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

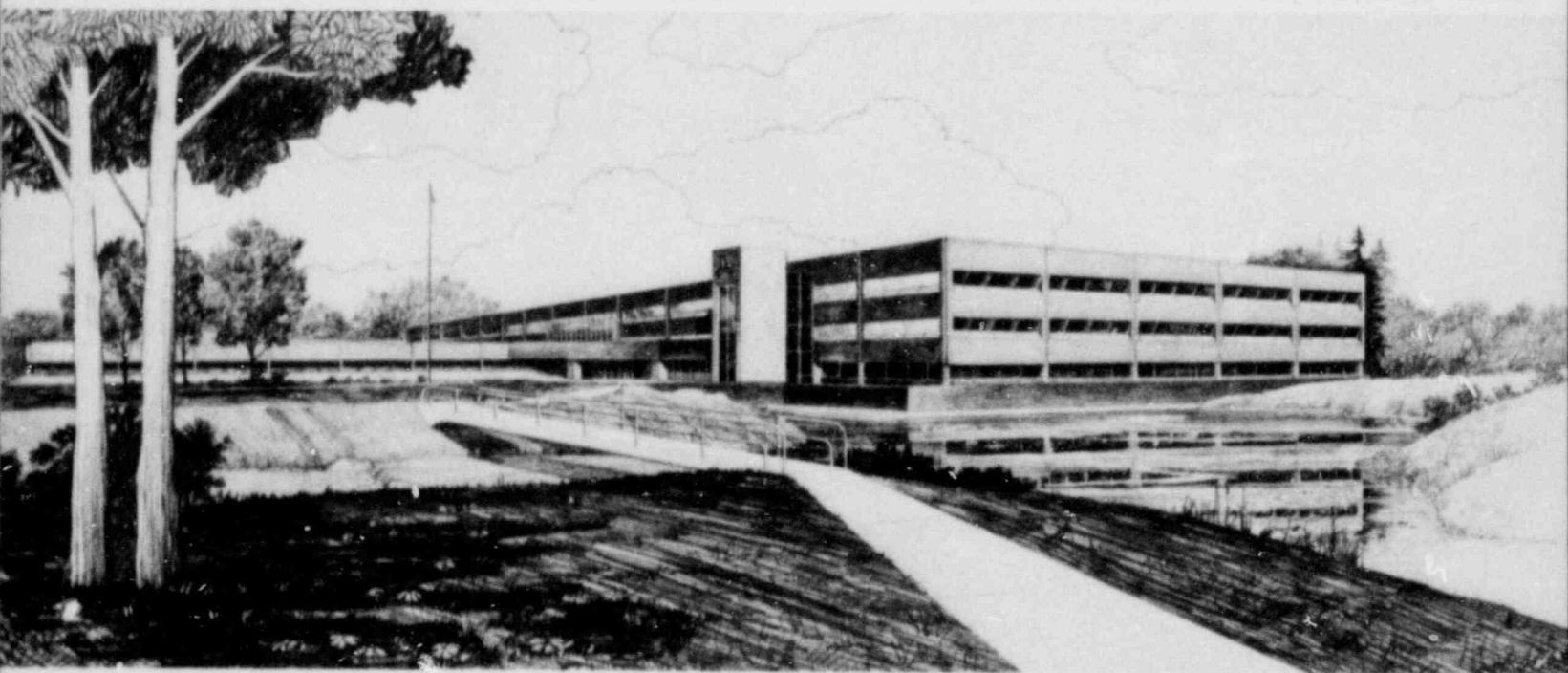
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E. R. Holloway
T. G. Humphrey



U.S. Department of Energy

Idaho Operations Office • Idaho National Engineering Laboratory



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Author(s):

E. R. Holloway
T. G. Humphrey

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Zoltan R. Rosztoczy, Division of Engineering, NRC

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EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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

Docket No. 50-416

E. R. Holloway
Thomas G. Humphrey

Reliability and Statistics Branch
Engineering Analysis Division
EG&G Idaho, Inc.

ABSTRACT

The Grand Gulf Nuclear Station, Unit 1 was audited to determine the environmental qualification of safety-related electrical equipment. Results of the audit are summarized in 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 GRAND GULF NUCLEAR STATION, UNIT 1

1.0 INTRODUCTION

On October 19-22, 1981 a team comprised of representatives of the Reliability and Statistics Branch of EG&G Idaho, Inc. and Nuclear Regulatory Commission Staff conducted an audit of the environmental qualification of safety-related electrical equipment at the Grand Gulf Nuclear Station Unit 1. The work effort consisted of: (1) a pre-audit review of the licensee's submittal, (2) an audit of the licensee's central files for selected equipment items, and (3) 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.

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. A more detailed justification for interim operation needs to be provided for some equipment items.
2. Electrical interfaces such as splices, terminal blocks, and terminal boxes were not included in the submittal. These items should be included and qualified.
3. Radiation doses for the drywell areas appeared to be low. These values should be justified.

3.0 CONCLUSIONS

As a result of the audit it was concluded that the Grand Gulf environmental qualification program was adequate and that the fourteen individual files reviewed were complete. The licensee agreed to respond to the remaining areas of concern.

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. Mississippi Power and Light Company, Grand Gulf Nuclear Station, Unit 1 Response to NUREG-0588.

APPENDIX A
QUALIFICATION STATUS OF EQUIPMENT ITEMS

APPENDIX A--QUALIFICATION STATUS OF INDIVIDUAL EQUIPMENT ITEMS (NON-NSSS)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
1. Transmitter	Rosemount	1153 DB	2	Qualified.
2. Transmitter	Rosemount	1153 DB4	10	Qualified.
		DB6	2	
		GB6	2	
3. Transmitter	Rosemount	1151 DP	40	No testing was done on the 1151 transmitter. 1151 was compared to 1152 but if 1151 cannot be qualified it will be replaced by 1153. 1152 was not shown to be qualified.
		1151 GP	4	
4. Transmitter	Rosemount	1153 GB9	1	Chemical content of spray. Are the sealing methods qualified for 27.3 yrs? What were the times and temp. used to calculate 27.3 yrs QL? No check sheet. Has testing been completed on solder?
5. Optical Isolater	Riley Co.	70-OC11	4	Qualified.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
6. H ₂ Analyzer	Comsip Delphi, Inc.	K-III	4	Bearing was replaced during LOCA test and not subjected to all 100 days + margin of DBA. Readings were inaccurate after thermal aging and irradiation test. What is the QL of this equip.--5 yrs or 10 yrs? and what aging environment was used? Does the 105 hrs bearing life allowance indicated by Comsip include lubrication irradiation damage?
7. CGC Heat Tracing	Thormon Mfg. Co.	EQ-2399-80		Incomplete.
8. Area Radiation Detectors	Cable: Boston Insulated Wire & Cable Detector: Victoreen	RG-59B/U Coax- ial 887-1	4	Even though pressure was uncontrolled during LOCA test what was the pressure? Were the sealed cable and junction box aged before LOCA. The detectors were not thermal aged and shown to be operational after aging.
9. Temp. Element	Thermoelectric	27620	56	What make are the (inorganic) terminal blocks not subject to aging? Has the o-ring been qualified to this DBA? No aging or testing, has been done on this equipment.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
10. Limit Switch	NAMCO	EA180	2	Humidity and spray was not present during test until 4 days after start of DBA. (Certificate of compliance not valid)
11. Solenoid Valves	ASCO	U1X8720A108V	6	Summary of results state a QL of 7.2 yrs and 4.0 yrs. Which is correct?
12. Solenoid Valves	Target Rock	76GG001	5	Qualified.
13. Electric Control Actuators	ITT General Cont	NH91A	2	Qualified.
14. 7.2 KV Switch-gear	GE	Power VAC VB-7.2-500	4	What is QL? What is OT?
15. Load Control Centers	Gould	V1D, K1600S K600S	8	No data supplied relative to aging or radiation. Vendor states equip. has demonstrated operability for 100 days by other parties. What other parties?
16. Motor Control Centers	Klockner-Moeller	Series 100/170 Type-NA	10	No data supplied relative to aging or radiation. What test numbers performed by vendor were performed to demonstrate operability for 100 days.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
17. DC Panels	RTE-Delta	Customer built	2	No data to support aging or radiation of the equip. as a whole. Radiation data for 100 days + margin after DBA has not been verified.
18. Hand Switch	Gould	SO#84-67274	6	What dose will hand switch M-009B be exposed to after shielding? What report # and analysis qualifies the terminal block? What report # and analysis qualifies the cable? What qualifies the selector switch and control wire for humidity?
19. DC Starter	Gould	84-63302 -63302B -63302C	9	Certificate of compliance cannot be used without test data. J15 relay has not been qualified for R. H. or aging.
20. Cable	Kerite	I/C 750MCM Triplex, 410 AWG	Various	Qualified.
21. 1KV pwr cable and 600 volt multi-conductor	Okonite	Various	Various	Pressure not enveloped at end of test. Temp. not enveloped at beginning of test. No margin claimed for OT. No aging data presented; submergence and spray not addressed.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
22. 600 Volt Multi-Conductor 600 Volt Power	Rockbestos	Firewall III	Various	Qualified.
23. Inst. and Computer Cable	S. Moore	Various	Various	Qualified.
24. Coaxial and tri-axial cable	Rockbestos	Various	Various	Qualified.
25. Coaxial and tri-axial cable	Raychem	STILAN	Various	No aging performed. Test did not envelope DBA for 100 days + margin.
26. Coaxial and tri-axial cable & speciality cable	Raychem	Flamtrol	Various	Qualified.
27. See #22				
28. Thermocouple Extension Wire	S. Moore	Various		Pressure not enveloped over whole DBA. Temp. not enveloped during, "shock treatment" dip. What aging was performed. No margin on 100 day OT.
29. Penetrations	GE Westinghouse	GE 15107 Canister type A,B,C		Temp. not enveloped for entire DBA. 100 day OT not met. No aging performed.
Terminal Block	KULKA	Various		No metallic boxes qualified for DBA.

APPENDIX A--NON-NSSS (continued)

Equipment Description	Manufacturer	Model No.	No. of Items	Environmental Qualification Status Information
30. Drywell seal condulet	Crouse-Hinds	EYS	2	No aging performed. Not tested for 100 days. No spray testing performed. Margin on temp. No testing for degradation of cables.
31. Motor short circuit protectors	Gould ITE	5600 MCC Cab MSCP Type: N,U,S,U,W,Y	8	No EQ test data. No aging.
32. Cable terminations	MMP, Raychem	Various		No test performed on one type of termination. Temp. not enveloped for Fig.-B22 No submergence testing. One type of Raychem has QL of 120 days. No margin on other types.
33. Terminal Block	GE Conax	EB-25, CR151B CR 2960SY139 3B thru 3D None.		No test report.
34. Drywell Purge Compressor motors	Turbonetics Reliance Motor	445 TS TEFC-XT	2	Qualified.
35. Cable Terminations	AMP Raychem	Various Various		No testing performed.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
36. Terminal Blocks & Seal Assembly	GE Conax	EB-25, CR151B CAT. # CR2960SY139 (3B thru 3D)		No testing performed.
37. Drywell Purge Compressor Motors	Turbonetics	Frame: 445 TS Enclosure: TE-FC-XT	2	Qualified.
38. Jockey Pump Motors	Westinghouse	Frame: 184T, SMP, 3500 RPM, TEFC	6	Operability not shown. A 201.8 day OT is indicated on Exhibit F but no analy- sis is given.
39. H ₂ Recombiners & Power Supply	Westinghouse	Model B	1	Pressure is not enveloped. Radiation is not enveloped for Beta. CS not suffi- cient. Since P, T, & H were not identified during test QT & M may be inade- quate. No aging performed on power supply. No radi- tion qualification on power supply (will shield).
40. DC Starters	Gould, Inc.	P21	1	Certificate of Compliance was used for qualification. Radiation and mechanical aging not verified. Extremes in voltage not applied. QT is only 107 hours.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
41. Limitorque Valve Actuator	Reliance	446014-JZ	169	Radiation and temperature not enveloped. Wiring and terminal blocks not qualified. A 16 day OT is indicated on Exhibit F. A QL of 209 days is indicated on Attach. 1.
42. Limitorque Valve	Reliance	601962-P	39	Submergence was not addressed except for an accidental submergence of the actuator. Spray was not adequately addressed for actuator and limit switches. Beta radiation was not enveloped. OT is only 30 days. Were extremes in voltage and freq. applied?
43. Limit Switch	NAMCO	EA740	10	Extremes in voltage and freq. not tested. Submergence not addressed. QL of only 47 days. OT of only 30 days. Pressure may not have been enveloped. Beta radiation not enveloped.
44. Solenoid	ASCO	HTX 8320A20V	61	No test report received for HTX solenoids.
45. Limit Switch	MICRO	LSQ-101	61	Review of test report not complete. No aging, no radiation testing performed.

APPENDIX A--NON-NSSS (continued)

	<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
	46. Terminal Block	Unknown	Unknown	61	No test report.
	47. Limitorque Valve Actuator	Reliance HK Porter	Model DC Motor Unknown	9	No test report.
	48. Limitorque Valve Actuator	Reliance	60196	24	Spray was not addressed. Beta radiation not enveloped. OT is only 30 days. Were extremes in voltage and Freq. applied? Will any of these valves be submerged?
13	49. Valve Position Switch	NAMCO	EA170	2	No test report. Equipment will be replaced.
	50. Bettis Air Actu- ator Solenoid Valve	ASCO	NP8321A6E NP831655 NP831654E	37	Radiation may not be enveloped. Valve not sub- jected to freq. extremes. DBA test was for only 30 days. Pressure not enveloped. Aging was not addressed.
	51. Fan Motor	Reliance	Various	18	Report # NUC 9 to be reviewed by GG which Joy says is applicable.
	52. Damper Motor Actuators	Raymond Control Systems	MAR 49-30-4	19	Qualified.
	53. Fan Motor	Reliance	34-26.5-1770	2	Report # NUC 9 to be reviewed by GG which Joy says is applicable.

APPENDIX A--NON-NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
54. SGTS Heater & Control	CVI	Unknown	2	No test report available.
55. SGTS Exhaust Fan	Westinghouse	25GT/20HP/460V Model TEFC	2	Voltage and freq. margins not addressed. OT margin not adequate, 105 vs 110. Attachment 1 states the manufacturer of the motor is CVI, which is correct?

APPENDIX A--QUALIFICATION STATUS OF INDIVIDUAL EQUIPMENT ITEMS (NSSS)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
1. Limit Switch	NAMCO	EA-740	2	Incomplete.
2. Main Steam SRV Actuator	Oijkers	O-108-562e	3	No qualified life specified. Pressure and Temp. did not envelope the DBA for 100 days; the valve is required to stay in designated position for 100 days after 2 days active service following DBA.
3. RHR Pump Motor	GE	5K6339XC186A	3	Pressure and temperature did not envelope the DBA and the test was ran for only 175 hours. No qualified life specified. Radiation not enveloped for 2 of the motors.
4. HPCS Motor Oper- ated Valves	Limitorque	SMB-00-15	1	Qualified life of only 564 days prior to DBA because of inadequate aging. Terminal strip inside operator cannot be identified for qualification.
5. HPCS Motor Oper- ated Valves	Limitorque	SB-3-100	1	No aging performed. No radiation testing. DBA does not envelope temperature and was for only 6 days instead of the required 100.

APPENDIX A--NSSS (continued)

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<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
6. HPCS Motor Oper- ated Valves	Limitorque	SMB-4-200	2	See # 4.
7. HPCS Motor Oper- ated Valves	Limitorque	SB-0-25 Check Moel on Equip. Eval. Worksheet	1	See # 4.
8. HPCS Motor Oper- ated Valves	Limitorque	SB-1-40	1	See # 4.
9. HPCS Motor Oper- ated Valves	Limitorque	SMB-4-150	1	See # 4.
10. Blower	Siemons	2CH6	2	Radiation not enveloped. No aging addressed. The claimed operating time has inadequate margin.
11. RCIC Turbine Electronics	Terry Corp.	GS-2N	1	Radiation not enveloped. No margin on temperature. No qualified life specified. No margin on operating time. Pressure not envel- oped at beginning of DBA.
12. LPCS Pump Motor	GE	5K6348XC94A	1	Qualified.
13. HPCS Pump motor	GE	5K6357XC17A	1	Qualified.
14. Leakage Control Heater	GE	47B518673	1	Qualified.

APPENDIX A--NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
15. Temperature Element	PYCO	N145C3224	38	Aging may not have been adequately addressed because of indeterminate aging test. Temperature and pressure were not enveloped during testing. Test was run for only 30 days instead of required 100 days. This test report was obtained from Carolina Power & Light Co. Two elements, E31-N017 and E31-N047 may not have been adequately addressed for flooding and spray.
16. Level Transmitter	Gould	PD3018 Series	3	Qualified.
17. Flow Meter	S&K	20-9651-8550	1	Radiation not enveloped. Operability only shown for 6 hours on similar device instead of required 100 days.
18. Flow Transmitter	S&K	91X-16	1	See # 17.
19. Pressure Trans- mitter	Rosemount	1152		Effect of spray and froth not tested. Test ran for only 42 hours. Pressure may not have been enveloped at the end of 42 hours.

APPENDIX A--NSSS (continued)

<u>Equipment Description</u>	<u>Manufacturer</u>	<u>Model No.</u>	<u>No. of Items</u>	<u>Environmental Qualification Status Information</u>
20. Sensor & Converter	GE	None	1	Lacks Radiation testing. Operability has not been addressed. No aging test performed. Test ran for only 30 hours. Temperature and pressure not enveloped.

APPENDIX B
SUMMARIES OF CENTRAL FILE REVIEWS

APPENDIX B
SUMMARIES OF CENTRAL FILE REVIEWS

Item: Samuel Moore & Co. Instrument and Computer Cable
Model: Dekorad
ID: QSR32T004H

The cable is located throughout the plant except in Room 1A105. The harsh environmental parameters specified are: Temperature, 330°F; Pressure, 30 psig; Humidity, 100%; Radiation 4.21×10^7 Rads gamma, 1.4×10^3 Rads neutron equivalent gamma, and 1.5×10^9 Beta; Spray 1 gpm/ft² for 12 days. The tested cable was exposed to: Temperature 340°; pressure, 103 psig; radiation 2×10^8 Rad, chemical spray .15 gpm/ft. No specific failure criteria were stated for the testing on the cable, the analysis given by G.G. was that the cable did not have a loss of function and it held the applied voltage with no insulation failure, also the applied test potentials were many times larger than what would be applied during operation. It is concluded that this cable meets the requirements of NUREG-0588.

Item: Rockbestos Multi-Conductor Control Cable
Model: Firewall III
ID: QSR35T007B

The cable is located throughout the plant except in room 1A105. The harsh environmental parameters specified are: Temperature 330°F; Pressure, 44.7 psig; Humidity, 100%; Radiation 4.21×10^7 Rad γ , 1.4×10^3 Rad neutron equivalent γ , 1.5×10^9 Rad β , Froth 18.8 lbm/ft² for 5 sec and 1 gpm/ft² spray for 12 days. The tested cable was exposed to; temperature, 346°F; pressure, 113 psig; radiation 2.2×10^8 Rad γ , RH, 100%. The cable in the plant is multiconductor but the tested cable was single conductor, also the test was ran for only 30 days instead of 100 days. The analysis given by GG for these items was adequate. It is concluded that the cable meets the requirements of NUREG-0588.

Item: Raychem, Speciality Cable; Coax. and Triax.
Model: Flamtrol
ID: QSRT001H

This cable is located throughout the plant except in room 1A105. The harsh environmental parameters specified are: Temperature, 330°F; Pressure, 44.7 psig; Humidity, 100%; and Radiation, 4.21×10^7 Rad. During testing the cable was exposed to the following environmental parameters; temperature, 357°F; pressure, >70 psig; radiation, 2×10^8 Rad. Relative humidity steam. The cable jacket shields the cable from Beta radiation. The GG submittal stated that the cable could be submerged for 100 days, but GG clarified this by stating that for any equipment that is required to operate after submergence, its cable is submerged for 10 sec or less, and any equipment that has cable submerged for >30 sec is not required to operate therefore the 14 day submergence of the tested cable is adequate. It is concluded that the cable meets the requirements of NUREG-0588.

Item: Raymond Control Systems Automatic Dumper Actuator
Model: MAR-49-30-4
ID: Q1T48F0018

The audited actuator is located in Room 1A527. The harsh environmental parameters specified are: Temperature, 80°F; Pressure, atmospheric; Radiation, 2.88×10^4 Rad; and Humidity, 50%. The tested actuator was exposed to; temperature 264°F for 57 days; pressure, 14.7 psig; radiation, 2.88×10^4 Rad; Humidity, 95%. There were some failures during the aging portion of the test. The lubricant was replaced by Exxon Beacon 325 hi temp grease and plastic cams were replaced by aluminum cams. The actuator has a maintenance schedule for replacement of parts. All age susceptible parts will be changed out at least every 20 yrs and more often on some parts. Using the Arrhenius method a QL of 23.6 years at 120°F was calculated for the actuator. It is concluded that the actuator meets the requirements of NUREG-0588.

Item: Electronic Signal Isolating Device
Model: 70-OC11
ID: 1H22-P502-1

The optical isolators are used to isolate class 1E circuits from non class 1E circuits. The harsh environmental parameters are specified as temperature (140°F max) and radiation (5.3×10^3 Rads TID). The specified operating time is 100 days. Review of the environmental qualification documentation indicated that a similar unit had been exposed to environmental conditions which exceeded those listed above by adequate margin. It is concluded that the optical isolators meet the requirements of NUREG-0588.

Item: MSIV LCS System Heaters
Model: 47B518673
ID: E32-B001

The MSIV LCS Heaters are located in the Auxiliary Building. They are required to operate for 100 days following a LOCA only. The heater does not function at any other time, normal or accident. The only harsh environmental parameter for the equipment location is radiation (2.11×10^6 Rads TID). The EQ documentation for this item shows that a similar unit was operationally tested for 124 days, however it was not exposed to radiation. The only radiation susceptible part of the heaters is the Raychem Stilan insulated wire. This type of wire has been qualified by Franklin Institute to 2.0×10^8 Rads TID. Therefore, it is concluded that the MSIV LCS heaters meet the requirements of NUREG-0588.

Item: LPCS and HPCS Motors
Model: 5K6348XC94A (LPCS), 5K6357XC17A (HPCS)
ID: E21-C001 (LPCS), E22-C001 (HPCS)

The LPCS and HPCS motors are located in the auxiliary building at an elevation of 109'. The motors must be able to withstand and operate during exposure to the harsh environment created by a high energy line break and the environment occurring for 100 days following the accident. The harsh

environmental parameters specified are: temperature (150°F), Humidity (90%), and Radiation (2.29×10^6 Rads TID). Operability time is 100 days.

The EQ documentation for these items indicated that a similar motor was exposed to environmental conditions which exceeded those listed above by adequate margin. Documentation showing similarity of the installed motors to the test motor was adequate. The 100 day operating time was established by test and analysis, (216 hours @ 383°F which is equivalent to 3000 hours @ 311° [winding temperatures]). It is concluded that these pumps meet the requirements of NUREG-0588.

Item: Kerite 9.0 kV Power Cable
Model: I/C, 750 MCM and Triplex, 4/0 AWG
ID: QSR21T000C

This cable is used outside containment throughout the plant to transmit power to safety related pumps. The harsh environmental parameters specified are: Temperature (340°F), Pressure (101 psig max.), Humidity (100%), and Radiation 4.21×10^7 Rad TID. The required operating time is 100 days.

The review of the EQ documentation for this cable indicated that samples of the cable were subjected to harsh environmental conditions which exceeded those listed above by adequate margin. The cables were tested for 100 days only without the 10% operating time margin. This is not considered significant, however, because the cables were pre-aged before LOCA testing. It is concluded that the cable meets the requirements of NUREG-0588.

Item: ITT Electric Control Actuator
Model: NH91A
ID: IT48-PD2-F500B

The Electric Control Actuator is used to control the HVAC dampers in the Standby Gas Treatment System. The actuator is located in an environment, where radiation (5.7×10^5 Rads TID) is the only harsh parameter.

Review of the EQ documentation indicated that a similar unit had been exposed to a TID of 3.96×10^7 Rads and a failure occurred due to outgassing of the oil in the unit. The failure, however, occurred at a radiation value which exceeded the specified value, listed above, by adequate margin. Two other test failures related to relief valves were adequately addressed in the documentation. It is concluded that the actuator meets the requirements of NUREG-0588.

Item: Level Transmitter
Model: Gould Inc. PD3018 series
ID: E22-N055

This device is located in the auxiliary bldg. and is used to sense suppression-pool water level. A high suppression-pool level trip automatically transfers the HPCS system suction source from the condensate storage tank to the suppression pool. the transmitter is located in an

environment where radiation (3.7×10^5 TID) is the only harsh parameter. The required operating time is 100 days.

Review of the qualification documentation indicated that a similar unit had been exposed to 2.0×10^7 Rads TID and then functionally tested satisfactorily. It is concluded that this transmitter meets the requirements of NUREG-0588.