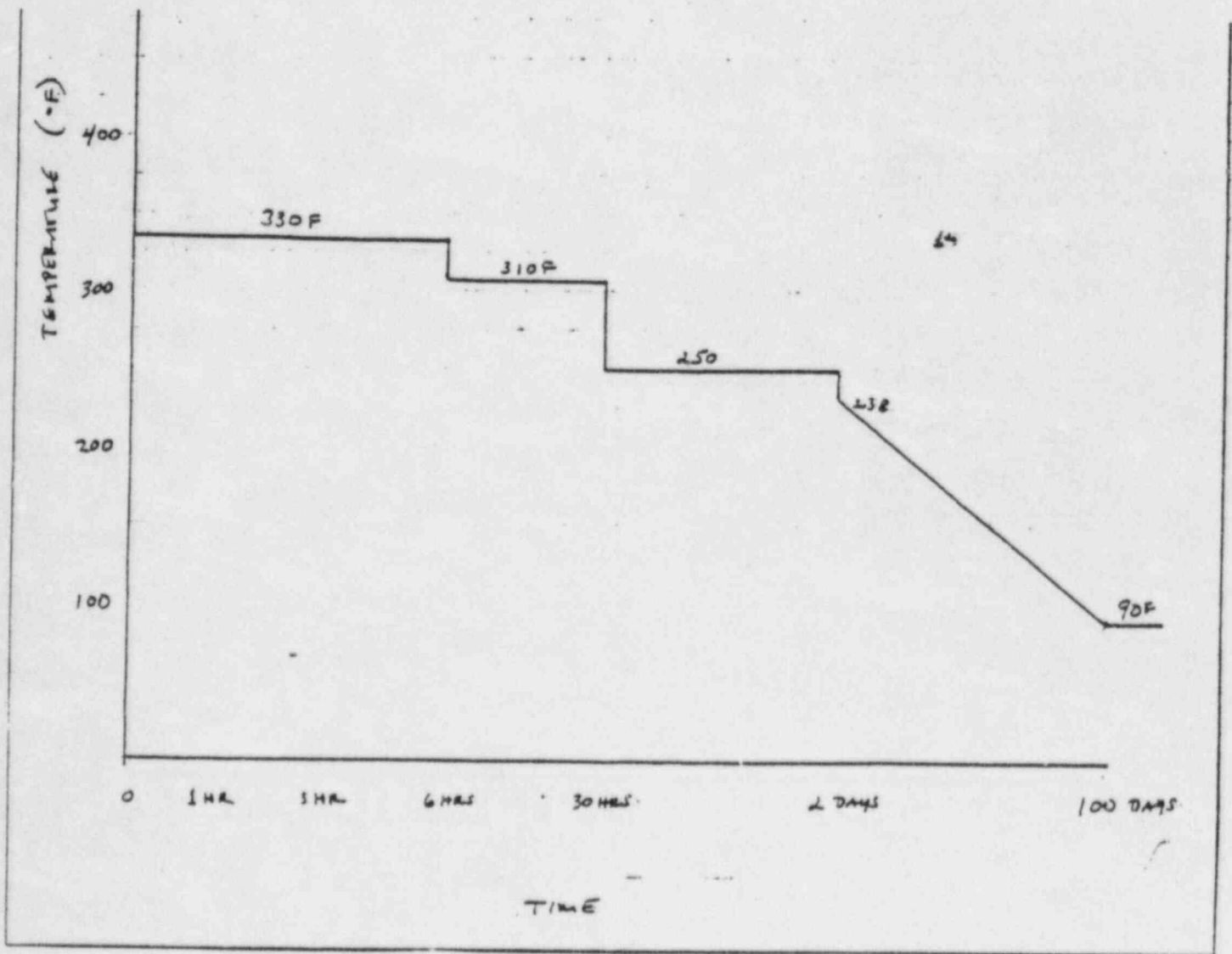
Since the forty (40) years expected life objective, has been obtained no further calculations are required.

SUMMARY CONCLUSION: For ball valves the polyethylene parts have a 21.8 year replacement interval and viton parts have a replacement interval in excess of forty years.

ENVIRONMENTAL ACCIDENT PROFILE

ZONE AB-9

ZONE DW-1 PROFILE  
TEMPERATURE VS. TIME  
(Not to Scale)



RADIATION CONVERSION CALCULATION  
NVT TO RADS (AIR)

From the reference, "Radiation Stability of Asbestos," Raybestos  
Manhattan Industrial Co., asbestos shows no changes in properties

20  
up to  $1 \times 10^{20}$  NVT. To convert to rads air use the reference,  
"Radiation Effects Organic Materials in Nuclear Power Plants,"  
EPRI RP 1707-3, Final Report. From this reference:  
for 1 Mev neutrons

$$\begin{aligned} X \text{ neutrons/cm}^2 & \times 4.17 \times 10^{-9} = Y \text{ rads (carbon)} \\ 1.0 \text{E}20 & \times 4.17 \text{E}-09 = 4.17 \text{E}11 \text{ rads (carbon)} \end{aligned}$$

Also from this reference:

$$\text{rads (carbon)} = 0.989 \text{ rads (air)}$$

$$\text{Therefore, } 4.17 \text{E}11 \text{ rads (carbon)} / 0.989 = Z \text{ rads (air)}$$

$$4.216 \text{E}11 \text{ rads (air)}$$

Because of the wide range of neutron energy levels and  
uncertainties in the rads carbon to air conversion, a value of  
 $1.0 \text{E}11$  rads (air) [gamma equivalent] will be used.