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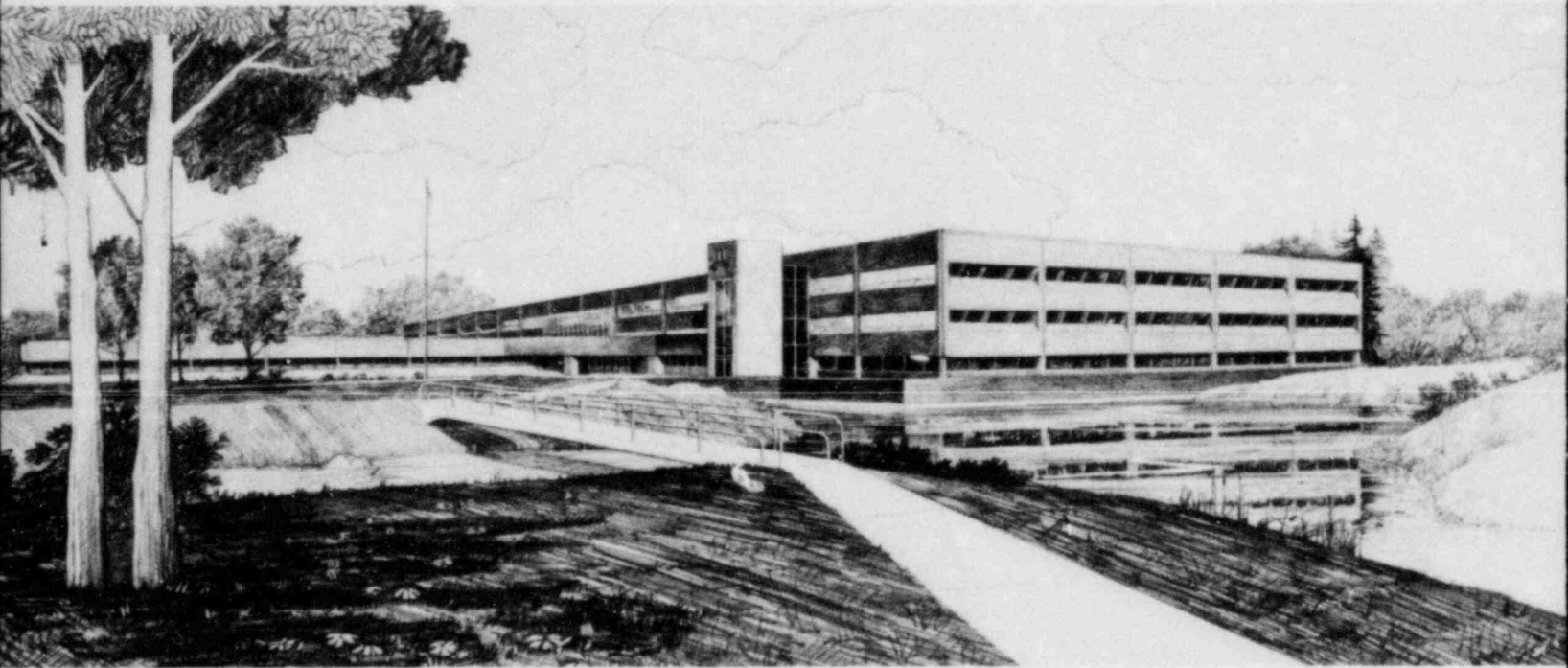
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AUDIT OF THE ENVIRONMENTAL QUALIFICATION OF
SAFETY-RELATED ELECTRICAL EQUIPMENT AT THE
SHOREHAM NUCLEAR POWER STATION, UNIT 1

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Idaho Operations Office • Idaho National Engineering Laboratory



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INTERIM REPORT

AUDIT OF THE ENVIRONMENTAL QUALIFICATION
OF SAFETY-RELATED ELECTRICAL EQUIPMENT
AT THE SHOREHAM NUCLEAR POWER STATION,
UNIT 1

Docket No. 50-322

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ABSTRACT

The Shoreham Nuclear Power Station, Unit 1, (Docket No. 50-322) was audited to determine the environmental qualification of safety-related electrical equipment. Results of the audit are summarized in this report. Results of a second, confirmatory audit are also included as an appendix to this report.

FOREWORD

This report is supplied as part of the "Equipment Qualification Case Reviews" being conducted for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Engineering, Equipment Qualification Branch, by EG&G Idaho, Inc., Reliability and Statistics Branch.

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AUDIT OF THE ENVIRONMENTAL QUALIFICATION OF
SAFETY-RELATED ELECTRICAL EQUIPMENT
AT THE SHOREHAM NUCLEAR POWER STATION, UNIT 1

1.0 INTRODUCTION

On April 25-30, 1982, a team composed of representatives of the Reliability and Statistics Branch of EG&G Idaho, Inc., and the Nuclear Regulatory Commission Staff conducted an audit of the environmental qualification of safety related electrical equipment at the Shoreham Nuclear Power Station, Unit 1. The work effort consisted of: (a) a pre-audit review of the licensee's environmental qualification submittal, (b) an audit of the licensee's central files for selected equipment items, and (c) a visual inspection of the equipment items for which the central files were audited. Qualification deficiencies for individual equipment items are provided in Appendix A. Summaries of the central file reviews are provided in Appendix B. Results of a confirmatory audit, conducted June 2-3, 1982, are provided in Appendix C.

2.0 EVALUATION

General areas of concern which remain as a result of both the audit and the pre-audit review are as follows:

1. The IJI (Interim Justification Inadequate) comment in Appendix A of this report usually indicates a lack of failure effects analysis.
2. In the Equipment Qualification Summary Sheets (EQSS) there are sometimes differing summaries of the same test report (see Magnetrol).
3. The EQSS sometimes lists the tested model and other times lists the model being qualified.
4. The cycle aging section of the EQSS seems to be arbitrarily filled out. Cycling of transmitters is usually not required.
5. In the revised Environmental Qualification Status Report (EQSR) some items have been changed to qualified with no Environmental Qualification (EQ) sheet referenced.
6. Some items which were changed from qualified to not qualified in the revised EQSR were not then included in the Qualification Action Plan.
7. The revised EQSR lists the 120 VAC distribution panels (systems control) as qualified; however, EQ sheet 124-01 states that qualification is unacceptable.
8. The NSSS environmental qualification action plan does not show completion dates for the Commonwealth Edison test schedule.

9. A review of the central files for 20 equipment items indicated that all of the files should be reviewed with emphasis placed in the following areas:
 - (a) similarity of models tested to models installed,
 - (b) operability time,
 - (c) post LOCA operability, and
 - (d) post LOCA accuracy.

3.0 CONCLUSIONS

As a result of the audit it was concluded that the Shoreham Nuclear Power Station environmental qualification program was not complete. The licensee will review and revise the central files for environmental qualification. This review/revision was completed on June 1, 1982, and a confirmatory audit was conducted to determine the licensee's qualification status. Results of this confirmatory audit are provided in Appendix C.

4.0 REFERENCES

1. Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment, NUREG-0588.
2. IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, IEEE Std. 323-1974.
3. Environmental Qualification Report for Class 1E Equipment, Shoreham Nuclear Power Station, Unit 1, Long Island Lighting Company.

APPENDIX A
EQUIPMENT QUALIFICATION STATUS

APPENDIX A

EQUIPMENT QUALIFICATION STATUS

Tables A-1 and A-2 list Nuclear Steam Supply System (NSSS) and Balance of Plant (BOP) equipment and qualification status, respectively. The following codes are used for status designation.

LILCO Evaluation--(Ref. 3 Appendix F)

Q--Equipment is qualified.

QG--Equipment is qualified except for aging.

DR--Documentation is in review.

FT--Documentation has been reviewed, further test/analysis recommended

IJ--Qualification documentation not expected to be completed prior to fuel load, [refer to Appendix G (Ref. 3) for status].

MR--Modification of equipment is recommended for qualification.

RR--Replacement is recommended, test report for qualified replacement will be evaluated.

TA--Testing/Analysis program has been initiated.

Reviewer Evaluation--

A--Aging deficiency

AA--Aging by analysis only

H--Humidity deficiency

IJA--Interim justification adequate

IJI--Interim justification inadequate

ND--No data

NQ--Not qualified

NT--No Test

O--Operability not demonstrated

OT--Operating Time deficiency

P--Pressure deficiency

Q--Qualified

R--Radiation deficiency

RA--Radiation by analysis only

RP--No resolution program

T--Temperature deficiency

T--Ramp deficiency (for Rosemount)

TRA--Test Report Applicability questioned.

TABLE A-1. SHOREHAM NUCLEAR POWER STATION NUCLEAR STEAM SUPPLY SYSTEM
EQUIPMENT QUALIFICATION STATUS

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
1. Solenoid Operated Valve	Asco	HT-X-8320A20	IJ	AA, RA, IJA, RP	24
2. Solenoid Operated Valve	Asco	NP8316C37	QG	Q	2
3. Solenoid Operated Valve	Target	1/2 SMS-A-1	RR	R, OT, AA	22
4. Explosive Valve	Conax	1832-159-01	FT	R, A, OT	2
5. Motor Operated Valve	Limitorque	SMB-2, -3 (003-01)	IJ	A, T, OT, RP, IJI	4
6. Pump	GE	CD259A7	TA	---	1
7. Pump	GE	1.5HP, 120VDC	TA	ND	1
8. Pump	GE	3HP, 1900RPM	--	ND	2
9. Pump	GE	3HP, 3500RPM	TA	---	1
10. Pump	GE	5K324AK2084	FT	ND	2
11. Pump	GE	5K6339XC91A/94A	Q	OT, R, AA	6
12. E/P Converter	Fisher Governor	546	DR	ND	2
13. Flow Transmitter	Ametek	078-5004	DR	ND	4
14. Pressure Transmitter	Bailey	KG556	RR	--	10
15. Level Transmitter	Barton	368	RR	---	2
16. Level Indicating Transmitter	Barton	760	RR	---	4
17. Level Transmitter	Rosemount	1152	Q	A	2
18. Transmitters	Rosemount	1151	Q	A	27
19. Transmitters	Rosemount	1151	FT	R, A, RP	28
20. Pressure Switch	Barksdale	B1T	IJ	AA, RA, RP, IJA	14
21. Pressure Switch	Barksdale	D2H	IJ	AA, RA, RP, IJA	16

TABLE A-1. (continued)

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
22. Pressure Switch	Bairdale	PIH	IJ	AA, RA, RP, IJA	4
23. DP Switch	Barton	288A/289A	IJ	A, R, OT, RP, IJI	33
24. Level Switch	Magnetrol	3.5-751-7X-MPG-M14HY	IJ	NT, R, IJI	2
25. Position Switch	Namco	D1200	TA	ND	2
26. Position Switch	Namco	EA740	RR	ND	8
27. Level Switch	Not Determined	---	DR	ND	1
28. Position Switch	Not Determined	---	DR	ND	3
29. Pressure Switch	Square D	9012, ACW-12	TA	ND	1
30. Level Switch	Square D	9038-AG154	TA	ND	1
31. Level Switch	Square D	9038-AG154	DR	ND	1
32. Level Switch	Square D	9038-A6154	DR	ND	1
33. Pressure Switch	Static-O-Ring	5N, 6N	DR	A, R, OT	6
34. Temperature Element	Calif. Alloy	145C3224P2	IJ	H, RP, IJI	6
35. Temperature Element	Calif. Alloy	145C3224P001	DR	NQ	4
36. Temperature Element	Fenwal	145C3224P002	DR	TRA, IJI, RP	4
37. Temperature Element	NECI	145C3224P001	DR	O, AA	4
38. Temperature Element	Pyco	102-3171	Q	Q	2
39. Radiation Element	GE	237X731G001	DR	ND	4
40. Flow Element	Schutte & Koerting	---	DR	ND	4
41. Blower	GE	2CH6 041-1U	IJ	RA, AA, RP	3
42. Hand Control	GE	47D518673	IJ	RA, AA, IJI, RP	4
43. Turbine	Terry	GS-1	TA	ND	1
44. Panel	GE	---	DR	ND	21
45. Panel	GE	M26	DR	ND	3

TABLE A-2. SHOREHAM NUCLEAR POWER STATION BALANCE OF PLANT EQUIPMENT QUALIFICATION STATUS

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
1. Motor Control Centers	General Electric	DC MCC	IJ	RP, IJA	4
2. Motor Control Center	Square D	Model 4	IJ	RP, IJI	22
3. Breaker	GE	M26	DR	ND	4
4. Solenoid Operated Valve	Asco	HV200-926-1F-EP	RR	--	12
5. Solenoid Operated Valve	Asco	WJHKX-8320-A89E	Q	TRA	37
6. Solenoid Operated Valve	Asco	WJK206-380-6F	Q	TRA	6
7. Solenoid Operated Valve	Valcor	V526-5295, -5683	Q	Q	19
8. Temperature Control Valve	Beck	14-101-023645(ES)	IJ	AA, O, R, IJI	18
9. Motor Operated Valve	Limitorque	SMB (197-01)*	Q	A	18
10. Motor Operated Valve	Limitorque	SMB, SR (88AD-02)	Q	A	24
11. Motor Operated Valve	Limitorque	SMB (88V-02)	Q	A	5
12. Motor Operated Valve	Limitorque	SMB (88V-03)	Q	A	65
13. Motor Operated Valve	Limitorque	SMB (88V-04)	Q	ND	3
14. Motor Operated Valve	Limitorque	SMB (88V-01)	Q	P, A, OT	23
15. Motor Operated Valve	Limitorque	SMB (253-01)	Q	P, A, OT	8
16. Motor Operated Valve	Limitorque	SMB, SMC (253-03)	Q	A, OT	26
17. Motor Operated Valve	Limitorque	SMB (289-02)	Q	A, OT	2
18. Motor Operated Valve	Limitorque	SMB (214-02)	Q	A, OT	10
19. Motor Operated Valve	Limitorque	SMB (253-02)	Q	A	2
20. Motor Operated Valve	Limitorque	SMB (214-01)	Q	P, A	2
21. Motor Operated Valve	Limitorque	SMB (88AD-01)	Q	A, P, OT	1

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TABLE A-2. (continued)

	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>	<u>LILCO Eval.</u>	<u>Reviewer Evaluation</u>	<u>Qty.</u>
22.	Motor Operated Valve	Limitorque	SMB	DR	ND	43
23.	Motor Operated Valve	Limitorque	SMB	RR	ND	3
24.	Air Operated Damper	Centerline	32046-6	Q	Q	2
25.	Air Operated Damper	Powers	331-2792	Q	T	2
26.	Motor Operated Damper	ITT	NH91	IJ	IJI	2
27.	Motor Operated Damper	Raymond	MASR-49	IJ	IJI, NQ	5
28.	Motor Operated Damper	Raymond	MASR-9	IJ	IJI, NQ	4
29.	Pump	Reliance	100-HP-405TS	DR	ND	3
30.	Pump	Reliance	20-HP-286T	DR	ND	2
31.	Inst. Cable	Brand Rex	Low Capacitance	Q	Q	1
32.	Power Cable	Kerite	5KV	Q	Q	1
33.	Power Cable	Okonite	600V	Q	Q	1
34.	Inst. Cable	Raychem	---	Q	Q	1
35.	Inst. Cable	Rockbestos	Coax & Triax	Q	TRA	1
36.	TC Wire	Rockbestos	---	Q	TRA	1
37.	Control and Inst. Cable	Rockbestos	300/600V	Q	Q	1
38.	Swbd Wire	GE	Vulkene Supreme	Q	NQ, IJI	1
39.	Swbd Wire	Rockbestos	Firewall III	Q	Q	1
40.	Flow Transmitter	Air Monitor Corp.	Veltron 800	IJ	IJA	2
41.	Transmitters	Rosemount	1152(406-02)	Q	T, OT, A	14
42.	Transmitters	Rosemount	1152	MR	ND	13
43.	Transmitters	Rosemount	1153(406-01)	Q	A, OT	5
44.	Transmitters	Rosemount	1153(406-02)	Q	TRA	4

TABLE A-2. (continued)

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
45. Pressure Switch	Asco	SB11AKR/TF10A32B	TA	ND	9
46. Pressure Switch	Asco	SB11AKR/TG10A32B	TA	ND	4
47. DP Switch	Dwyer	1627	IJ	NQ, IJI	6
48. Level Switch	Magentrol	291-MPG-X-M14DC	IJ	NT, R, IJI	6
49. Level Element	GEMS	XM-54854	IJ	IJI	3
50. Radiation Element	Kamen	---	TA	---	2
51. Temperature Element	Rosemount	88-149-1	Q	Q	4
52. Temperature Element	Rosemount	88-149-2	Q	Q	8
53. Temperature Element	Rosemount	89-138-2/88-14-3	Q	Q	1
54. Temperature Element	Rosemount	89-86-4/88-14-1	Q	Q	9
55. Temperature Element	Rosemount	89-86-4/88-14-3	Q	Q	6
56. Position Switch	Namco	EA180	DR	ND	17
57. Position Switch	Namco	EA740	RR	ND	55
58. Position Switch	Namco	EA750	RR	ND	8
59. Fan	Westinghouse	143TCZ	Q	Q	1
60. Fan	Westinghouse	143T	DR	ND	2
61. Fan	Westinghouse	213T	DR	ND	8
62. Fan	Westinghouse	286T	DR	ND	1
63. Fan	Westinghouse	326T	DR	ND	4
64. Fan	Westinghouse	364T	DR	ND	4
65. Fan	Westinghouse	405TCZ	DR	ND	3
66. Fan	Westinghouse	7.5HP 245T	DR	ND	2
67. Blower	Reliance	324T	Q	Q	2

TABLE A-2. (continued)

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
68. Transfer Switch	Asco	307A66C	TA	ND	2
69. Selector Switch	GE	CR2940	IJ	IJI	1
70. Hand Selector Switch	GE	294 OUS 203E	IJ	ND	2
71. Panel	Atomics Int.	---	TA	ND	2
72. Panel	Comsip	K-IV	Q	T,A	4
73. Panel	Gould	5600 Series	FT	O,R,AA	4
74. Panel	Kamen	---	TA	ND	2
75. Panel	NMC	---	--	ND	1
76. Panel	Square D	Bkr Dist	IJ	IJI,RP	6
77. Panel	Square D	480V	IJ	IJI,RP	3
78. Panel	Systems Control	120VAC Dist	Q	R,O	2
79. Flex Conduit	Electro Flex	CEA Sealtite	IJ	IJI	1
80. Conduit Coupling	Service-Air	Amer. BOA SS	DR	ND	1
81. Penetration	Conax	Low Volt Pwr, Cont	Q	Q	1
82. Penetration	Conax	Low Volt Pwr, Cont	Q	TRA	2
83. Penetration	GE	Series 100 Med Volt	IJ	R,A	3
84. Penetration	GE	Series 200 Med Volt	IJ	R,A	20
85. Lugs & Splices	Amp	52900-53900	Q	T,OT,TRA,IJA	1
86. Lugs & Splices	Amp	52900-53900	IJ	T,OT,TRA,IJA	--
87. Tape	Kerite	S-5MT-NUC	DR	ND	1
88. Tape	Okonite	T35,T95	IJ	TRA,IJI	1
89. Insulating Material	Raychem	WCSF-N	Q	NQ,IJI	1
90. Chico Compounds	Crouse-Hinds	Chico (X), (A)	IJ	IJI	1

TABLE A-2. (continued)

Equipment	Manufacturer	Model	LILCO Eval.	Reviewer Evaluation	Qty.
91. Terminal Blocks	GE	EB25A04W, -12W	IJ	IJI	1
92. Terminal Blocks	GE	EBI	IJ	IJI	1
93. Terminal Blocks	GE	CR151	IJ	IJI	1
94. Recombiner	Atomics Int	---	IJ	IJI	1
95. Hydrogen Analyzer	Comsip	B	Q	T,A	4
96. Oxygen Analyzer	Comsip	J	Q	T,A	2
97. Filter Train	Farr	N-240	IJ	NQ,IJI	2
98. Motor Generator	Louis Allis	COGSF	Q	NI	4
99. Transformer	Magnetics	L-12514	Q	ND	2

* Number in parenthesis indicates Equipment Qualification Summary Sheet (EQSS) that evaluates specific equipment groups. The Limitorque motor operators are evaluated in 14 groups with only five test reports referenced. A similar situation exists for the Rosemount transmitters.

APPENDIX B
SUMMARIES OF CENTRAL FILE REVIEWS

APPENDIX B

SUMMARIES OF CENTRAL FILE REVIEWS

RHR Pump Motor: General Electric, Model 5K6339XC91A, Plant ID No. 1E11*P014A

The General Electric motor is located in the secondary reactor building and is used to drive RHR pump 1E11*P014A.

The specified accident parameters are as follows: temperature 149°F decreasing to ambient at 16 hours, pressure 0.9 psig, humidity 100%, radiation 4.14×10^6 Rads total integrated dose (TID), and operating time 180 days.

General Electric tested on a similar motor and documented the test in GE Report No. NEDM-10672 and analysis reported in EDS calculation No. 0630-001-011. General Electric also performed radiation and thermal analysis testing on a motor formette and documented the test in GE report 419HA988 and analysis reported in EDS calculation No. 0630-001-012. The environmental parameters that the motor was subjected to were: temperature 212°F, pressure 7 inches water column, and humidity 100%. The test duration was 12 hours (extended to 58.2 hours by analysis) with 86 hours post-DBE operation. The steam environment test was performed on a motor which had been used for two years on pump tests. The motor was considered to be near "end-of-life" at the time of the steam test. Radiation and thermal aging data were obtained from qualification testing on an ECCS motor formette. Radiation exposure was 5.5×10^6 Rads TID with thermal aging for 1362 hours at 200°C. A qualified life of >40 years was calculated provided that a recommended maintenance schedule is followed.

It is concluded that the General Electric RHR pump motor is environmentally qualified and that evidence of qualification is contained in the applicant's files.

600 V Power Cable: Okonite, Plant ID No. 1R31*NFMO2c

This cable is used to supply power to various Class 1E loads throughout the plant.

The specified accident environmental parameters are: temperature 340°F, pressure 48 psig, humidity 100%, demineralized water spray, radiation 1.76×10^6 Rads TID, and operating time 180 days.

Environmental testing of this type of cable is recorded in three test reports (Okonite report No. NQRN-1, Wyle Laboratories report No. 17464-1802, and Franklin Laboratories report No. F-C3694). The maximum environmental parameters that the cable was subjected to are: temperature 345°F, pressure 112 psig, humidity 100%, borated water spray pH 10.5, radiation 2.0×10^6 Rads TID, test duration 130 days (extended to 180 days by analysis). The test margins are considered adequate except for temperature; however, the fact that the temperature margin was only 5°F is considered insignificant. The cable was pre-aged for 21 days at 150°C. A qualified life of >40 years was calculated using the Arrhenius method.

It is concluded that the Okonite power cable is environmentally qualified and that evidence of qualification is contained in the applicant's files.

Air Cylinder Actuator: Centerline, Model 32046-6, Plant ID No. 1T46*A0D040B

This component is part of an automatic temperature control system for the HVAC and is used in the reactor building refueling level exhaust damper. The damper closes on RBSVS initiation signal.

The specified accident parameters are: temperature 138°F, pressure 1 psig, humidity 100%, radiation 8.5×10^3 Rads TID and operating time 70 min.

Environmental testing was performed on this model actuator by Wyle Laboratories and reported in Wyle test report No. 44540-1.

The maximum environmental parameters that the unit was subjected to are as follows: temperature 170°F, pressure 1 psig, humidity 100%, radiation 1×10^7 Rads TID; the test duration was 722 hours. The test margins are adequate to envelop the accident environment. The unit was thermally aged for 54 days at 180°F. The only nonmetallic material in the unit, however, is the Buna-N O-Ring seal. Wyle supplemental report No. 17464-1002 recommends that this seal be changed every eight years.

It is concluded that the Centerline air cylinder actuator is environmentally qualified and that evidence of the qualification is contained in the applicant's files.

Drywell Hydrogen Analyzer: Comsip Inc., Model K-IV, Plant ID No. 1T48*H2Z115B

This equipment is located in the secondary reactor building and is used to measure post accident hydrogen concentration in the drywell.

This equipment is required for loss of coolant accidents (LOCA) only; therefore, the only harsh environmental parameter is Radiation: 2.47×10^6 Rads TID. The sample gas itself reaches a temperature of 340°F at 48 psig; however, it has cooled to <104°F before reaching the gas analyzer. Operating time is 180 days.

Environmental testing was performed on a prototype gas analyzer by Engineering Analysis and Test Company Inc., and reported in Project 1035-1 Rev. 1 report supplemented by Reliance Electric Co. Report NUC-9. The maximum environmental parameters that the prototype was subjected to are as follows: temperature 150°F, pressure 0 psig, humidity 90%, radiation 1×10^6 Rads TID; the test duration was 100 days extended to 180 days by analysis. The test margins and analysis are adequate to envelop the accident environment. No thermal aging was performed. The applicant indicated a qualified life of 40 years; however, the qualification documentation indicated that some components had a design life of only five years.

The environmental testing resulted in two anomalies; after 42 days the sample pump failed due to frozen bearings and after 100 days the sample

pump diaphragm began to leak. A new test plan for retesting the sample pump is included in the qualification data package. The retest was completed, however in June 1982, but data are not yet available.

It is concluded that the hydrogen gas analyzer is not qualified, this agrees with the applicant's conclusion.

Electrical Penetration: Conax, Low Voltage Power, Plant ID No. 1T23-Z-WC1

The penetration covered by the qualification file will be used for inservice inspection only and will not be energized.

The specified accident parameters are: temperature 340°F, pressure 48 psig, humidity 100%, demineralized water spray, radiation 1.2×10^8 Rads TID, and operating time 180 days.

Four Conax test reports are included in the qualification data package (IPS-583, IPS-631, IPS-585.3, and IPS-325).

Test report IPS-585.3 is used for qualification of the adapter module feedthrough assemblies. This test report is incomplete until the following items have been addressed:

1. Similarity between the tested item and the items installed at Shoreham has not been established.
2. The DBE test profile was not shown to be equivalent to the Shoreham DBE profile.
3. Radiation total integrated doses should be in equivalent air instead of equivalent water.
4. The thermal aging time and temperature used during the test were not analyzed specific to Shoreham's normal service temperature.

It is concluded that the Conax electrical penetration is not environmentally qualified, which agrees with the applicant's conclusion. Conax Corp. has agreed, by letter, to respond to the concerns by June 1982.

Fan Motor for MCC Unit Cooler: Westinghouse, Model 143TCZ, Plant ID No. 1T46*FN023

This motor is located in the secondary reactor building and is used in conjunction with 1T46*UC023 MCC unit cooler.

The specified accident environmental parameters are: temperature 153°F, pressure 0.9 psig, humidity 100%, radiation 2.9×10^6 Rads TID, and operating time 180 days.

Environmental testing for this type of unit was performed by the Buffalo Forge Company and documented in their qualification document No. DO-146F, Rev. T (includes Westinghouse report MM 9112). The maximum environmental parameters that the motor was subjected to are as follows:

temperature 227°F, pressure 3.3 psig, humidity 100%, radiation 2×10^6 Rads TID, test duration 30 days. The test margins are adequate except for operating time which was established by analysis. The motor was pre-aged for 1369 hours at 210°C. A qualified life of >40 years was calculated using the Arrhenius method. The applicant has requested a maintenance schedule for the motor bearings from Westinghouse.

It is concluded that the Westinghouse fan motor is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Hydrogen Recombiner Blower Motor: Reliance Electric Company, Model 324T,
Plant ID No. 1T48*BLC0TA

The motor is located in the secondary reactor building and used to drive the blower used in hydrogen recombiner operation.

The motor is for post-LOCA use only. The specified accident environmental parameters are as follows: temperature 104°F, pressure atmospheric, radiation 2.47×10^5 Rads TID, and operating time 180 days. Environmental testing of this type of motor is recorded in Limatorque report No. 600456 and Reliance report No. NUC-9. The maximum environmental test parameters are: temperature 310°F, pressure 70 psig, humidity 100%, radiation 2.04×10^6 Rads TID, and test duration 30 days. All margins are adequate except for operating time; however, there is considerable margin demonstrated by the thermal aging of 180°C for 100 hours. By analysis, a portion of the thermal aging period was used to establish the accident duration requirement. The qualified life was calculated as much greater than 40 years by the Arrhenius method.

It is concluded that the Reliance blower motor is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Barton Pressure Switch, Model No. 288A, Plant ID No. 1E41PS023C

This pressure switch is used to trip the HPCI turbine on low steam pressure, and is located in the secondary reactor building.

The specified accident parameters are: temperature 176°F, pressure 1 psig, humidity 100%, radiation 5.75×10^6 Rads TID and operability time 180 days.

Environmental testing was performed on identical models of this pressure switch. The file contains a hand copied portion of ITT Barton test report No. 9999.1217.2 Rev. 1, and complete Barton test report No. R3-288A-1.

The maximum environmental parameters that the tested pressure switches were subjected to are: temperature 212°F, pressure 7 inches water column, relative humidity 100%, radiation 3×10^6 Rads TID, and a test duration of 6 hours. A qualified life of 40 years is claimed based on material search and industrial data.

It is concluded that the documentation presented in the applicants file is inadequate to establish qualification. Areas of concern include lack of any functional testing during the steam test, radiation testing that did not envelop the specified accident parameters, and use of separate effects testing.

Valcor Solenoid Valve, Model No. V526-5683-27, Plant ID No. 1E 11SOV 167 A

This valve is used to sample water from the primary side of the RHR heat exchanger and is located in the secondary reactor building.

The specified accident parameters are: temperature 194°F, pressure 1 psig, relative humidity 100%, radiation 5.75×10^6 Rads TID, and operability time 180 days.

Environmental testing was performed on a similar valve as reported in Valcor test report No. QR52600-5940-2 with supplemental analysis reported in Wyle Laboratories report No. 17464-4802.

The maximum environmental parameters that the tested valve was subjected to are: temperature 346°F, pressure 113 psig, relative humidity 100%, chemical spray at pH 10.5, radiation 2×10^8 Rads TID, and a test duration of 31 days. The margins are adequate to envelop the accident environment. Thermal aging was performed at 318°F for 172 hours. Arrhenius methodology was used to calculate a qualified life of >40 years.

It is concluded that the Valcor solenoid valve (plant ID No. 1E 11SOV 167 A) is environmentally qualified. Evidence of qualification is maintained in the applicant's files.

Kerite 5 KV Power Cable with HTK(N-98) Insulation and FR(HC-711) Jacket.
Plant ID No. 1R31NFN03

This power cable is used to supply power to Class 1E equipment in all areas of the plant.

The specified accident parameters are: temperature 340°F, pressure 48 psig, relative humidity 100%, demineralized water spray, radiation 1.7×10^8 Rads TID, and operating time of 180 days.

Environmental testing was performed on an identical cable by Isomedix Co. and Kerite Co. as stated in an unnumbered combined report issued May 14, 1981. Additional analysis was provided by Wyle Laboratory report No. 17464-3502.

The maximum environmental parameters the tested cable was subjected to are: temperature 340°F, pressure 95.5 psig, relative humidity 100%, chemical spray at pH 10.0, radiation 2×10^8 Rads TID, and a test duration of 100 days. Margins are adequate to envelope the accident environment. While no temperature margin exists, duration at test temperatures exceed the required test duration by a wide margin, and this is considered adequate. Thermal aging was performed at 150°C for 100 hours. Using Arrhenius

methodology, a 40 year qualified life was developed using conductor temperatures of 90°C and insulation surface temperatures of 83°C. Surveillance provisions include monitoring these temperatures during plant operation.

It is concluded that the Kerite 5 kV power cable specified is environmentally qualified. Evidence of qualification is maintained in the applicant's files.

Instrument Cable: Brand Rex Low Capacitance Instrument Cable with XLPE Insulation, Plant ID No. 1R32NPF-63

This cable is used for instrument signals on various systems throughout the plant. The specified accident parameters are: temperature 340°F, pressure 48 psig, relative humidity 100%, demineralized water spray, radiation 1.76×10^6 Rads TID, and operating time 180 days.

Environmental testing was performed on similar cable by Franklin Research Center and reported in Brand Rex/Franklin Research Center reports Nos. F-C5120-2 and FC4113.

The maximum environmental parameters that the cable was subjected to are: temperature 385°F, pressure 113 psig, relative humidity 100%, chemical spray at pH 10, radiation 2×10^6 Rads TID, and test duration of 30 days. The margins are adequate to envelop the accident environment. Thermal aging was performed at 277°F for 168 hours. The Arrhenius method was used to calculate a qualified life of 40 years.

It is concluded that the Brand Rex instrument cable (plant ID No. 1R32NPF-63) is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Limitorque Motor Operated Valve Actuator, Model No. H2BC-SMB-00-05, Plant ID No. 1P41MOV034A

This motor operated valve actuator operates the discharge valve of RHR heat exchanger No. 1E11-HXE-34A, and is located in the secondary reactor building.

The specified accident parameters are: temperature 154°F, pressure 0.9 psig, relative humidity 100%, radiation 5.75×10^6 Rads TID and operating time of 180 days.

Environmental testing performed on a similar valve is reported in Limitorque test reports B00058 and B0003. Additional analysis is furnished in EQREF-88V-03 Attachment 1.

The maximum environmental parameters that the tested valve was subjected to are: temperature 250°F, pressure 25 psig, relative humidity 100%, radiation 2×10^7 Rads TID, and a test duration of 16 days. Thermal aging at 165°C for 200 hours accounted for part of the claimed 40 year qualified life. Analysis methods to extend qualified life to 40 years included material investigation yielding activation energies and standard industrial data on motor insulation.

It is concluded that the Limitorque motor operated valve actuator specified is environmentally qualified and evidence of qualification is maintained in the applicant's files.

ASCO Solenoid Valve, Model No. NP8C16C37, Plant ID No. 1E11*SOV042A/B

The ASCO solenoid valve is used in the backup scram system and is located in the reactor building secondary Zone G-05.

The bounding environment qualification parameters are: temperature 173°F, pressure 1 psig, relative humidity 100%, radiation 1.7×10^5 Rads TID, and operability time 70 min.

The environmental qualification documents include the Isomedix (for ASCO) test report No. AQS21678/TR Revision A, dated July 1979 and the analyses by EDS calculation No. 0630-001-021, Rev. 0.

The qualification file reviewed showed a similar unit had been tested to the following parameters: temperature 346°F, pressure 110 psig, relative humidity 100%, chemical spray solution of 3000 ppm boron, 0.064 molar sodium thiosulfate buffered with sodium hydroxide to a pH of 10, radiation 2×10^8 Rads TID, test duration 30 days, and thermal aging 268°F for 12 days. The above test parameters envelop equipment environmental parameters by significant margin. Qualification methods include sequential tests and analysis by the Arrhenius method, which extends a simulated life of 4 years to 22.93 years. The manufacturer recommends that the elastomeric materials be replaced at 4 year intervals.

The staff found this file to be adequate.

PYCO 102-3171 Temperature Elements: Plant ID No. 1E11-TE012A/B

The PYCO temperature elements are used in the RHR main flow system. The unit reviewed is located in the reactor building secondary Zone G-02.

Bounding environmental qualification parameters are: temperature 153°F, pressure 1 psig, relative humidity 100%, radiation 5.75×10^6 Rads TID, and operability time 180 days.

The environmental qualification documentation includes the Isomedix qualification tests for thermocouples and RTD Assemblies (for PYCO), PYCO test report No. 770831, and Arrhenius model for PYCO temperature elements (EDS calculation No. 0630-001-017). The test parameters found in the above documentation are as follows: temperature 346°F, pressure 113 psig, relative humidity 100%, chemical spray solution of 3000 ppm boron .064 molar sodium thiosulfate buffered with sodium hydroxide to a pH of 10, test duration 720 hours, and thermal aging 121°C for 7 days.

Methods of qualification are sequential testing and analysis. Qualified life is 28.9 years by analysis. Areas of concern are as follows:

- o Appendix 2 of the test report was not included in the data package

- o Equivalency and/or similarity between the tested and installed thermocouples was not established in the files.

The applicant was able to resolve the above concerns by the end of the audit.

Rosemount RTD, Model No. 88-149-1, 88-149-2, 89-86-4/88-14-1
89-86-4/88-14-3, 8-132-2/88-14-3.

The Plant ID Nos. are 1Z93*TE110W; x, y, and z 1Z93*TE134A,
B-1Z93*TE132A; B-1Z93*TE135A; and B-1Z93*TE133A

The Rosemount RTDs are used to monitor area temperatures and modulate temperature control valves and are located in the reactor building drywell and secondary buildings.

The bounding environmental qualification parameters are: temperature 225°F, pressure 48 psig, relative humidity 100%, demineralized water spray, radiation 1×10^8 Rads TID, and operability time 180 Days.

The environmental qualification documentation includes the Rosemount test report for RTD Assemblies (report No. 2767, Rev. B) and Wyle Labs. Arrhenius analysis report No. 17464-1502.

The test parameters are: temperature 340°F, pressure 125 psig, relative humidity 100%, chemical spray of NaOH and 15000 ppm boric acid (pH 11), radiation 2×10^8 Rads TID, and test duration 50 hours (extended to 180 days by Wyle Laboratories analysis).

Methods of qualification are test and analysis. Thermal aging was not done (Category II Plant). The qualified life was calculated to be 271 days.

The staff had three areas of concern. First, the RTDs installed in the reactor building drywell are located at the 25-ft level which is below the stated 47-ft flood level. The RTDs were not tested for operability while submerged. The second concern is that equivalency and/or similarity between the installed and tested RTDs was not established. The third concern is how the applicant plans to contend with the stated qualified life of less than one year.

The applicant was able to resolve the above concerns by the end of the audit.

Raychem Cable, Flametrol, Plant ID 1R32*NFP044

The Raychem instrument cables are used to transmit instrument signals and are located inside containment and in all reactor buildings.

The bounding environmental qualification parameters are: temperature 340°F, pressure 48 psig, relative humidity 100%, demineralized water spray, radiation 1.76×10^8 Rads TID, and operating time 180 days.

The qualification test report for the cable is Franklin Institute Research Laboratory report F-C4033-1 with supporting aging analysis from Wyle report No. 17464-1102.

Test parameters envelop the required environmental parameters by substantial margins and are as follows: temperature 357°F, pressure 70 psig, relative humidity 100%, chemical spray boric acid and NaOH, radiation 2×10^8 Rads TID, test duration 336 days, and aging at 302°F for 32 days.

The methods of qualification are sequential testing and analysis. Thermal pre-aging and analysis are adequate to demonstrate a 40-year qualified life.

The staff found this file to be adequate.

Rockbestos 300/600 V Control and Instrument Cable, Model No. Firewall III, Plant ID No. 1R32*NFPO20 and 1R32*NFPO10.

The Rockbestos cable is used for transmitting control and instrument signals in containment as well as outside containment.

The bounding environmental qualification parameters are: temperature 340°F, pressure 48 psig, relative humidity 100%, demineralized water spray, radiation 1.76×10^8 Rads TID, and operating time 180 days.

The environmental qualification documentation includes the Rockbestos Firewall III (chemical and irradiation crosslinked insulation) Revision December 8, 1980 (SNPS test report No. 129-01).

The test parameters found in the above documentation are: temperature 346°F, pressure 113 psig, relative humidity 100%, chemical spray 0.28 molar H_3BO_3 and, NaOH with a pH between 9 and 11, radiation 2×10^8 Rads TID, test duration 365 days, and thermal aging 302°F for 1300 hours.

Qualification methods are sequential testing and analysis with a qualified life of 40 years.

The SNPS environmental qualification report evaluation form recommends that this test report be accepted to the Category II position of NUREG 0588 provided that the vendor provides the following:

1. Description of the test facility including type, location, accuracy, and calibration data for the test instruments
2. Test data indicating the results of all readings during testing.

The reviewer agrees that the test report meets IEEE Standard 383-1974 for cable and is adequate; however, the applicant should follow up on the above recommendations and include the documentation in the test report.

APPENDIX C
CONFIRMATORY AUDIT RESULTS

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CONFIRMATORY AUDIT RESULTS

On June 2 and 3, 1982, the same audit team returned to the Shoreham Nuclear Power Station, Unit 1, to conduct a confirmatory audit based on the findings of the April 25-30, 1982, audit. The licensee had issued a revised environmental qualification submittal dated May 17, 1982.

Based on the review of the revised submittal as well as a limited reaudit of the licensee's central files for selected equipment items it was concluded that all general areas of concern had been addressed and that specific concerns had either been resolved or were in the process of being resolved. It was further concluded that the Shoreham Nuclear Power Station environmental qualification program was complete.

Summaries of central files reviewed during the confirmatory audit are as follows:

Terminals and Splices: AMP Models 52979, 53409-1, 53425-1, 53426-1, and 53946-1

These terminals and splices are used in electrical connections throughout the plant.

The specified accident environmental parameters are: temperature 340°F, pressure 48 psig, humidity 100%, demineralized water spray, radiation 1.76×10^6 Rads TID, and operating time 180 days.

Environmental testing of this type of equipment is recorded in AMP qualification test report No. 110.11004 dated February 2, 1982. The maximum environmental parameters that the terminals and splices were subjected to are as follows: temperature 470°F, pressure 74.5 psig, humidity 100%, borated water spray pH 12.5, radiation 2.59×10^6 Rads TID, and the test duration was 30 days (extended to 180 days by analysis). The test margins are considered adequate. The PVC splices were aged at 329°F for 21 days yielding a qualified life of >40 years using Arrhenius methodology.

It is concluded that the AMP terminals and splices are environmentally qualified. Evidence of qualification is contained in the applicant's files.

Level Switch: Magnetrol, Model 3.5-751-IX-MPG, Plant ID No. 1E41*LS092A

These level switches are located in the reactor building and are used to transfer suction from the condensate tank to the suppression pool on high pool level.

The specified accident environmental parameters are: temperature 150°F, pressure 1 psig, humidity 100%, radiation 6.5×10^5 Rads TID, and operating time 12 hours.

Environmental testing of a similar level switch is recorded in Wyle Laboratories report No. 43235-1, Revision A. The maximum environmental parameters that the level switch was subjected to are: temperature 300°F, pressure atmospheric, humidity 100%, and radiation 4.4×10^4 Rads TID for the device and 3.3×10^0 Rads TID for the separate components in the device. The test duration was 160 hours. The test margins are considered adequate except for pressure which is considered insignificant. The qualified life is six years based on a "weak link" analysis.

It is concluded that this Magnetrol level switch is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Fan Motor: Westinghouse, Model No. 405TCZ, Plant ID No. 1T46*FN003B

This fan motor is located in the secondary reactor building and is used to power the reactor building standby ventilation exhaust fan.

The specified accident parameters are: temperature 150°F, pressure 0.9 psig, humidity 100%, radiation 1.8×10^3 Rads TID, and operating time 180 days.

Environmental testing for this type of unit was performed by the Buffalo Forge Company and documented in their qualification document No. D0-146, Rev. T (including Westinghouse report MM 9112). The maximum environmental parameters that the motor was subjected to are: temperature 227°F, pressure 3.3 psig, humidity 100%, radiation 2×10^0 Rads TID, test duration 30 days. The test margins are adequate except for operating time which was established by analysis. The motor was preaged for 1369 hours at 210°C. A qualified life of >40 years was calculated using the Arrhenius method. The applicant has requested a maintenance schedule and grease for the motor bearings and grease from Westinghouse.

It is concluded that the Westinghouse fan motor is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Hydrogen Analyzer Electronics and Indicator: Model No. 7045-N5-4702-0000, Plant ID No. 1T48*H2115BX (Part of Comsip Inc. Model K-IV Hydrogen Analyzer)

This equipment is located in the reactor building and is used to indicate the post-accident hydrogen concentration in the drywell.

This equipment is required for LOCA only; therefore, the only harsh environmental parameter is radiation of 2.47×10^5 Rads TID. The sample gas itself reaches a temperature of 340°F at 48 psig; however, it has cooled to <104°F before reaching the gas analyzer. Operating time is 180 days.

Environmental testing was performed on a prototype analyzer by Engineering Analysis and Test Company, Inc., and reported in Project 1035-1 Revision 1 report supplemented by Reliance Electric Co. report NUC-9. The

maximum environmental parameters that the prototype was subjected to are: temperature 150°, pressure 0, humidity 90%, radiation 1×10^6 Rads TID; the test duration was 100 days extended to 180 days by analysis. The test margins and analysis are adequate to envelop the accident environment. Although the sample pump in the prototype failed, the analyzer electronics and indicator performed satisfactorily.

It is concluded that the hydrogen analyzer electronics and indicator are environmentally qualified. Evidence of qualification is contained in the applicant's files.

Namco Limit Switch, Model EA-180-11302, S/N 138-90, Plant ID No. 1E11*PNS031C

This device is used to indicate the RHR pump suction valve position and is located in the reactor building secondary.

The specified accident environmental parameters are: temperature 178°F, pressure 1 psig, humidity 100%, radiation 5.75×10^6 Rads TID, operating time 180 days.

The test reports supporting environment qualification are: Qualification of Namco Controls Limit Switch Model EA-180, to IEEE Standards 344-1975, 323-1974, and 382-1972 Revision 1, September 5, 1978. Qualification of EA 180 Series Limit Switches for use in nuclear power plants, QRT 105 August 30, 1981, Rev. 3, and Wyle Laboratories assessment report No. 17464-6002 February 26, 1982.

The environments parameters this device was subjected to are: temperature 340°F, pressure 100 psig, humidity 100%, radiation 3.04×10^8 Rads TID, test duration 30 days. Thermal aging was performed at 248°F for 400 hrs. Using Arrhenius methodology and periodic maintenance and parts replacement, a qualified life of 40 years was developed. The test method was sequential testing and analysis.

It is concluded that the Namco limit switch, plant ID No. 1E11*PNS031C, is environmentally qualified. Evidence of qualification is maintained in the applicant's files.

Barksdale Pressure Switch, Model B1T, Plant ID No. 1E11*PS134A

This pressure switch is used in the RHR pump discharge and is located in the reactor building secondary.

The specified accident environmental parameters are: temperature 150°F, pressure 1 psig, humidity 100%, radiation 2×10^6 Rads TID, operating time 7 days.

Environmental testing of this component is recorded in the Barksdale Procedure 9993 and test report Number 3018A and EDS calculation Numbers 0630-001-013 and 0630-001-014. The maximum environmental parameters this component was subjected to are: temperature 212°F, pressure 0.25 psig, humidity 100%, radiation 3×10^6 Rads TID, test duration 6 hrs. The test margins are considered adequate. Extrapolation of the test data indicates

the device is expected to remain operational for the required time of 7 days and not fail in a manner detrimental to plant safety for 180 days. The qualification methods are separate test and analysis. All components are qualified for 40 years except the Neoprene face gasket, which limits the qualified life to 6 years; however, this data will be put into the plant Preventive Maintenance Program for parts replacement to ensure that this device is not used beyond its qualified life.

It is concluded that the Barksdale pressure switch, plant ID Number 1E11*PS134A, is environmentally qualified. Evidence of qualification is contained in the applicant's files.

Transformer: Magnetics Dry Type Single Phase, 480V/120-240V, Model No. L12514, Plant ID No. 1R35*T-82

This transformer supplies electrical power to several Class 1E loads, including gas analyzers and radiation monitoring panels, and is located in the secondary reactor building, Zone 21, at the 112-foot elevation.

The specified accident environmental parameter is radiation at 3.06×10^5 Rads TID.

While no testing of the transformer was performed, Wyle Laboratories report No. 17464-1302 approaches radiation qualification by material search and analysis. It is shown that the most susceptible materials will exhibit little or no degradation at 3.06×10^5 Rads TID with adequate margin.

The same report calculates a qualified life by material analysis using Arrhenius methodology, and concludes that, at loads less than 90% of rated load, a lifetime of greater than 40 years is shown. A load study is supplied showing loading at 33%.

It is concluded that the Magnetics transformer, model No. L12514, is environmentally qualified. Evidence of qualification is contained in the applicant's file.

Barton Pressure Switch, Model No. 288A, Plant ID No. 1E41PS023C

This pressure switch is used to trip the HPCI turbine on low steam pressure and is located in the secondary reactor building.

The specified accident parameters are: temperature 150°F, pressure 1 psig, humidity 100%, radiation 7×10^5 Rads TID (LOCA), 2.5×10^4 Rads TID (PBOC) and operating time 12 hrs.

Environmental testing was performed on identical models of this pressure switch. The file contains a hand copied portion of ITT Barton test report No. 9999.1217.2, Rev. 1, and complete report No. R3-288A-1. Also included are EDS calculations for operability time and qualified life.

The maximum environmental parameters that the tested pressure switches were subjected to are: temperature 212°F, pressure 7 inches water column,

relative humidity 100%, radiation 3×10^6 Rads TID and a test duration of 6 hours. Analysis provided extends operating time to 56 hours and aging calculations provided a qualified life of 40 years based on material evaluation and Arrhenius methodology.

Concerns developed during the previous audit have been corrected by:

1. Additional information presented in the file verifying energized switches during the steam test and calibration data taken immediately after the steam test.
2. Additional analysis justifying the separate testing employed.
3. Separation of the pressure switches into three groups, depending on location and function, with qualification being claimed for only one group. The other groups require further testing or analysis before qualification will be claimed by the applicant.

It is concluded that the documentation presented in the applicant's file is inadequate to establish qualification for two groups of switches. The Barton pressure switch, Model No. 288A, Plant ID No. 1E41PS023C is in one of these groups and is not qualified. This agrees with the applicant's conclusion.

It is also concluded that the applicant is correct in claiming environmental qualification for one group of switches.