Omaha Public Power District
1623 Harney Omaha, Nebraska 68102
402/536-4000

May 31, 1984
LIC-84-121

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Denton:

Environmental Qualification of
Safety-Related Electrical Equipment

On January 17, 1983, the Omaha Public Power District received the Safety Evaluation Report (SER) regarding the environmental qualification of safety-related electrical equipment at the Fort Calhoun Station Unit No. 1 (letter from R. A. Clark to W. C. Jones dated January 11, 1983). This SER contained a Technical Evaluation Report (TER) written by Franklin Research Center, while under contract with the Nuclear Regulatory Commission. This TER noted a number of deficiencies for safety-related electrical equipment. On March 23, 1984, a meeting was held with your staff to discuss the proposed resolutions to TER-identified deficiencies. These proposed resolutions, as discussed, are provided in Attachments 1 and 2 to this letter. Discussions were also held at the March 23, 1984 meeting regarding the District's general methodology for compliance with 10CFR50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants". The purpose of this letter is to provide documentation of the discussions held during the March 23, 1984 meeting.

Attachment 7 contains the Justifications for Continued Operation (JCO's) currently being relied on by the District. These JCO's were most recently submitted to the Commission in a letter dated April 3, 1984 (Jones to Denton, LIC-84-093) which requested an extension to September 30, 1984 to complete specific equipment qualification items.

The District has included, in Attachment 3, a discussion of the methodology used for compliance with 10CFR50.49(b)(1), (b)(2), and (b)(3). A list of safety-related electrical equipment, as defined in 10CFR50.49(b)(1), was generated. This equipment is that which is required to remain functional during or following a design

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basis loss of coolant accident (LOCA) or a high energy line break (HELB) accident. The LOCA/HELB accidents are the only design basis accidents which result in significantly adverse environments to electrical equipment required for safe shutdown or accident mitigation. The list was based on reviews of the Final Safety Analysis Report (FSAR), Technical Specifications, Emergency Operating Procedures, Piping and Instrumentation Diagrams (P&ID's), and electrical distribution diagrams. The District conducted a review of electrical equipment to determine the equipment falling within the scope of 10CFR50.49(b)(2). The results and methodology for this review are as described in Attachment 3, Section IV. Equipment within the scope of 10CFR50.49(b)(3) will be handled on the schedule negotiated for Regulatory Guide 1.97 equipment. Further information on this can also be found in Attachment 3, Section V. The District believes that the post-accident environment assumed for the purpose of the equipment qualification program envelopes the worst case conditions and those environmental profiles and assumptions have been approved by the Commission.

It is the District's belief that the environmental qualification documentation currently maintained by the District adequately demonstrates compliance with 10CFR50.49. This documentation is on file and available for Commission audit. The District also believes that continued operation without risk to the health and safety of the public is justified based upon the District's current level of compliance and supplemented by the JCO's provided with the District's April 3, 1984 extension request discussed above.

The District committed in a letter dated September 9, 1982 to provide various test reports and SCEW sheets to the Franklin Research Center (FRC). Because these test reports were received by the District after the FRC completed their reviews, they will not be submitted to the FRC. In a letter dated May 20, 1983, the District revised that commitment to submit the reports and SCEW sheets to the Commission. Based on a recent telephone conversation with Mr. Paul Shemanski of the EQB, it was determined that submittal of these reports and SCEW sheets will not be necessary. The test reports are available in the District's central file and the SCEW sheets can be found in the District's Electrical Equipment Qualification Manual.

As discussed at the March 23, 1984 meeting, it is requested that a final SER be issued to indicate that the District's electrical equipment qualification program meets the requirements of 10CFR 50.49 and the deficiencies noted in the January 11, 1983 draft SER are considered resolved.

Sincerely,

W. C. Jones
Division Manager
Production Operations

WCJ/DJM:jmm

Attachments

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036

Mr. E. G. Tourigny, Project Manager
Mr. L. A. Yandell, Senior Resident Inspector

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Introduction

The discussion provided represents the item by item discussion and resolution of the March 23, 1984, meeting to discuss the Franklin Research TER. The item by item resolution presented at that meeting has been modified and notes added to define qualification based on the meeting.

The District's methodology and efforts are described in the section entitled "Compliance with 10CFR50.49 (b)(1), (b)(2), (b)(3)."

Enclosure 9 and Wyle Report #26333-26 (Attachments 5 & 6) are supplied to document qualification of the containment vent fan splices.

Several items not directly addressed at the TER meeting are discussed in the "Notes" section. These include submergence of NAMCO limit switches, HCV-348 operating time, and a discussion of Limitorque lubrication.

Since the TER meeting, the splices on the containment electrical penetrations for equipment required to operate during a LOCA or MSLB, installed during plant construction, (as discussed in the Attachment 7 JCO) have been replaced with qualified splices. During the testing, the outer jacket became brittle and cracked after 40 years equivalent aging.

ATTACHMENT 1

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
1	6-61	Foxboro Flow transmitter Model NE13DH in Containment for HPSI Loops 1A, 1B, 2A, 2B.	II.a.	a. Radiation b. T/P Exposure Duration c. Qualified Life d. Submergence	Upgraded to NE-10 Series transmitter. Moved above flood level.	See Note 1.
2	6-109 6-113 6-116	Foxboro Pressure transmitter Models NE11GM, and NE13GM in Containment for Pressurizer Pressure & Steam Generator Pressure.	II.a.	a. T/P Exposure Duration b. Qualified Life	Upgraded to NE-10 Series transmitters.	See Note 1.
3	6-123	Foxboro Level transmitter Model NE13DH in containment for Steam Generator Level indication.	II.a.	a. Similarity b. Qualified Life	Upgraded to NE-10 Series transmitter.	See Note 1.
4	6-1A	Foxboro Level transmitter NE11GM in Containment for Pressurizer Level.	II.a.	a. P-T Exposure Duration b. Similarity c. Qualifed Life	Upgraded to NE-10 Series transmitter.	See Note 1.
5	5-10	Barksdale Pressure Switch 15055 in Containment.	I.b.	a. Radiation b. Temperature c. Pressure d. Qual. Method e. Relocation/Replacement-Adequate Schedule Not Provided	Barksdale has been replaced with an ASCO Pressure Switch to resolve items a-e.	Switch is qualified. Test Report must be incorporated into files.
6	6-26 6-27 6-28	Alison Control Temp. detectors (TE866,867) for monitoring of charcoal filters in containment.	I.b.	a. Documentation	Analysis indicated that these temperature detectors are not required for post-accident operation. Therefore, these items are now considered outside of the scope of 10 CFR 50.49.	No further action required. SCEW sheet to be removed.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
7	6-1C 6-4E 6-4G 6-18B 6-18D 6-35B 6-35E 6-36B 6-77D 6-77F 6-79A 6-98B 6-115B 6-125B 6-125C 6-129	Namco Limit Switch EA-180-11302 in containment for TCV-202, HCV-241, HCV-238, HCV-239, HCV-240, HCV-425A, HCV-425C, HCV-438A, HCV-438C, HCV-467A, HCV-467C, PCV-742E, PCV-742G, HCV-746A, HCV-864, HCV-865, HCV-2916, HCV-2936, HCV-2956, HCV-2976, PCV-2909, PCV-2929, PCV-2949, PCV-2969, HCV-881, HCV-882, HCV-883A, HCV-884A, HCV-2603B, HCV-2604B, HCV-2504A, HCV-2506A, HCV-2507, HCV-1387A, HCV-1388A, HCV-1107A, HCV-1108A, HCV-545	I.a.	None	None Required Submergence deficiency resolved. See Note 2.	All switches are qualified. See Note 3.
*Special Note	6-78D*	ASCO Model X206-381-6RF electric solenoid valves on: HCV-883C, HCV-883D, HCV-883E, HCV-883F, HCV-883G, HCV-883H, HCV-820C, HCV-820D, HCV-820E, HCV-820F, HCV-820G, HCV-820H			*Franklin Research Center reviewed these items as a part of the Item #7 NAMCO limit switches. These ASCO units do not have limit switches.	These solenoid valves are qualified. See #107.
8	6-3 6-11A 6-77B 6-91 6-125 6-127	Fisher 304 Limit Switches in Room 13 providing position indication on HCV-204, HCV-206, HCV-467B, HCV-467D, HCV-438B, HCV-438D, HCV-349, HCV-350, FCV-326, HCV-341, HCV-1387B, HCV-1388B HCV-500A, HCV-500B, HCV-506A, HCV-506B, HCV-508A, HCV-508B, HCV-509A, HCV-509B	II.a.	a. Radiation b. Preventive Maintenance c. Documentation	Radiation testing and aging analysis complete.	These switches are qualified. See Note 4.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
9	6-106 6-8	Fisher 304 Limit Switches in Room 21 providing position indication on: HCV-2808C, HCV-2808D, HCV-2810C, HCV-2810D, HCV-2812C, HCV-2812D, HCV-2813C, HCV-2813D, HCV-2808A, HCV-2808B, HCV-2810A, HCV-2810B, HCV-2812A, HCV-2812B, HCV-2813A, HCV-2813B	II.a.	a. Radiation b. Qualification Documentation	Radiation testing and aging analysis complete a and b.	These switches are qualified. See Note 4.
10	6-104	Fisher 304 Limit Switches in Room 22 providing position indication on: HCV-2809C, HCV-2809D, HCV-2811C, HCV-2811D, HCV-2814C, HCV-2814D, HCV-2815C, HCV-2815D	II.a.	a. Radiation b. Qualification Documentation	See Resolution of Item #9 above.	These switches are qualified. See Note 4.
11	6-14 6-98 6-42 6-31	Fisher 304 Limit Switches located in Room 59, providing position indication for HCV-425B, HCV-425D, HCV-2603A, HCV-2604A, HCV-344, HCV-345, HCV-742A, HCV-742B, HCV-742C, HCV-742D.	II.a.	a. Radiation b. Qualification Documentation	See Resolution of Item #9 above.	These switches are qualified. See Note 4.
12	6-23	Fisher 304 Limit Switch in Room 60 providing position indication for Containment HVAC on: PCV-742F, PCV-742H, HCV-746B.	II.a.	a. Radiation b. Qualification Documentation	See Resolution of Item #9 above.	These switches are qualified. See Note 4.
13	6-18 6-45 6-81 6-100	Fisher 304 Limit Switches in Room 69 providing position indication for: HCV-400C, HCV-401C, HCV-402C, HCV-403C, HCV-1559A, HCV-1559A, HCV-1560A, HCV-1500B, PCV-1849, HCV-1749.	II.a.	a. Radiation b. Qualification Documentation	See Resolution of Item #9 above.	These limit switches are qualified. See Note 4.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
14	6-5 6-95 6-102	NAMCO EA-180 limit switches in Room 81 providing position indication on HCV-2898A, HCV-2898C, HCV2898B, HCV-2898D, HCV-2899A, HCV-2899B, HCV-2899C, HCV-2899D, MS-291, MS-292	II.a.	a. Steam Exposure b. Qualification Documentation	Fisher 304 limit were replaced with fully qualified NAMCO EA-180 switches to resolve a, b.	Equipment has been installed; documenttion is in file. These switches are qualified. See Note 3.
15	6-17 6-108	NAMCO Model EA-180 limit switches in Room 69 providing position indication on HCV-400A, HCV-400B, HCV-400D, HCV-401A, HCV-401B, HCV-401D, HCV-402A, HCV-402B, HCV-402D, HCV-403A, HCV-403B, HCV-403D, HCV-400E, HCV-400F, HCV-401E, HCV-401F, HCV-402E, HCV-402F, HCV-403E, HCV-403F.	I.a.	None	None Required.	Qualified. See Note 3.
16	6-67	NAMCO Model EA-180 limit switches in Room 21 providing position indication for LCV-383-1 and LCV-383-2.	I.a.	None	None Required.	Qualified. See Note 3.
17	6-74	NAMCO Model EA-180 limit switches in Room 21 providing position indication for HCV-2917 and HCV-2927.	I.a.	None	None Required.	Qualified. See Note 3.
18	6-72	NAMCO Model EA-180 limit switches in Room 21 providing position indication for HCV-2907 and HCV-2908.	I.a.	None	None Required.	Qualified. See Note 3.
19	6-77	NAMCO Model EA-180 limit switches in Room 13 providing position indication for HCV-306 and HCV-307.	I.a.	None	None Required.	Qualified. See Note 3.
20	6-65	NAMCO Model D2400X limit switches in Room 21 providing position indication for HCV-304 and HCV-305.	II.a.	a. Radiation b. Qualification Documentation	NAMCO Model D2400X replaced with fully qualified NAMCO EA-180's to resolve a, b.	Equipment has been installed; documentation is on file; these switches are qualified. See Note 3.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
21	6-115	NAMCO Model EA-180 limit switches in Room 60 providing position indication for HCV-2504B, HCV-2506B, and HCV-2507B.	I.a.	None	None Required.	Qualified. See Note 3.
22	6-29	NAMCO Model EA-180 limit switches in containment providing position indication for PCV-742A and PCV-742C.	I.a.	None	None Required.	Qualified. See Note 3.
23	6-34	NAMCO Model EA-180 limit switches in containment providing position indication for HCV-724A, HCV-724B, HCV-725A, and HCV-725B.	I.a.	None	None Required	Qualified. See Note 3.
24	6-33	NAMCO Model EA-180 limit switches in Room 69 providing position for PCV-742B and PCV-742D.	I.a.	None	None Required.	Qualified. See Note 3.
25	6-69 6-87	NAMCO Model EA-180 limit switch in Room 21 providing position indication for HCV-2947, HCV-2948, HCV-2918, and HCV-2928.	I.a.	None	None Required.	Qualified. See Note 3.
26	6-38 6-40 6-89	NAMCO Model EA-180 limit switches in Room 22 providing position indication for HCV-2937, HCV-2938, HCV-2957, HCV-2958, HCV-2967, HCV-2968, HCV-2977 and HCV-2978.	I.a.	None	None Required.	Qualified. See Note 3.
27	6-79A	NAMCO Model EA-180 limit switches in containment providing position indication for HCV-883A and HCV-884A.	I.a.	None	None Required.	Qualified. See Note 3.

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
28	6-118	Limitorque SMB 4T motor operated valve, limit and torque switches in Room 81 on HCV-1385 and HCV-1386.	II.a.	a. Aging b. Preventive Maintenance c. Similarity d. Qualified Life	Items a, b and d to be resolved by incorporation into Qualified Life Program. Similarity (c) was established and documentation is on file. Inspection was made this outage. Completed in early May, 1984.	- Motor brakes were replaced during 1984 outage. Items are qualified. See Note 7.
29	6-117	Limitorque Model SMB-00 motor operated valve, limit and torque switch in Room 81 on HCV-1384.	II.a.	a. Aging b. Qualified Life c. Similarity	Items a and b have been resolved by incorporation into the Qualified Life Program. Similarity (c) was established and documentation is on file.	See Note 6.
30	6-78	Valcor Solenoid Valves in Room 59 for HCV-820A, HCV-821A, HCV-883B, HCV-884B.	I.a.	None	None Required.	Qualified.
31	6-96A	Limitorque Model SMB-00 Motorized Valve in Room 81 Actuators on HCV-1041C and HCV-1042C.	II.a.	a. Aging b. Qualified Life c. Similarity	See resolution to Item #29.	These items are qualified. See Note 6.
32	6-75	Limitorque Model SMB-000 Valve Actuator and limit switch in Room 13 for HCV-308.	II.a.	a. Similarity b. Documentation c. Aging d. Qualified Life	Similarity was established and documentation is on file to resolve a, b. Items c & d have been resolved by incorporation into the Qualified Life Program.	These items are qualified. See Note 6.
33	6-92	Limitorque Model SMB-2 Valve Actuator and limit switch in Room 13 for HCV-347.	II.a.	a. Similarity b. Documentation c. Aging d. Qualified Life	See Item #32.	These items are qualified. See Note 6.
34	6-63	Limitorque Model SMB-0 motor operated valve and limit switches in containment for HCV-383-3, HCV-383-4.	II.a.	a. Similarity b. Qualified Life c. Aging	See Item #29.	These items are qualified. See Note 6.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
35	6-62A	Limitorque Model SMB-0 Valve Actuators and limit switches in containment for HCV-311, HCV-312, HCV-314, HCV-315, HCV-317, HCV-318, HCV-320 and HCV-321.	II.c.	a. Aging b. Qualified Life c. Similarity	See Item #29.	These items are qualified. See Note 5.
36	6-62	Limitorque Model SMB-00 Valve Actuators and limit switches in containment for HCV-2914, HCV-2934, HCV-2954, HCV-2974.	II.b.	a. Aging b. Qualified Life c. Similarity	See Item #29.	These items are qualified. See Note 5.
37	6-84	Limitorque Model SMB-0 Valve Actuators in containment for HCV-327, HCV-329, HCV-331, HCV-333.	II.a	a. Aging b. Qualified Life c. Similarity	See Item #29.	These items are qualified. See Note 5.
38	6-113a	Limitorque Model SMB-00 motor operated valve and limit switches in containment for HCV-150, HCV-151.	II.a.	a. Aging b. Qualified Life c. Similarity See FRC TER 38, page 4b.	Items to be part of QLP and remain in EEQ Program.	No further action to be taken. See Note 8.
39	6-85	Limitorque Model SMB-3 motor operated valve and limit switch in containment for HCV-348.	II.a.	a. Aging b. Qualified Life c. Similarity	See Item #29.	These items are qualified. See Note 5.
40	6-4	Limitorque SMB-00 motor operated valve and limit switches in Room 7 for LCV-218-3.	II.a.	a. Aging b. Similarity c. Qualified Life	Deleted from the scope of 10CFR50.49	Failure effects analysis complete.
41	6-83	GE Electric Motor in Room 21 & 22 for LPSI pumps SI-1A, SI-1B.	II.a.	a. Aging Degradation b. Aging Simulation c. Qualified Life d. Radiation	Aging and radiation test reports reviewed to resolve a, b, c and d. Required splices will be analyzed or replaced during 1984 outage. Lubrication included.	Items are qualified.
42	6-60	GE Electric Motor for HPSI Pumps SI-2A, SI-2B and SI-2C.	II.a.	a. Aging Degradation b. Aging Simulation c. Qualified Life d. Radiation	See Item #41.	See Item #41.

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
43	6-36	GE Electric Motor for Containment Spray Pumps SI-3A, SI-3B and SI-3C.	II.a.	a. Aging Degradation b. Aging Simulation c. Qualified Life d. Radiation	See item #41.	See Item #41.
44	6-24	Reliance Motor for Joy Vane Axial Fans VA-3A and VA-3B in containment.	II.b.	a. Aging Degradation b. Similarity c. Qualified Life d. Pressure-Temperature Duration e. Pressure-Temperature Profile f. Spray g. Radiation	Aging analysis performed to resolve (a). Similarity deficiency (b) resolved by fact that tested fan is one of four installed. Incorporation into Qualified Life Program resolves c. Verification performed to resolve d, e. Items f & g resolved by analysis.	Qualified.
45	6-25	Reliance Motor for Joy Vane Axial Fan for VA-7C and VA-7D in containment.	II.a.	a. Aging b. Similarity c. Qualified Life d. Pressure-Temperature Duration e. Pressure-Temperature Profile f. Spray g. Radiation	See Item #44.	See Item #44
46	6-21	Trane motor for Control Room air conditioning units VA-46A and VA-46B	III.a. Exempt	None	None Required.	Exempt from qualification. SCEW Sheet to be removed.
47	6-22	ILG Industries Fan Motor VA-63 for Control Room Ventilation.	III.a.	None	None Required.	Exempt from qualifications. SCEW Sheet to be removed.
48	6-15	Allis Chalmers Motor for component cooling water pumps AC-3A, AC-3B and AC-3C.	II.a.	a. Documentation	Documentation based on radiation and aging analysis has been added to the file to resolve a.	Qualified.
49	6-115A	ASCO Solenoid in containment for remote operation of HCV-2504A, HCV-2506A, HCV-2507A.	I.a.	None	None required.	Qualified.
50	6-96	ASCO Solenoid in Room 81 for HCV-1041A.	II.c.	a. Qualified Life	Deficiency (a) has been resolved. Qualified life established, required maintenance included in Qualified Life Program.	Qualified.

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
51	6-96	ASCO Solenoid in Room 81 for HCV-1042A.	II.c.	a. Qualified Life	See Item #50.	Item is qualified.
52	6-29A	ASCO Solenoid in containment for remote operation of PCV-742A and PCV-742C.	I.a.	None	None Required.	Items are qualified.
53	6-78A	ASCO Solenoid for remote operation of HCV-883A and HCV-884A.	II.a.	Similarity	Same as #81	Same as #81.
54	6-78	Valcor solenoid in Room 59 for HCV-883B & HCV-884B.	II.c.	a. Qualified Life	Valcor solenoids incorporated into the Qualified Life Program.	Item is qualified.
55	6-120	ASCO Solenoid in Room 81 for HCV-1107B and HCV-1108B.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
56	6-90	ASCO Solenoid in Room 13 for FCV-326 and HCV-341.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
57	6-97	ASCO Solenoids in Room 59 for HCV-2603A and 2604A.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
58	6-80 6-99 6-107	ASCO Solenoids in Room 69 for PCV-1849, HCV-1749, HCV-400E, HCV-400F, HCV-401E, HCV-401F, HCV-402E, HCV-402F, HCV-403E, HCV-403F.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
59	6-119	ASCO Solenoids in Room 81 for HCV-1107B and HCV-1108B.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
60	6-18 6-18A, 6-18C, 6-35A, 6-35D 6-77C, 6-77E, 6-98A, 6-125A	ASCO Solenoids in containment for: TCV-202, HCV-241, HCV-425A, HCV-425C, HCV-467A, HCV-467C, HCV-746A, HCV-2956, HCV-2976, HCV-2916, HCV-2936, HCV-2603B, HCV-2604B, HCV-1387A, HCV-1388A, PCV-742E, PCV-742G, PCV-2909, PCV-2929, PCV-2949, PCV-2969	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
61	6-4D 6-4F	ASCO Solenoids in containment for HCV-238, HCV-239, HCV-240.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualifed Life Program.	Items are qualified.
62	6-128	ASCO Solenoid in containment for HCV-545.	III.a. Exempt	None	TER references #49. Items are qualified, not exempt.	Items are qualified, and included in EEQ program.
63	6-77A	ASCO Solenoids in Room 13 for HCV-349, HCV-350	II.a.	a. Documentation	Replaced by qualified ASCO solenoids to resolve a.	Items are qualified.
64	6-105	ASCO Solenoids in Room 21 for HCV-2808C, HCV-2808D, HCV-2810C, HCV-2810D, HCV-2812C, HCV-2812D, HCV-2813C, HCV-2813D.	III.a.	None	Qualified ACSO. Item should be included in EEQ Program.	Items are qualified.
65	6-103 6-7	ASCO Solenoids in Room 21 for HCV-2808A, HCV-2808B, HCV-2810A, HCV-2810B, HCV-2812A, HCV-2812B, HCV-2813A, HCV-2813B, HCV-2809A, HCV-2809B, HCV-2811A, HCV-2811B, HCV-2814A, HCV-2814B, HCV-2815A, HCV-2815B.	III.a.	None	Qualified ASCO. Items should be included in EEQ Program.	Items are qualified.
66	6-35	ASCO Solenoid in Room 60 for PCV-742F, PCV-742H, HCV-746B.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
67	6-101 6-6	ASCO Solenoids in Room 81 for HCV-2898C, HCV-2898D, HCV-2899C, HCV-2899D, HCV-2898A, HCV-2898B, HCV-2899A, HCV-2899B.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	Items are qualified.
68	6-76 6-2 6-11	ASCO Solenoids in Room 13 for HCV-306, HCV-302, HCV-204, HCV-206, HCV-467B, HCV-467D, HCV-438B, HCV-438D.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	These items are qualified.
69	6-66 6-126	ASCO Solenoids in Room 21 for LCV-383-1, LCV-383-2, HCV-304, HCV-305.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	These items are qualified.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
70	6-41 6-30 6-13	ASCO Solenoids in Room 59 for HCV-344, HCV-345, A/HCV-742, C/HCV-742, B/HCV-742, D/HCV-742, HCV-425B, HCV-425D.	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	These items are qualified.
71	6-16 6-44	ASCO Solenoid in Room 69 for HCV-1559A, HCV-1559B, HCV-1560A, HCV-1560B, HCV-400A, HCV-400B, HCV-400C, HCV-400D, HCV-401A, HCV-401B, HCV-401C, HCV-401D, HCV-402A, HCV-402B, HCV-402C, HCV-402D, HCV-403A, HCV-403B, HCV-403C, HCV-403D	II.c.	a. Qualified Life	Resolved (a) by incorporation into Qualified Life Program.	These items are qualified.
72	6-86 6-37 6-73	ASCO Solenoids in Room 21 for HCV-2917, HCV-2927, HCV- 2947, HCV-2948, HCV-2957, HCV-2958	I.b.	a. Documentation	Replaced with fully qualified ASCO NP-1 solenoid to resolve a.	Incorporated into EEQ Program. Items are qualified.
73	6-88 6-70 6-39 6-88A	ASCO Solenoids in Room 22 for HCV-2907, HCV-2937, HCV-2967, HCV-2968, HCV-2977, HCV-2978, HCV-2938.	I.b.	a. Documentation	Replaced with fully qualified solenoids to resolve a.	These items are qualified. HCV-2937 incorporated into EEQ Program.
74	6-32	ASCO Solenoids in Room 69 for PCV-742B, PCV-742D.	II.c.	a. Qualified Life	Incorporated into Qualified Life Program to resolve a. (See Note 1).	These items are qualified.
75	6-68	ASCO Solenoid in Room 21 for HCV-2918, HCV-2928	I.b.	a. Documentation	To be replaced with fully qualified solenoids to resolve a.	To be incorporated into EEQ Program.
76	6-71	ASCO Solenoid in Room 22 for HCV-2908	I.b.	a. Documentation	To be replaced with fully qualified solenoids to resolve a.	To be incorporated into EEQ Program.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
77	6-126 6-124	ASCO Solenoids in Room 13 for HCV-1387B, HCV-1388B, HCV-500A, HCV-500B, HCV-506A, HCV-506B, HCV-507A, HCV-507B, HCV-508A, HCV-508B, HCV-509A, HCV-509B.	II.c.	a. Qualified Life	Incorporated into Qualified Life Program to resolve a.	Items are qualified.
78	6-114	ASCO Solenoid in Room 60 for HCV-2504B, HCV-2506B, HCV-2507B.	II.c.	a. Qualified Life	Incorporated into Qualified Life Program to resolve a.	Items are qualified.
79	6-34a	ASCO Solenoids in containment for HCV-724A, HCV-724B, HCV-725A, HCV-725B.	I.a.	None	None Required. Incorporated into Qualified Life Program.	Items are qualified.
80	6-94	ASCO Solenoids in Room 81 for MS-291, MS-292.	II.c.	a. Qualified Life	Item (a) resolved by implementation into Qualified Life Program.	Items are qualified.
81	6-19 6-36A 6-79B 6-125D 6-78A	Valcor Solenoid Valve for HCV-438A, HCV-438C, HCV-864, HCV-865, HCV-881, HCV-882, HCV-1107A, HCV-1106A, HCV-883A, HCV-884A.	I.b.	a. Documentation	Replaced with fully qualified ASCO Model NP-1 Solenoids.	Items are qualified.
82	6-113b	Target Rock Model 80B-001-7 solenoids on HCV-176, HCV-177, HCV-178, HCV-179, HCV-180, HCV-181.	II.a.	Similarity	District has documentation from Target Rock to establish similarity between test specimens & those installed.	These items are qualified.
83	6-20	Johnson Controls I&C Panels AI-106A and AI-106B.	III.a.	None	None Required.	Exempt from Qualification SCEW Sheet to be removed.
84	6-91A	Fisher Controls E/P Transducer for FCV-326, HCV-341.	IV	Documentation not made available.	Letter - Jones to Clark 5/11/83. Aging established using DOR Guidelines. Replacement-in-kind 10 year intervals.	Qualification documentation is on file - items are qualified.
85	6-55	Cerro Wire & Cable Co. W-57 and W-59 cable.	II.a.	a. Aging b. Qualified Life c. Radiation d. Similarity	Being tested to resolve a. b, d. Additional data has been obtained to resolve c.	Being tested. See Note 9.
86	6-58B	W-11 Cerro Power Cable Located in Room 69.	II.c.	a. Aging b. Qualified Life	Being tested to resolve a, b.	See Note 9.

ITEM-BY-ITEM RESOLUTION

FRC #	EQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
87	6-58A	W-10 Cerro Cable located in Containment.	II.a.	a. Aging b. Qualified Life c. Radiation	Being tested to resolve a, b, c.	See Note 9.
88	6-57	Cerro Cable W-14, W-16, W-17, W-18, W-19, W-21.	II.a.	a. Aging b. Qualified Life c. Radiation	Being tested to resolve a, b, c.	See Note 9.
89	6-56	Cerro Cable W-37, W-38, W-39, W-40, W-41, W-42	II.a.	a. Aging b. Qualified Life c. Radiation	Being tested to resolve a, b, c.	See Note 9.
90	6-59	Anaconda 5KV Power Cable W-3.	I.a.	None	None Required	Item is qualified.
91	6-50	AMP Cable splices at solenoids and at transmitters.	II.a.	a. Qualification Documentation b. Preventive Maintenance c. JCO	Transmitters upgraded & no longer require cable splices. They use transmitter terminal blocks. Solenoids which operate or energize post-LOCA have been upgraded.	See Note 10.
92	6-49	Cable Splice at electrical penetrations and valcor solenoids.	II.a.	a. Aging b. Qualified Life c. Radiation d. Test Sequence	Being tested to resolve a, b, c, d. (Valcor solenoids have been replaced - see #81)	See Item #85. See Note 9. Splices replaced - see introduction.
93	6-47	Electric Sealant Dow-Corning RTV-3144/3145	[illegible]	None	None Required	Items are qualified.
94	6-48	Burndy Terminal Lugs.	III.b.	None	None Required	See Item #103. Part of Raychem Splice System.
95	6-51	Cable Splices @ 480V Containment Vent Fans	I.b.	a. Documentation	District believes these are qualified.	Items are qualified. See Note 11.
96	6-52	Containment Vent Fan Motor Lead Splices at the electrical penetrations.	II.a.	a. Documentation	See Item #95.	See Item #95 above.
97	6-53	States 4, 6, 8 and 12 point terminal blocks.	II.a.	a. Similarity b. Documentation	Similarity established by reference to vendors catalog to verify installed terminal blocks are type NT. Documentation on file, this resolves a,b.	Items are qualified. See Note 12.
98	6-54	Hoffman Junction Boxes.	III.a.	None	Exempt - None Required.	Exempt from Qualification.

ITEM-BY-ITEM RESOLUTION

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
99	6-46	Conax Electrical Penetrations in containment.	II.a.	a. Radiation b. Test Sequence c. Aging d. Qualified Life	See Item #85.	See Note 10.
100	6-59A	Conax Electrical Conductor Seal Assembly	II.a.	a. Similarity	Similarity established by 1) reporting model #, 2) providing cert. of conformance.	Items are qualified.
101	6-120E	Fisher 304 Limit Switches in Room 81 for YCV-1045A, YCV-1045B, HCV-1107B and HCV-1108B.	I.a.	None	Limit switches were replaced during 1984 outage with qualified NAMCO-EA-180's.	Items are qualified.
102	6-65	NAMCO EA-180 Limit Switch providing position indication for HCV-304 and HCV-305	I.a.	None	None Required.	Items are qualified. See Note 3.
103	6-59B 6-59C 6-59D	Raychem Cable Splices in containment and Auxiliary Building.	II.a.	a. Similarity	Splices are correctly, Raychem Model WCSF-N inline splices. These are qualified per FRC TER #103 pg. 5g. This resolves (a).	These splices are qualified.
104	6-78C	H_2 Analyzer Comsip	II.c.	a. Qualified Life b. Aging Degradation c. Aging Simulation	Vendor material data was verified using Arrhenius Method and found acceptable.	Item is qualified. See Note 13.
105	6-59E 6-59F 6-59G	Rockbestos Firewall III Cable	I.a.	None	None Required	Fully Qualified.
106	6-100A 6-100B	Victoreen High Range Containment Radiation Area Monitor. Model 877-1 and cables and connectors.	II.a.	a. Similarity	The similarity problem arose from incorrectly reported model number. Test report cited various degradations - cables are enclosed in stainless steel tubing to resolve this.	Items are fully qualified.
107	6-78D	ASCO Solenoids in containment for HCV-883C, HCV-883D, HCV-883E, HCV-883F, HCV-883G, HCV-883H, HCV-820C, HCV-820D, HCV-820E, HCV-820F, HCV-820G, HCV-820H.	II.c.	a. Qualified Life	Incorporated into Qualified Life Program to resolve (a).	Fully Qualified.

FRC #	EEQ PAGE #	DESCRIPTION	CATEGORY	QUALIFICATION DEFICIENCIES	RESOLUTION	STATUS
108	6-78A	ASCO Solenoid in containment for HCV-883A, HCV-884A	II.a.	a. Similarity	See #81.	Fully Qualified.
109	6-9	ASCO Solenoids in Room 22 for HCV-2809A, HCV-2809B, HCV-2811A, HCV-2811B, HCV-2814A, HCV-2814B, HCV-2815A, HCV-2815B.	II.c.	a. Qualified Life	See Item #107.	Fully Qualified.
110	6-120D	ASCO Solenoids in Room 81 for YCV-1045A, YCV-1045B.	II.c.	a. Qualified Life	See Item #107.	Fully Qualified.
111	6-120A 6-125C	ASCO Solenoid Valves for FCV-1368, FCV-1369, YCV-1045.	II.c.	a. Qualified Life	These solenoids are not within the scope of 10 CFR 50.49.	Not located in a harsh environment. SCEW to be deleted.
112	6-36A	ASCO Solenoids in containment for HCV-865, HCV-864	II.c.	a. Qualified Life	See Item #81.	See Item #81.
113	6-19 6-125D	ASCO Solenoids in containment for HCV-438A, HCV-438C, HCV-1107A, HCV-1108A.	II.c.	a. Qualified Life	See Item #81.	See Item #81.
114	6-78B	Valcor Solenoids in containment for HCV-820B and HCV-821B.	I.a.	None	Items have been incorporated into Qualified Life Program.	Fully qualified.

ATTACHMENT 2

FRC-TER ITEM BY ITEM RESOLUTION

NOTES

1. TER Items 1, 2, 3, 4 - Foxboro Pressure and Differential Pressure Transmitters

The District is upgrading all transmitters which are required to operate in a harsh environment to latest models of NE-10 Series Foxboro which have been tested to meet the requirement of IEEE/323-1974. The District will have completed any necessary hardware upgrade by the end of the current refueling outage scheduled to be completed in early May of 1984. Due to the late arrival of the test reports and the work required to insure similarity, review power supply voltages, review accuracy data, update the qualified life program and update the central file an extention to September 30, 1984 has been requested. This includes a justification for continued operation.

The transmitter upgrade will resolve the radiation exposure, T/P (temperature and pressure) exposure duration, and provide a transmitter qualified life which will be factored into the District's Qualified Life Program. All transmitters are now installed above the flood level.

2. TER Items 7 - NAMCO Limit Switches

The limit switches listed in Table 1-Note 2 are limit switches which are installed on valves whose location is below the maximum projected flood level in containment.

It is the District's judgment that the switches should remain operable in a flood condition. A review of the test report indicates that the switches were flooded several times due to malfunctioning test equipment with no indicated failures.

Flooding and potential failure of these limit switches will not jeopardize the safe shutdown of the reactor in a DBA. As listed in Table 1, all limit switches provide position indication only. Although the switches may cause a short or a ground of the circuit, no problems are expected. A short is expected to cause both position indications to be on. In the event of ground only one lead to ground is possible; the other is isolated by the indicating light. The lead which could be grounded is provided (modification complete the end of the 1984 refueling outage) with a fuse to isolate this portion of the circuit from the remaining circuit to preclude the possibility of the loss of the control function in the event grounding would occur.

2. TER Item 7 - See Table 1-Note 2 (Continued)

The system includes Conax Seals, Raychem Splices, and Pyrotrol III Cable. The District believes that the insulation system should be adequate for the low voltage (130 VDC or 120 VAC) position indication power.

Based on this evidence, the District believes that these limit switches have been adequately addressed.

TABLE 1 NOTE 2

Tag No.	System	Limit Switch Function	Elevation Position	Accident Position	Fail Position
HCV241	Let Down CVCS Containment Isolation	Position Indication	1,000'	C	C
HCV238	Charging Long Term Core Cooling	Position Indication	999'	O Accident C Long Term Core Cooling	O
HCV239	Charging Long Term Core Cooling	Position Indication	1,000'	O Accident C Long Term Core Cooling	O
HCV438A	CCW to RC Pumps Containment Isolation	Position Indication	996' 9"	C	O
HCV438C	CCW to RC Pumps Containment Isolation	Position Indication	997'	C	O
HCV467A	CCW to Nuclear Detector Well Cooling Containment Isolation	Position Indication	999' 5"	C	C
HCV467C	CCW to Nuclear Detector Well Cooling Containment Isolation	Position Indication	999' 2"	C	C
HCV1387A	Blowdown from SGA Containment Isolation	Position Indication	1000'	C	C
HCV1388A	Blowdown from SGB Containment Isolation	Position Indication	1000'	C	C

MAXIMUM PROJECTED FLOOD LEVEL 1000.9' INCLUDING ENTIRE RCS INVENTORY

3. TER Item 7, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27

The FRC-TER indicated the NAMCO EA 180 limit switches as fully qualified. It should be noted that these are qualified but require periodic refurbishment.

These limit switches have been incorporated in the District's Qualified Life Program.

4. TER Item No. 8, 9, 10, 11, 12, 13 - Fisher 304 Limit Switches

The District has completed qualification by a combination of test and analysis. Several switches (with approximately 10 years service) were removed from operating systems in the plant and irradiated to 2.24 x 10^7R. The switches remained operable following irradiation with no apparent degradation.

Table C-1 of the DOR Guidelines was used to identify materials with significant aging. None were identified. The District considers the switches fully qualified with radiation as the only harsh environment parameter.

The testing of naturally aged (including vibration) limit switches removed from the plant accounts for synergistic effects.

5. TER Items 35, 36, 37, 39 - Limitorque Motor Operators

It is the District's judgment that the Limitorque Operators are qualified for the intended service at the Fort Calhoun Station.

For those operators in containment, Report number 600198 demonstrates qualification for steam, temperature, and chemical spray. Test B0003 and related Test B0058 are used to demonstrate aging and radiation qualification. Class H insulated motors are installed on the in-containment operators. Limitorque has indicated that the characteristics of the Class H Motors are equal or better than the Class B Motors tested in B0003 and related Test B0058.

Since the Class H Motors have an inherently higher thermal rating than the Class B, qualification for the high LOCA/MSLB temperatures is assured, with radiation and aging characteristics similar to Class B insulation system.

5. TER Items 35, 36, 37, 39 - Limitorque Motor Operators (Continued)

HCV348 Failure Modes Analysis.

Purpose

This analysis evaluates the effects of a failure of HCV-348 that may be caused by a radiation exposure in excess of the motor operator's environmental qualification.

EEQ Problem

HCV-348 is a motor operated valve whose Limitorque operator has been qualified to 2×10^7 Rads. The maximum post-LOCA total integrated dose has been calculated to be 2.7×10^7 Rads.

HCV-348 Function

a. HCV-348 is the safety injection shutdown cooling isolation valve. It is opened to supply water from the RCS hot leg to the LPSI pump suction so that shutdown cooling may be initiated.

b. HCV-348 is locked closed during normal operations and is a containment isolation valve.

c. If a LOCA occurs while SDC is aligned for operation, EP-5A indicates that HCV-348 is to be closed as one of the first steps.

d. HCV-348 remains closed for long term core cooling as this flow path is not required.

Failure Modes and Effects

The only failure that will be considered here is one that could be attributed to excessive radiation. All other failures are within the design basis of Fort Calhoun Station, as discussed in the USAR.

The only credible failure due to radiation would be a failure of the motor operator to operate when required. There is no mechanism for spurious actuation.

The effects of a failure to actuate are negligible because there are no operations required after the radiation dose exceeds the qualified dose (about 250 hours post LOCA).

a. The valve is a containment isolation valve and is closed while the RCS is pressurized.

b. Operation is not required for long term cooling after either small or large break LOCAs because the flow path through HCV-348 is not used.

c. Opening the valve for shutdown cooling after a MSLB would not be prevented because the radiation exposure associated with a MSLB (5 x 10^6 Rads) is less than the qualified dose.

d. Depending on the severity and isolability of a LOCA, it might be desirable to be able to open HCV-348 for shutdown cooling. In all likelihood, however, for any LOCA that could be isolated so that shutdown cooling could be utilized, either the system alignment through HCV-348 would be accomplished before 250 hours, or the dose would be low enough that the exposure limit would not be reached by the time the motor operator had to function.

Limitorque Motor Operator Lubrication: The District has taken steps to insure that lubrication of the operators will also be qualified. The operators' gear trains were qualified with Exxon Nebula EP-1. Limitorque recommends the use of Exxon Netula EP-0. During conversations with Limitorque the District asked if any other greases could be used. Limitorque stated that the only information available to them indicated the use of the Exxon grease. However, other lubricant vendors could be contacted for grease qualification.

As a result of this, the District has several of its valve operators using Texaco Marfac-2 as the lubricant. Texaco has provided qualification information which the District believes is adequate. The remaining valves have the Exxon Nebula EP-0 lubricant.

Limitorque Limit Switch Lubrication: The limit switches on these items are lubricated with either Becon 325 or Mobil 28.

The District believes the valves are fully qualified.

6. TER Items 29, 31, 33, 34, 40 - Limitorque Motor Operators

It is the District's judgment that the Limitorque Operators are qualified for the intended service at the Fort Calhoun Station.

For those operators outside containment Test Report B0003 and related Report B0058 established qualification for all parameters.

HCV347 is located in Room 13. However, qualification and operation are the same as those provided for HCV348. Room 13 is a hign radiation area only. LCV218-3 has been reviewed and found to operate prior to being exposed to a harsh environment. It is located on the charging system suction for which no credit is taken. Although not expected to fail, a failure modes and effects analysis indicates that no problems should be encountered.

Limitorque Motor Operator Lubrication: The District has taken steps to insure that lubrication of the operators will also be qualified. The operators' gear trains were qualified with Exxon Nebula EP-1. Limitorque recommends the use of Exxon Nebula EP-0. During conversations with Limitorque the District asked if any other greases could be used. Limitorque stated that the only information available to them indicated the use of the Exxon grease. However, other lubricant vendors could be contacted for grease qualification.

As a result of this, the District has several of its valve operators using Texaco Marfac-2 as the lubricant. Texaco has provided qualification information which the District believes is adequate. The remaining valves have the Exxon Nebula EP-0 lubricant.

Limitorque Limit Switch Lubrication: The limit switches on these items are lubricated with either Becon 325 or Mobil 28.

The District believes the valves are fully qualified.

7. TER Item 28 - Limitorque Motor Operators

It is the District's judgment that the Limitorque Operators are qualified for the intended service at the Fort Calhoun Station. For those operators in Room 81 Report F-C3271 establishes environmental qualification based on similarity of the operators. Reports B0003 and B0058 establish a qualified life.

The brakes on these operators were upgraded during the 1984 outage.

Limitorque Motor Operator Lubrication: The District has taken steps to insure that lubrication of the operators will also be qualified. The operators' gear trains were qualified with Exxon Nebula EP-1. Limitorque recommends the use of Exxon Nebula EP-0. During conversations with Limitorque the District asked if any other greases could be used. Limitorque stated that the only information available to them indicated the use of the Exxon grease. However, other lubricant vendors could be contacted for grease qualification.

7. TER Item 28 - Limitorque Motor Operators (Continued)

As a result of this, the District has several of its valve operators using Texaco Marfac-2 as the lubricant. Texaco has provided qualification information which the District believes is adequate. The remaining valves have the Exxon Nebula EP-0 lubricant.

Limitorque Limit Switch Lubrication: The limit switches on these items are lubricated with either Becon 325 or Mobil 28.

The District believes the valves are fully qualified.

8. TER Item 38 - HCV150 and HCV151

The PORVs and their associated block valves were addressed in the IE Bulletin 79-01B submittal as part of the equipment referenced in the plant emergency procedures (EP's). Under the EPs, the PORVs potentially function in two different areas. The first is as a possible source of a LOCA in which the PORV may open and fail to close.

As a result of the TER meeting with the NRC staff held on March 23, 1984 the District has conducted further investigation into the qualification of HCV150 and HCV151, Limitorque motor operators on the PORV block valves. These motor operators have been qualified to 40 psig, 250°F.

The District is in the process of obtaining a computer-generated small break LOCA containment response expected in late May, 1984. There has not been sufficient time to complete this response information.

In the interim, the District has made a simple heat balance calculation to obtain the time in which either the qualification test temperature or pressure was exceeded. This modeled only the containment atmosphere and the saturated steam, (2150 psig) from one "failed PORV". The operating time was demonstrated to be 22.8 minutes at which time the containment reaches 40 psig. No credit was taken for heat sinks in containment, or drop in RCS temperature and pressure as the pressurizer empties. The analysis takes no credit for containment spray which initiates at approximately 4 PSIG and would be expected to limit to pressure and temperature transients.

Additional operating time is available since the harsh environment is delayed until the pressurizer quench tank rupture disc is ruptured.

Based on this information and the availability of PORV position indication via the qualified acoustic position indication, the District believes these operators are qualified for their intended service: manual isolation of the PORVs.

The District also believes that this system's failure is bounded by the small break LOCA, and that this alone is adequate.

8. TER Item 38 - HCV150 and HCV151 (Continued)

Challenges to the PORV's are expected to be very infrequent. The NSSS design inherently minimizes the challenges to the PORVs. This is discussed in the District's NUREG-0737 submittals.

The second use of the PORVs is that of a backup to the steam generators for long term cooling, if the primary system is above 700 psia. This would require the failure of the redundant auxiliary feedwater system. It is felt that the auxiliary feedwater system is adequate. In addition, the size of the PORVs would limit their effectiveness in providing cooling. The District plans to leave the equipment in the EPs to provide maximum flexibility in accident mitigation.

Limitorque Motor Operator Lubrication: The District has taken steps to insure that lubrication of the operators will also be qualified. The operators' gear trains were qualified with Exxon Nebula EP-1. Limitorque recommends the use of Exxon Nebula EP-0. During conversations with Limitorque the District asked if any other greases could be used. Limitorque stated that the only information available to them indicated the use of the Exxon grease. However, other lubricant vendors could be contacted for grease qualification.

As a result of this, the District has several of its valve operators using Texaco Marfac-2 as the lubricant. Texaco has provided qualification information which the District believes is adequate. The remaining valves have the Exxon Nebula EP-0 lubricant.

Limitorque Limit Switch Lubrication: The limit switches on these items are lubricated with either Becon 325 or Mobil 28.

9. TER Item 85, 86, 897, 88, 89, 92, 99, 103 Pyrotrol III Cable, Cable Splice, Electrical Penetrations, Raychem Splices

The Fort Calhoun Station is equipped with approximately 400 electrical penetration subassemblies which are used to provide electrical paths for instrumentation, control, and power for normal plant operation, and certain accident and post-accident functions. These electrical penetration subassemblies were manufactured by the Conax Corporation using TFE teflon for the seal, and FEP teflon for the lead wire insulation. As part of the preparation of the response to IE Bulletin 79-01B, testing information as described in Section 5.9 of the USAR was reviewed.

Upon completion of a re-review of the available vendor-supplied documentation in February 1981, the District concluded that additional testing was necessary to meet the DOR Guidelines. A separate radiation test was done on the assemblies, and was not done in sequence as part of a LOCA test. This was not in full compliance the DOR Guidelines which require sequential testing if a material is known to degrade severely under a stress parameter (in this case radiation). Therefore, a purchase order for testing was issued to Wyle Laboratories on August 31, 1981.

9. TER Item 85, 86, 897, 88, 89, 92, 99, 103 Pyrotrol III Cable, Cable Splice, Electrical Penetrations, Raychem Splices (Continued)

The time between purchase order issuance and the beginning of actual testing was used to determine what alternate methods of sealing (RTV or Raychem sleeving) could potentially be tested and for preparing the test fixture and test samples. In preparation for final testing by Wyle, in March of 1982, a test sample consisting of seal and lead wire was irradiated to 9.9 x 10^6R gamma at Iowa State University. Although some material degradation was noted, the sample showed no leakage, the lead wire insulation remained flexible, and the insulation withstood a 500 VDC insulation resistance test while immersed in salt water. NOTE: After experimentation with the alternate methods (RTV or Raychem sleeving) it was determined that the alternates could not be acceptably implemented and were subsequently dropped.

The initial testing at Wyle Laboratories began in the fall of 1982, and consisted of the 40-year accelerated aging test. At the end of this testing, excessive leakage was found. This was reported to the Commission in a letter dated December 30, 1982. This seemed to be contrary to information contained in the District's surveillance test program which indicated no leakage.

The District then began a research effort to identify the failure mechanism. A test sample was aged using the original criteria with leakage testing conducted at more frequent intervals. Failure was found to occur between 20 and 30 years of qualified life. This was reported to the Commission in a letter dated March 8, 1983.

Contact was then made with Conax and DuPont. The problem was identified as a cold flow problem due to high accelerated aging temperatures in which the seal material "flowed" in the subassembly tubing. Conax then developed a new aging criteria to more accurately model aging. This was completed in August of 1983. A second test sample was then aged, and no leakage was measured.

The District restarted the test program with a modification such that the penetrations would be aged at the new temperature and then spliced on the already aged penetration lead wires, splice, and cable system. However, due to a communications problem, the aged cable splices were destroyed in mid-February, 1984.

Subsequent to mid-February, the District attempted to locate parts, construct new assemblies, and evaluate the impact on the schedule to determine if the overall commitment date could be met. It then became necessary to age the lead wire, splice and cable assembly. The aging began on March 20, 1984. On April 11, 1984 the splices addressed in Item 92 exhibited severe cracking of the outer heat shrink jacket following the aging test. The District has replaced these splices with qualified Raychem splices. Testing, issuance and review of the final report, will be completed by September 30, 1984. This is after the District's

9. TER Item 85, 86, 897, 88, 89, 92, 99, 103 Pyrotrol III Cable, Cable Splice, Electrical Penetrations, Raychem Splices (Continued)

commitment date of the end of the present refueling outage (early Mary 1984). Thus, an exemption from this deadline was requested. Continued safe operation is justified as discussed below.

Justification for Continued Operation: (Franklin TER Items 85, 86, 87, 88, 89, 92, 99, 103)

The District elected to resolve specific qualification deficiencies in the above noted Franklin TER items by testing.

Specifically, Items 85 through 89, Rockbestos Pyrotrol III cable, were cited for deficiencies related to aging, qualified life, and radiation. Item 92, cable splices at electrical penetrations, were cited for deficiencies related to radiation, test sequence, aging, and qualified life. Item 103, Raychem cable splices, lacked adequate similarity (which has been resolved.)

To summarize, the Conax penetrations (Item 99) are being re-tested to insure the proper test sequence (eliminating separate effects) is completed. Items 92 and 103 are being tested to insure the penetration/splice system under proper test sequence is accounted for. The cables, Items 85 through 89, are being tested to account for radiation and aging in proper test sequence.

It is the District's engineering judgment that safe operation is justified until the test is completed and evaluated. Based on the information supplied by the vendor, the District believes the Pyrotrol III cable is similar to the qualified Firewall III which has a 40-year qualified life at 90°C. Since the cable is similar and operates at significantly lower than 90°C (qualification level of the Firewall III), the District expects little aging degradation.

It should be noted that the Pyrotrol III has successfully completed several LOCA tests, including radiation up to 1.79 x 10^8R. Based on similarity to Firewall III and the several tests, the District believes that continued operation with Pyrotrol III is justified.

On April 11, 1984 the splices addressed in Item 92 exhibited severe cracking of the outer heat shrink jacket after the 40 year aging test. The District has elected to replace these splices with fully qualified splices as addressed in TER Item 103. The District plans to continue the interface testing with the Raychem.

It should also be noted that the District has irradiated a penetration sample to 9.9 x 10^6R at Iowa State Univeristy. The lead wire insulation was found to have degraded but is quite flexible and should remain strong enough to insure the splice interface does not degrade.

9. TER Item 85, 86, 897, 88, 89, 92, 99, 103 Pyrotrol III Cable, Cable Splice, Electrical Penetrations, Raychem Splices (Continued)

The District believes safe continued operation is justified for the electrical penetrations, Item 99. As discussed earlier, a test sample was irradiated to 9.9×10^6R (approximate accident dose). The sample functioned properly under the limited testing. No leakage was measured at 60 psig, the insulation did not break down at 500 VDC with the lead wires immersed in salt water, and although there was some loss of structural strength, the insulation still required physical effort to remove from the wire and did not exhibit cracking when bent sharply. The District has also completed a successful aging test in which no leakage was measured after the equivalent of 40 years life. It should also be noted that the penetrations have successfully passed a LOCA test without aging or radiation.

10. TER Item 91 - Amp Cable Splices at Solenoids

These splices are installed on solenoids in the containment and Room 81 which are de-energized by the accident signal and are not required to operate in an accident/post-accident environment. Potential leakage of moisture will not affect operation. The splices are in conduit, protected from direct spray or steam.

The District considers that the qualification is adequate. It should be noted that it is the District's judgment that coating the splices with RTV 732 clear will qualify the splices for use in a DBA for both energized and de-energized use.

In spite of this analysis the District has installed Raychem qualified splices on all solenoid splices which must be energized in a DBA (which includes a steam and/or spray environment).

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations

A. Qualification Analysis: 480V Vent Fan Splices

Based on the results of the attached Wyle Laboratories evaluation of the Fort Calhoun Station cable splices and the District's engineering judgment, the 480 VAC vent fan motor cable splices at the motor leads and on both sides of the containment electrical penetration are adequately qualified for both LOCA and post-LOCA environments. The key to full qualification of these splices involves the consideration that the splice

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations

A. Qualification Analysis: 480V Vent Fan Splices (Continued)

is a system in which the inner layers of tape ensure the electrical integrity of the circuit. The outer layer of RTV sealant (Dow Corning 3144 or 3145 clear) provides the protection and electrical insulation from normal and potential harsh environment parameters. A complete description of the motor lead cable splice system is detailed in Enclosure 9 to the District's letter dated August 26, 1981 (see Attachment 5). A description of the cable splice system at the electrical penetrations is provided as Figure 1, page 22 of the enclosed Wyle Laboratories Report, (see Attachment 6).

To substantiate the District's engineering judgment, each of the applicable environmental stress parameters (pressure, humidity, steam, temperature, chemical spray, radiation, and aging) was evaluated to determine its impact on the splice systems. The results of the investigation are as follows:

1. Pressure: The splices are a mechanically passive system which provide electrical insulation and protection for the connection. Insulation has been placed over the connector and wire jacket in such a fashion as to minimize voids and a layer of RTV covers all of this. With this configuration and the small surface area of the splice, only a small mechanical force can be exerted. The District believes this small compression could not cause mechanical damage that would lead to splice failure. In addition, this force tends to compress the splice, ensuring water tightness. Aging information indicates that the material should remain functional throughout the life of the plant, indicating that a pressure transient should not cause splice failure. This conclusion is also substantiated by the fact that the splices have remained functional throughout three containment integrated leak rate tests in which the fans operated at accident pressure.

2. Humdity: The RTV and various tapes provide an adequate barrier which is substantiated by almost 10 years of successful operation. (NOTE: The RTV was applied to the electrical penetration splices in 1980.)

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations (Continued)

A. Qualification Analysis: (Continued)

3. Steam: The District believes the protection provided by the RTV is an adequate barrier to steam.

4. Temperature: The District judged the splices to be adequate to withstand the accident temperature environment. The RTV is expected to remain pliable during the DBA transient and be able to accommodate any expansion of the splice due to current induced heating and environment. Since the major contribution to the expansion is the environment (which will return to near normal within one hour), radiation is not expected to cause embrittlement which would detract from the RTV "response". Wyle Laboratories Report No. 26333-26 concludes that the splices and their material constituents can withstand the effects of exposure to the peak accident temperature of 305°F. Please refer to Section 4.3.3.3 of the subject report.

5. Chemical Spray: The only splices which potentially could be exposed to chemical spray are the containment side electrical penetration splices. The motor lead splices are protected by a junction box, and the penetration splices in Room 81 are not exposed to chemical spray. Furthermore, RTV is not affected by mild acid and basic solutions and precludes damage by chemical spray.

6. Radiation: For radiation qualification, three categories of splices were evaluated and the results are presented below. The first splice of concern is the electrical penetration cable splice located in Room 81 of the auxiliary building. These splices are outside the containment and are not expected to be affected by radiation. No further evaluation is required for these splices.

The second splice category includes the vent fan motor lead wire splices inside containment. These splices are protected by a junction box which eliminates the effect of beta radiation on the splice. Calculations indicate that VA-3A and VA-3B could be exposed to a maximum gamma dose of 8.64×10^6 rads, and VA-7C and VA-7D could be exposed to 1.92×10^7 rads gamma. Both of these exposures are less than the 1.0×10^8 rads threshold level for these splices which is summarized in Table 5 of the Wyle report.

The third category of splice evaluated was the electrical penetration cable splices located inside containment. The radiation exposures to these splices would be as follows:

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations (Continued)

A. Qualification Analysis: (Continued)

	Maximum Exposure at O. D. of RTV (Rads)	Maximum Exposure at I.D. of RTV and O.D. of Splice Insulation (Rads)
Gamma Radiation	1.475×10^7 (1)	1.475×10^7
Beta Radiation	2.0×10^8 (2)	2.0×10^5 (3)
Total Integrated Dose (TID)	2.1475×10^8	1.495×10^7

NOTES:

(1) Includes a normal exposure of 3.5×10^5 rads (i.e., a conservative 1 R/hr for a 40 year operating life) and an accident exposure of 1.44×10^7 rads.

(2) Combined normal and accident exposure as recommended by the DOR Guidelines.

(3) RTV of approximately 1/8" thickness (125 mils) reduces the beta radiation of a factor of 1000, therefore reducing the beta exposure to 2.0×10^5 rads at the outer layer of splice tape.

As indicated in the table above and in the Wyle Laboratories report, the RTV is a nominal 1/8" thick on the splice and attentuates the beta exposure to approximately 2.0×10^5 rads at the splice RTV/tape interface. This results in a TID to the tape surrounding the splice of 1.5×10^7 rads. In reviewing the effect of this radiation exposure on the splice electrical insulation (i.e., tape), a system review is necessary. The insulation consists of inner layers of Irrathene SPT tape, and Irrasil and Scotch 33 tape are utilized for protection and to hold the Irrathene SPT tape. Item 3 of Table 3 on page 29 of Wyle Report No. 26333-25 demonstrates that the Scotch 33 and Irrathene SPT tape provide adequate radiation resistance to the maximum expected exposure. The Irrasil tape could be expected to degrade after approximately one hour of accident operation; however, since its purpose is to hold the qualified Irrathene SPT tape and is itself supported by the Scotch 33 tape, the District believes the Irrasil tape would not contribute to failure of the splice system. Additionally, in reviewing

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations (Continued)

A. Qualification Analysis: (Continued)

radiation test information (attached) provided by Dow Corning, both RTV 3144 and 3145 clear are known to embrittle with radiation exposure. However, RTV 3144 did not fail at an exposure of 1.94×10^8 rads and failure only occurred after mechanical stress was applied at 4.55×10^8 rads. Based on this embrittling test information, and the fact that each 30-40 mils of RTV reduces the beta radiation by a factor of ten, the District is confident that at a minimum the inner thickness of RTV will maintain its integrity and ensure operability of the splice.

7. Aging: Wyle Laboratories Report No. 26333-26 (see attached) indicates that no aging related failures should be encountered. Please refer to Section 3.0 of the subject report for details.

B. Operating Experience: - As stated earlier, these splices are required to maintain the electrical integrity of the power circuit. The District must insure that the RTV remains pliable to expand during temperature transients to accommodate any expansion of the cables and tapes. Some of the splices have been in service for approximately 9 years. An inspection was conducted in early April 1984. The RTV was found to still be resilient. This included full load on the fan motors during the containment leak rate test.

The other materials in the splices are normal for splice applications and many have demonstrated years of satisfactory service.

C. Qualification Maintenance: The District plans to inspect the splices each refueling to insure integrity and pliability of the RTV.

D. Conclusion: The District considers the splices qualified based on the preceding discussion. One further area should be reviewed, that of potential moisture and current leakage.

The analysis demonstrates that the splice system will exclude the environs from the circuit. Therefore, it is reasonable to make the assumption that a major failure of the splice would not be expected. The District judges that any leakage would be minor. The fans are supplied from a floating 480V Delta 3 Phase System. Two phases shorting or two phases to ground are required to cause any interruption of the circuit.

11. TER Item 95, 96 - Containment Vent Fan Splices at Motor and Electrical Penetrations (Continued)

D. Conclusion (Continued)

Since at worst only minimal moisture leakage is expected, leakage currents would be on the order of milliamps to the 1 amp range. Full load current for VA-3A and VA-3B is 238 amps and 143 amps for VA-7C and VA-7D. Milliamps to 1 amp leakage currents are not large enough to cause a fault. Additionally, there would not physically be enough room for enough moisture to conduct fault current. It could also be expected that any heating cause by leakage current would not damage the splice material and would be expected to "dry" the circuit, interrupting the leakage path. Minor moisture leakage is not expected to be a problem if it were to occur.

12. TER Item 97 - States Terminal Blocks

To insure the integrity of the circuits which are made using the terminal blocks, each terminal block, including wire lugs and incoming lead wires, are coated with qualified RTV3144 (3145 clear). The blocks are enclosed in junction boxes which protect against direct spray.

Since the circuit is protected, leakage currents are not expected to cause a problem.

13. TER Item 104 - COMSIP H_2 Analyzer

The District has investigated the aging methodology used in the COMSIP qualification. The vendor used the 10°C rule to establish a qualified life of 5 years. This included addressing of the sample pump failure (weak link) in the system. The District applied the Arrhenius Method to the aging information and obtained a plant specific qualified life of 15 years. In spite of this information, the District intends to refurbish the analyzer on a 5-year interval.

There is a GE CR2940 control switch installed which is susceptible to radiation damage as reported in IE Information Notice 83-45 (failure occurred at 3.7×10^7 rads). The expected exposure is 1.56×10^6R. This lower than tested exposure (which passed the qualification test) leads the District to judge the unit to be qualified. A review of EPRI NP2129 indicates that at the expected dose the Delrin material would lose about 30% of its tensile strength vs greater than 75% for the tested exposure.

ATTACHMENT 3

Omaha Public Power District
Fort Calhoun Station
Electrical Equipment Qualification Program and
Compliance With 10CFR 50.49 (b)(1), (b)(2), (b)(3)

I. History

The District's present program for compliance with the electrical equipment in a harsh environment qualification rule 10 CFR 50.49 began in January of 1980 with the actions required by IE Bulletin 79-01B Environmental Qualification of Class 1E Equipment. The required action expanded the scope of IE Bulletin 79-01 and its related documents.

The District based its investigation on the DOR Guidelines provided with IE Bulletin 79-01B. The exceptions to this are those items which require different qualification criteria as provided in NUREG-0578 and subsequently NUREG-0737.

Several submittals to the NRC were made including the "45 day", "90 day", "November 1, 1980", "Inclusion of Equipment to Achieve Cold Shutdown", and several to note equipment changes. A large submittal of test reports was also made to the Franklin Research Center, from which the latest TER was written.

The District has also responded to one SER with many specific questions.

The unit is in a refueling outage and the modifications which were discussed in the response to the TER are to be accomplished. The submittal document used by the District is being transformed into a more streamlined document to be used during the day-to-day operation by District personnel. Necessary Qualified Life Program maintenance is to be performed. Documentation open items are to be closed out and the District has hired an independent contractor experienced in equipment qualification to audit the District's entire Electrical Equipment Qualification Program.

Additionally, the District believes it would be beneficial to explain the manner in which IE Information Notices are handled. Upon receipt, the Licensing Department makes an assessment of the notice to determine the appropriate department for response preparation. An assignment is made and progress is tracked via the District's Licensing Action Log. The assignment requests a review with respect to applicability, potential impact, and possible corrective action. The results of the review are documented for in-house record-keeping purposes and are retained by the District's Licensing Department.

II. District's Electrical Equipment Qualification "Philosophy" (10CFR 50.49 (b)(1)

A. Basis for the Evaluation

1. In order to establish the bases for the assessment and this report, as well as the master lists and environmental worksheets, several preliminary steps were taken. The first step in the assessment program was to conduct a review of the facility flow diagrams to establish which systems were required to mitigate the consequences of a LOCA. After the bases for the LOCA conditions were established, the District began an

1. (Continued)

evaluation of the high energy piping systems to determine where failure of a pipe could cause Engineered Safeguards systems to be challenged.

After these lines were identified, a cross-check of areas within the plant was made to determine if a HELB would affect any Class 1E electrical equipment which was required to function under the postulated accident conditions.

The components which were identified as a result of the above studies were then further evaluated for their suitability for operation in the postulated environment.

The following is a description of the safety systems, high energy lines, and areas taken under consideration by the District.

a. Identification of Safeguards System:

In order to ensure that all of the components required to operate to mitigate design basis events were identified and assessed for their impact on plant safety, a survey of each plant system was made to identify required flow paths for accident mitigation.

In addition, all systems were reviewed for isolation requirements after receipt of Engineered Safeguards Signals. As a result of this survey, the following systems were identified as either being required to operate or as having components which required isolation on receipt of Engineered Safeguards Signals:

(1) Reactor Coolant System
(2) High Pressure Safety Injection System
(3) Low Pressure Safety Injection System
(4) Containment Spray System
(5) Containment HVAC System (Containment cooling units and isolation valves)
(6) Component Cooling System
(7) Raw Water System
(8) Main Steam System
(9) Steam Generator Feedwater and Blowdown System
(10) Chemical and Volume Control System
(11) Containment Hydrogen Purge System
(12) Control Room Ventilation System
(13) Instrument Air System (Isolation valves only)
(14) Plant Air System (Isolation valves only)
(15) Sampling System (Isolation valves only)
(16) Demineralized Water System (Isolation valves only)

II. District's Electrical Equipment Qualification "Philosophy" (Continued)

A. Basis for the Evaluation (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

(17) Waste Disposal System (Isolation valves only)
(18) Electrical Auxiliary Components (which were common for all of the above systems)
(19) Nitrogen System (Isolation valves only)
(20) Charging and Concentrate Boric Acid[7]
(21) Reactor Protective System[6]
(22) ESF Actuation System[1]
(23) 120 VAC 1Ø and 130V DC Instrument and Control Power[2]
(24) 480 VAC 3Ø and 4160 VAC 3Ø Power[2]
(25) Emergency Diesel Generator[2]
(26) Ventilation for Areas Containing Safety Related Equipment[3]
(27) Post Accident H_2 Sampling and Radiation Monitoring
(28) Long Term Core Cooling[8]

After identification of the systems had been completed, the system list was cross-checked against Appendix A of the Guidelines for Evaluating Environmental Qualifications of Class 1E Electrical Equipment in Operating Reactors. In general, there is a close correlation between Appendix A and the system listed for the Fort Calhoun facility. However, certain specific systems are not required at Fort Calhoun to achieve a safe shutdown under the postulated accident condition. In addition, some of the systems listed are unaffected by either LOCA or HELB environments since they are located outside of affected areas. It should be noted that hot shutdown condition is defined as safe shutdown condition for Fort Calhoun Station.

These systems and the basis for excluding them from the District's response are as follows:

(1) Engineered Safeguards Actuation - The system components which initiate safeguards actuation are contained and evaluated as components within the systems identified for Fort Calhoun.

(2) Emergency Power - The emergency power system for Fort Calhoun consists of two diesel generators and associated distribution equipment such as switchgear and motor control centers. In addition a 130VDC system consisting of fully redundant batteries, chargers and associated distribution equipment is available at Fort Calhoun. None of the postulated accident situations affect the environment where this equipment is located. Since this is the case, no evaluation of individual components has been done.

II. District's Electrical Equipment Qualification "Philosophy" (Continued)

A. Basis for the Evaluation (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

(3) Ventilation for Areas Containing Safety Equipment - Where ventilation equipment is required for operation of safety equipment, and it is affected by the postulated event, then it has been assessed for the resultant environmental conditions.

(4) Emergency Shutdown - The District has performed an analysis of the systems required to bring the reactor to a cold shutdown condition after an accident involving rapid depressuriztion of the primary system with no breach of the reactor coolant pressure boundary. The safety analysis for Fort Calhoun shows one possible event which could cause this situation to occur. The event is a steam line rupture incident. Plant emergency procedure EP-6 "Uncontrolled Heat Extraction" was referenced to determine those systems necessary to limit the consequences of this event. After review of EP-6, it was determined that there are no additional systems required to function than those which have been previously identified.

(5) Safety Related Display Instrumentation - The plant emergency procedures for both loss of coolant accident and main steam line break uncontrolled heat extraction have been investigated and the components which are relied upon to function after these events have been assessed for environmental qualifications. These items are evaluated as components within the systems identified for Fort Calhoun.

Also included is the instrumentation installed under NUREG-0578 and 0737.

(6) Reactor Trips - For the LOCA analysis, Low Pressurizer Pressure initiates a reactor trip. See the following discussion on Small Break LOCA.

Review of the small break LOCA analysis has shown that for all small break LOCAs, low pressure is the parameter which initiates a reactor trip. The reactor protective system (RPS) uses loop temperatures and reactor power (Delta T or nuclear whichever is higher) to generate a calculated pressure (thermal margin low pressure) which is fed into a bistable and compared with

II. District's Electrical Equipment Qualification "Philosophy" (Continued)

A. Basis for the Evaluation (Continued)

1. (Continued)

a. Identification of Safeguards System: (Continued)

(6) (Continued)

actual reactor pressure. If reactor pressure falls below the calculated number, the reactor trips. In addition, the bistable is set with an absolute low limit such that no matter what the calculated input, the reactor will trip at a pressure no lower than 1750 psig. It is this 1750 psig trip point which trips the plant in the small break LOCA analysis.

Since the failure of unqualified equipment in containment cannot affect the low limit trip value and the RPS pressurizer input are LOCA qualified, no further analysis is required for small break LOCA reactor trip. The remaining equipment used to mitigate a small break LOCA is discussed in the master list.

Discussions with the District's NSSS vendor have indicated that for small steam line breaks, low steam generator levels will be the reactor trip initiating parameter. Therefore, worksheets are included for the low steam generator level LOCA qualified transmitters.

For the MSLB, the reactor trip is initiated by Low Steam Generator Pressure which is LOCA qualified. No other reactor trips are required to be qualified.

Clutch deenergization is accomplished in the control room mild environment.

(7) The Fort Calhoun Station Safety Analysis does not take credit for the charging pump or concentrated boric acid system.

(8) The long term core cooling system is made up of components from other systems. It should be noted that hot shutdown condition is defined as safe shutdown condition for Fort Calhoun Station.

A master list has been prepared for each system, listing those components which were identified as Class 1E and which could be affected by a LOCA or a high energy line break. This completed the first step of the District's review.

II. District's Electrical Equipment Qualification "Philosophy" (Continued)

A. Basis for the Evaluation (Continued)

1. (Continued)

b. Identification of High Energy Lines

The basis for evaluation for HELB effects on Class 1E electrical components is Appendix M of the Final Safety Analysis Report. A review of the high energy lines listed in Appendix M was conducted to determine which, if any, would have an effect on plant systems and equipment. It was determined from the review that only a main steam or main feedwater line break could cause an accident condition under which plant safety systems might be challenged. HELB for any other systems listed would not require engineered safeguards systems to operate for any reason, these lines were excluded from this analysis.

After determination that main steam and main feedwater lines could cause actuation of safety systems, these lines were reviewed to determine where Class 1E equipment could be affected as a result. Two areas were subsequently identified and investigated in greater depth.

The first area is within the reactor containment itself. Since a main steam line break is of more consequence than a main feedwater line break, the main steam break was addressed. The Fort Calhoun facility is equipped with an automatic containment spray system equipped with redundant pumps, lines and spray headers. As such, it is not subject to disabling by single component failures. Therefore, in accordance with Enclosure 4 of IE Bulletin 79-01B, it has been determined that the LOCA environment will govern qualification of equipment located within the containment.

For a main steam line or main feedwater line break outside of containment, the only Category 1E electrical equipment which could be affected is located in Room 81. The effects of a main steam or feedwater line break on the environment of Room 81 are discussed in Appendix M of the Final Safety Analysis Report and in Enclosure 2 of this document. The break within Room 81, results in the "worst case environment". The analysis conducted on the components within the areas affected was thus governed by the main steam line break, with the exception of flooding.

Flooding within Room 81 is more limited for a main feedwater line break and the flood level predicted in the FSAR was utilized to analyze the components subject to possible flood damage. This completed the second step of the District's review.

II. District's Electrical Equipment Qualification "Philosophy" (Continued)

A. Basis for the Evaluation (Continued)

1. (Continued)

c. Areas Where Fluids Are Recirculated to Accomplish Long-Term Core Cooling

The areas which have been addressed for consideration of fluids from inside containment are Rooms 13, 21, 22, 59, 60, and 69. These areas were chosen since this is the only area where fluids would be recirculated following the postulated accident.

Other systems where fluids from inside the containment are normally circulated are isolated under the postulated accident conditions. The isolation valves for those systems have been reviewed for their capability to function under the environment expected.

2. Radiation Analysis - Reactor Containment

The postulated radiation environment for components located in the Fort Calhoun reactor containment are based on a specified gamma level of 1R/HR for 40 years, plus the dose received during a LOCA (see Enclosure 1). This total dose of 3×10^6 RADS was specified for the equipment used within the containment which is required to function in the accident environment. Since this dose level is less than the 2×10^7 RADS considered acceptable under Enclosure 4 of IE Bulletin 79-01B "Guidelines for Evaluating Environmental Qualifications of Class 1E Electrical Equipment in Operating Reactors", the District has performed a series of calculations to determine the expected doses.

For equipment whose geometry or location influenced dosage, special calculations were done using ISOSHLD.

For those components located below flood level, the District has calculated the expected dosage using ISOSHLD.

The shielding study and subsequent refinements performed for areas outside containment as part of NUREG-0578 were used to provide dose levels in the auxiliary building.

3. Submergence

After completion of the master list, a survey was made for the components located within the containment building to determine if they were subject to flooding.

The flood level used as the basis for this evaluation is 1000.9'. This level was arrived at by investigating all possible sources of water which could be pumped into the containment or released from systems within the containment prior to entering the recirculation mode. For conservatism, the entire contents of the Safety Injection Tanks, the Safety Injections Refueling Water Tank, and the Reactor Coolant System were assumed to be dumped into containment prior to any recirculation actuation.

The resultant flood level thus represents the entire water inventory available to mitigate the consequences of a LOCA and is considered to be a conservative number.

B. Component Qualification Philosophy

The District's "Philosophy" on Electrical Equipment Qualification stems from the manner (method) in which qualification was demonstrated. Specifically, the District's Qualifica ion Program is organized to demonstrate the listed equipment's ability to function under environmental stress (harsh environment) and have adequate margin to insure operation, and operating time.

As discussesd in Section A, "Basis for Evaluation", the FSAR was used to provide LOCA and HELB information. For evaluation of equipment plant specific environmental profiles were used as provided in the FSAR Section 14 and Appendix M. Please note, for the LOCA profile this was modified by the first SER which required the use of 305°F temperature.

The methods used to demonstrate the compliance of equipment to the above philosophy can be placed in four categories:

1. For those items where analysis indicated that qualification could not be accomplished or where testing of some type was available, but where analysis to demonstrate complete qualification could not be accomplished, a replacement to fully qualified equipment was, or is presently being, accomplished.

   The solenoid and limit switch upgrades are examples of equipment in which analysis indicated that qualification was not feasible. The Foxboro transmitters are examples of equipment which were upgraded when analysis and testing could not be combined to demonstrate qualification.

B. Component Qualification Philosophy (Continued)

2. For those items where existing test data and/or analysis could not completely qualify the equipment and there was adequate information to indicate that additional testing (coupled with analysis where applicable) could demonstrate qualification, additional testing was done or is planned to be done. The Conax penetrations and Fisher 304 limit switches are examples of this effort. Also, in the case of the 304s and 546 positioners, the components were reviewed for significant aging of materials. This was based on the DOR guideline, Table C1. No aging tables were used, as long as applications were within vendor temperature limits.

3. For those items whose existing analysis or test data was not adequate, additional analysis was performed to establish qualification in aging, chemical spray, and radiation. The component cooling water pump motors are an example of this effort.

4. For those items which have some test data but for which specific analysis is required, a system (i.e., splicing materials which are combined to form a splicing system) analysis is made to demonstrate how the system is qualified to perform the function. To date this has been performed only on the containment cooling and filtering unit ventilation fan motor splices. This type of analysis has been limited to systems which are not active in a DBA, i.e., these splices perform a protective function. This analysis was provided in the District's TER response.

To complete the qualification of any equipment covered by the EEQ Program, the following items must all be included; margin, aging, operating time, and operator presentation.

It is the District's judgement that the margin, aging or qualified life, and operating times must be reviewed as a single item. Margin is the "parameter" which demonstrates that if the equipment is exposed to a Design Basis Accident, sufficient testing stress or analysis demonstrated stress capabilities are built into the equipment such that failure would not be expected. Aging is a deteriorating characteristic which must be accounted for to insure that equipment has not deteriorated to the extent that the stresses presented in a DBA would cause failure and that assurance of post accident operation (operating time), if required, can be assured.

IE Bulletin 79-01B, Enclosure 3, "System Component Evaluation Worksheet" requires specification of the time period that the component or equipment is required to function and identification of the document which provides the basis for this time interval. Enclosure 4 of the bulletin requires that the time duration of the test should be at least as long as the period from the initiation of the accident until the temperature and pressure service conditions return to essentially the same levels that existed before the postulated accident. Additionally, Enclosure 4 stated that a shorter duration may be acceptable if specific analyses are provided to demonstrate that the materials involved will not experience significant thermal aging during the period not tested.

Supplement 2 to IE Bulletin 79-01B requires that equipment designed to perform its safety-related function within a short time into the event be qualified for a period of at least 1 hour in excess of the time assumed in the accident analysis. Also, Supplement 2 references NUREG-0578 in requiring qualification of equipment in close proximity to recirculating fluid systems inside and outside containment as a result of LOCA. This equipment is the equipment required to function in "long term" as required in Supplement 2.

As a result of the above-mentioned requirements, the District defined four levels of required qualification - 1 hour, 1000 hours (42 days), 100 days and 1 year. The 1 hour specification is applied to equipment whose safety function is completed within a few seconds after receipt of an accident signal. The 1 hour equipment was evaluated for the effects of subsequent failure on the safety systems and the potential for misleading the operator. Where subsequent failure could degrade the plant safety system status or the potential for misleading the operator existed, the level of required qualification was increased. The 1000 hour specification is applied to equipment which is required for LOCA, HELB, or safe shutdown. The equipment in this category functions during the entire DBE until the plant environments return to essentially the same levels that existed before the postulated accident (see discussion below). The 100 days is for the containment hydrogen analyzer. The 100 days are expected to be adequate to detect a containment H_2 problem and take necessary action. The long term (1 year) specification is applied to equipment which must operate for a significant amount of time after LOCA and is not accessible during the course of the accident. Long term is defined as the maximum time necessary to achieve cold shutdown. The long term specification is consistent with Supplement 2 of IE Bulletin 79-01B.

B. <u>Component Qualification Philosophy</u> (Continued)

In some instances the District did not believe a rigorous aging solution was required, as in the case of Fisher 304 limit switches which are not subjected to high temperatures or pressure, and which use materials which do not show significant aging. The only environmental stress is that of radiation for which the switch is tested; the temperature exposure is within the range the vendor feels is correct for the limit switch application. Since the material shows no significant aging and no radiation induced failures were encountered, the switches are considered qualified for forty years.

The last area of the EEQ program is that of presentation of information to the operator. This is divided into two areas, accuracy of analog information and a method to insure instrumentation which may fail does not mislead the operator into taking an improper action.

With regard to instrument accuracy, the District has performed analyses to show that although the accident stress causes inaccuracies, these should not mislead the operator, or cause actions which are detrimental to plant safety. Also, for any accident, not all transmitters are required to function, or could these be expected to give a large amount of useful information. This is defined in the analysis. For those transmitters which must initiate an automatic action in an accident, the environmental stress induced inaccuracies are accounted for.

The other area of operator interface is the quick and easy identification of valid information. The District believes that this must be presented in a way which is quickly identified and does not cause confusion. To accomplish this, orange dots have been placed on the control board name plates to identify qualified equipment. This allows the operators to conduct post-accident operation without referring to special additional instructions.

III. Qualified Life Program

The District's Qualified Life Program (QLP) is the means by which the District has implemented a system which accomplishes several aspects of an ongoing Electrical Equipment Qualification Program. These items may be characterized as, 1) qualified equipment tracing program, 2) qualification documents, 3) maintenance or refurbishment schedule to maintain qualification, 4) breakdown maintenance, and 5) future modification control.

As implemented, administrative and technical direction for the QLP resides in three documents, 1) Fort Calhoun Station Standing Orders, 2) Generating Station Engineering Manual, and 3) the Electrical Equipment Qualification Manual.

The QLP's operation is summarized in the following discussion.

First is the actual maintenance of qualification (refurbishment to account for aging). This is accomplished by the previously discussed Items 1, 2 and 3.

The District has elected to maintain a central file where, in the District's judgement, are all the test and analysis documents necessary to establish equipment qualification. These documents (tests, analyses, etc.) must be tied to field equipment to both demonstrate qualification and establish any needed refurbishment interval. This is done in the form of an Equipment Qualification Documentation Form (EQDF) in which one of these, per device, is issued.

Once necessary maintenance (or cycling)·has been identified, the refurbishment, including procedures, must be placed in the plant maintenance system. The effort is controlled by plant Standing Order.

Maintenance Procedures were written as required to refurbish. However, maximum use was made of existing plant procedures including surveillance tests, calibration procedures, and existing preventive maintenance procedures.

When refurbishment is completed, an FC-198 form is completed which updates the central file to document continued qualification. It should be noted that although such things as cycling are noted and accomplished, the central file is not updated. In many of these cases existing procedures are used.

Breakdown maintenance and equipment failure is controlled under plant Standing Orders. These controls insure compliance with 10 CFR 50.49 - spare or replacement parts - and documentation of continued qualification.

If the repair requires replacement and an upgrade to NUREG-0588 is to be done, the station modification controls (to be discussed later) are used. If a subcomponent is replaced or a one for one replacement is justified (sound reasons to the contrary) the FC-198 is used to establish continued qualification.

In order to insure future qualification of yet-to-be-installed (and unknown) modifications, it is necessary that all modifications to the station be included in the QLP if their function warrants inclusion. To accomplish this, Standing Orders have been updated to insure that equipment is included in the ongoing program. Other administrative control documents related to station modification control (GSE Manual and the EEQ Manual) serve to insure all modifications meeting the QLP criteria are treated in the same manner as the equipment originally in the QLP scope.

Update of all document files, procedures, and programs will be handled in the same manner as other document and program updates, as required by plant standing orders governing modifications.

It should be noted that the QLP documents provide guidance as to how to establish qualification, fill out necessary forms, and evaluate vendor information.

To summarize, the District's QLP accomplishes three major test tasks, 1) documents qualification, 2) actually maintains equipment in a qualified condition, and 3) accounts for future unknown modifications. The District believes this is accomplished within the guidance of 10 CFR 50.49.

IV. District Position on 10CFR50.49(b)(2)

10CFR50.49(b)(2), "Nonsafety-related electric equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified in subparagraphs (i) through (iii) of this section by the safety-related equipment."

It is the District's engineering judgement that the Fort Calhoun Station is in compliance with the requirement of 10CFR50.49(b)(2).

To insure this, the District has used a four step approach. These steps are:

1. A review of the station's 480 and 4160 volt power distribution system to insure adequate circuit protection.

2. A review of the District's response to IE Bulletin 79-22 on potential unreviewed safety questions caused by the interaction of non-safety grade and safety grade systems and IE Bulletin 79-27 on the adequacy of station instrument and control power distribution systems.

3. A review of station modifications installed since the bulletins were issued to insure no modification had been made which could cause an unreviewed safety question.

4. A review and update of the safety analysis procedure (Standing Order G-46) to insure that all modifications (including those designed prior to the issuance of 10CFR50.49) are reviewed for the effect of non-safety related failures on safety related equipment.

Based on these reviews it is the District's engineering judgement that the following statements are applicable:

1. The Fort Calhoun Station instrument and control power and three phase AC (4160V and 480V) systems are designed with proper isolation and fault clearing coordination. A fault on a non-safety related device should not affect the operation of a safety-related device.

2. There is no known failure of a non-safety related device (i.e. solenoid failure causing a valve to open) which would create an accident outside the bounds of any analyzed event.

3. No modifications have been installed which would alter the conclusions made in 1 and 2. This is based on an independent study by Stone and Webster Engineering Corporation.

4. The station modification control is adequate, the requirement for an unreviewed safety question analysis per 10CFR50.59 is required. Additional information was added regarding electrical equipment in a harsh environment.

   Based on this review it is the District's judgement that no further action is required with regards to 10CFR50.49(b)(2).

V. (b)(3) Certain Post Accident Monitoring Equipment

It is the District's judgement that post accident monitoring equipment has been adequately considered. Those items required in the Station Emergency Procedures have been identified and qualified for the required function and environment.

Final implementation of all post accident monitoring equipment will be completed in accordance with the schedule for Reg. Guide 1.97, Rev. 2, as negotiated in NUREG-0737, Supplement 1.

Any changes or upgrades to accident monitoring equipment will be implemented on a negotiated schedule.

Also included in the EEQ Program are certain components of the accident monitoring equipment installed as part of NUREG-0737.

ATTACHMENT 4

ELECTRICAL EQUIPMENT PRESENTLY
UNDERGOING QUALIFICATION TESTING

As discussed in Note 9, the District presently has underway a qualification program for the containment electrical penetrations, splices, and electrical cable. The testing is tentatively scheduled to be done in accordance with the following:

Aging	-	April 9, 1984
Short Time Overload and Short Circuit	-	April 18, 1984
Seismic	-	April 23-24, 1984
Irradiation*	-	April 27-30, 1984
LOCA*	-	May 3-21, 1984
Short Circuit*	-	May 24-28, 1984
Report Complete*	-	June 29, 1984

* Based on schedule estimate made prior to testing. Schedule has slipped with irradiation in progress the week of May 14, 1984.

ATTACHMENT 5

ENCLOSURE 9

Containment Vent Fan Motor Splices

The containment vent fan motor lead splices (VA-3A, 3B, 7C and 7D motor lead splices) are, in OPPD's engineering judgment, environmentally qualified for the adverse conditions of a LOCA. Reasons for this judgment stem from the following:

1) First, eight half-laps of Scotch Brand #70 tape are applied to the bare joint/splice. Second, eight half-laps of Bishop Brand #3 high voltage tape are applied over the splice surface. Third, the joint/splice area is then covered with eight half-laps of Scotch Brand #88 tape. Fourth, an additional two half-laps of Scotch Brand #70 tape is then applied over the general splice/joint area. Lastly, the entire splice/joint area is covered with Dow Corning RTV #3144 compound at least 1/8" thick and at least 1" beyond all applied tape. The RTV is smoothed to completely seal the splice/joint and then the RTV is allowed to cure in accordance with instructions.

2) Recent conversations with the manufacturer of Scotch Brand #70 and #88 tapes have revealed satisfactory test results were obtained for samples of the two aforementioned tapes when subjected to radiation fields in the neighborhood of 50-100 x 10^6 rads. Due to the RTV sealant, this tape will not be subjected to the pressure, moisture (100% R.H.), boric acid conditions present in a LOCA. In addition, both tapes mentioned above are capable of operating in temperatures in excess of 350°F with no subsequent damage.

3) The entire splice/joint is covered with a layer of RTV #3144 adhesive/sealant. Conversations with the manufacturer of the RTV, Dow Corning, revealed that several laboratory tests were run on the aforementioned RTV. Results of these tests revealed that the Dow Corning RTV #3144 was capable of operating in environments greater than 102 x 10^6 rads (total integrated dose) with no appreciable deficiencies. In addition, the #3144 RTV reacts with water vapor in the air to cure. Upon curing, the adhesive/sealant becomes resistant to humidity and temperatures up to 482°F over long periods of time. The RTV #3144 sealant will effectively seal off all environments from the underlying Scotch Brand tapes and the splice except for radiation. The #3144 RTV is also not adversely affected by boric acid solutions in excess of 5%.

<u>Containment Vent Fan Motor Splices</u>
(Continued)

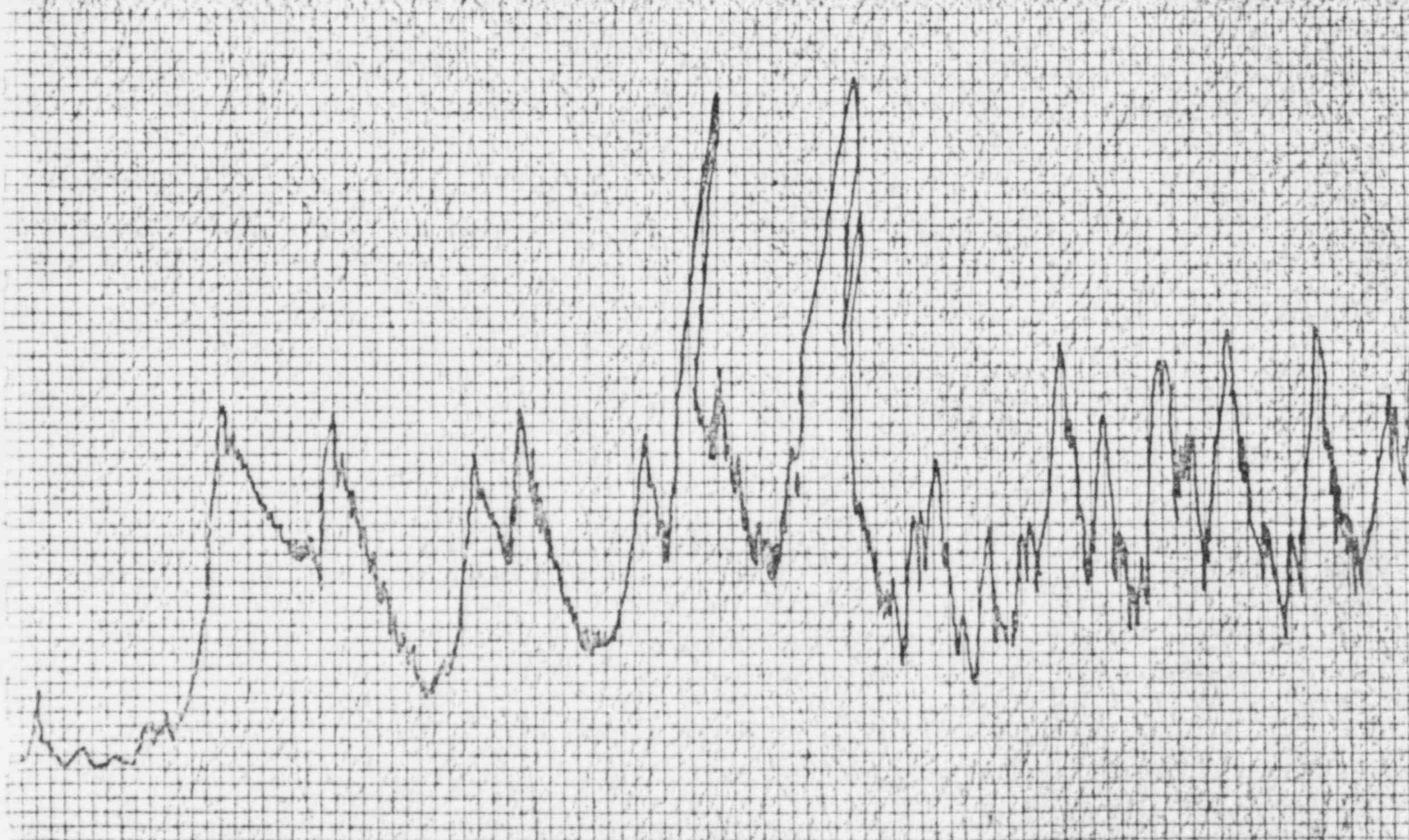
3) (Continued)

Further evidence of Dow Corning #3144 RTV sealant/adhesive's ability to stand up to the adverse conditions of a LOCA is documented by the Fisher Controls Company valve actuator tests. In these tests, Dow Corning #3144 adhesive/sealant was used to cover all bare terminations. Results of the tests provided evidence that throughout the simulated LOCA environment no termination covered with #3144 RTV was found to be shorted or damaged. Test parameters included temperatures in excess of 288°F, pressure in excess of 60 psig, and a 100% saturated steam environment.

No credit is taken for the Bishop #3 high voltage tape.

ATTACHMENT 6

WYLE LABORATORIES
SCIENTIFIC SERVICES AND SYSTEMS GROUP
WESTERN OPERATIONS, NORCO FACILITY
1841 HILLSIDE AVENUE, NORCO, CALIF. 91760



engineering REPORT

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ENGINEERING REPORT

Wyle Report No. 26333-26

Wyle Job No. 26333-26

Customer P.O. No. 50843

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Date: 25 June, 1982

ENVIRONMENTAL QUALIFICATION EVALUATION

OF

CABLE SPLICES

INSIDE CONTAINMENT

FOR OMAHA PUBLIC POWER DISTRICT

FOR USE IN

FORT CALHOUN NUCLEAR GENERATING STATION, UNIT 1

PREPARED BY: [signature]

VERIFIED BY: [signature]

APPROVED BY: C E Richardson

QUALITY ASSURANCE: L Houstead

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1.0 SCOPE

This document was prepared by Wyle Laboratories for Omaha Public Power District (The District) for safety-related cable splices installed inside containment at Fort Calhoun Nuclear Generating Station, Unit 1.

1.1 Objective

The purpose of this report is to present an environmental qualification evaluation in accordance with the requirements of IE Bulletin 79-01B, including an aging analysis of six types of cable splices for safety-related electrical equipments inside containment.

1.2 Applicable Qualification Standards, Specifications, and Documents

- Wyle Laboratories Western Test and Engineering Quality Assurance Manual 380, dated June 1, 1981

- IE Bulletin No. 79-01B, Enclosure 4, "Guidelines for Environmental Qualification of Class IE Electrical Equipment in Operating Reactors," January 14, 1980.

- IE Supplement No. 2 to Bulletin 79-01B, "Environmental Qualification of Class IE Equipment," September 30, 1980.

1.0 SCOPE (CONTINUED)

1.3 Equipment Description

The subject equipment consists of the six types of cable splices listed below for six electrical cable size and multiple conductor combinations (Table 1). For details see Tables 2 and 3 and Figure 1.

1) Cable Splices at Transmitters

2) Cable Splices at the 480 V Containment Vent Fan Motor Lead Wires

3) The 480 V Containment Vent Fan Motor Splices at the Electrical Penetrations

4) Original Plant Cable Splices at Electrical Penetrations

5) TMI Modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N)

6) Cable Splices at Solenoid Valves

1.4 Safety-Related Functions

The specific safety-related functions of the cable splice components are described in the following paragraphs:

- Cable Splice: provides the electrical paths for safety-related electrical circuits.
- Insulation: provides the necessary electrical isolation to eliminate unwanted electrical paths.
- Heat Shrink Tubing: provides a vapor and liquid (chemical) seal covering the insulation of the cable and connectors. For certain splices, heat shrink tubing is also insulation.
- RTV Silicone Rubber: provides a vapor and liquid (chemical) barrier over the heat shrink tubing of the cable splice.

2.0 DEFINITION OF SERVICE CONDITIONS

The following environmental service conditions have been specified by the District[20,29,30]:

		Normal	FSAR Design Basis Event (DBE*)
o	Temperature	84F(29C)	305F(152C) Maximum **
o	Relative Humidity	90 ± 5%	100%
o	Pressure	Atmospheric	60 Psig Maximum
o	Chemical Spray	N/A	Boric Acid Solution (2500 ppm Boron)
o	Radiation	3.42×10^5	1.12×10^6 to 3.0×10^7 Rads, gamma, depending on the location (see Table 3)***
o	Time:		
	a) Transmitters	Continuous	Continuous
	b) Solenoid	Intermittent	Note 1
	c) Containment Vent Fan	Intermittent	Continuous
	d) Cable	Continuous	Continuous

Temperature and pressure profiles are given in Figures 2 and 3

* The DBE is a loss of coolant accident (LOCA).

** This is Main Steam Line Break (MSLB) temperature, used in lieu of lower 288F LOCA temperature per SER Section 3.3 Response[30].

*** This is the total calculated integrated dose for 40 years plus accident[28].

NOTE 1 After the first few seconds into a DBE situation, all the solenoids in containment move to their fail positions with the exception of the following:

The Long Term Core Cooling Solenoids (238, 239, 240) are required to operate in a DBE situation.

The Reactor Coolant Solenoid (HCV-438 A & C) moves to its fail position which is the open position, and is driven closed in a DBE.

The Auxiliary Feedwater (HCV-1107A, 1108A) move to their fail position which is their open position, and are driven closed in a DBE.

Charcoal Spray may operate intermittently in a DBE, HCV-864, 865.

Purge system, HCV-881 and 882, move to their fail position which is their open position and are driven closed in a DBE.

3.0 AGING EVALUATION CRITERIA

The following sequence of steps were used to evaluate the non-metallic materials in each splice with respect to thei: safety-related functions under normal and Design Basis Event (DBE) conditons.

3.1 Evaluation of Susceptibility to Radiation Degradation

The approach for evaluating the components for their radiation resistance is a four step process:

1. Review the individual materials of construction as provided on the contract specific materials list.
2. Research Wyle Laboratories Aging Library for information on threshold levels, severe damage levels, degradation characteristics, and failure criteria.
3. List threshold level for radiation damage in the aging matrix.
4. Evaluate the item based on potential degradation and ability to perform its design function after exposure to the specified radiation dose.

It is generally recognized that metallic and inorganic materials are immune to radiation degradation at the specified dose, hence, the evaluation is focused on the non-metallic (organic) materials.

3.2 Evaluation of Susceptibility to Time/Temperature Related Mechanisms

Deterioration due to thermal aging is insignificant for metallic and inorganic materials under the specified environmental conditions. Therefore, component aging is based on the non-metallic (organic) materials.

For many organic materials, it is known that the degradation process can be defined by a single temperature-dependent reaction that follows the Arrhenius equation:

$$k = A \exp(-(Ea/k_b T)) \quad (1)$$

where,

- k = reaction rate
- A = frequency factor
- exp = exponent to base e
- Ea = activation energy (eV)
- k_b = Boltzmann's Constant (8.617×10^{-5} eV/^{o}K)
- T = absolute temperature (^{o}K)

3.0 AGING EVALUATION CRITERIA (CONTINUED)

3.2 Evaluation of Susceptibility to Time/Temperature Related Mechanisms (Cont'd)

It is further noted that, for many reactions, the activation energy can be considered to be constant over the applicable temperature range. Equation (1) can be transformed into a slope-intercept form of a linear equation which yields the expected life:

$$\ln(\text{life}) = (Ea/k_B)(1/T) + \text{Constant} \quad (2)$$

Since the materials follow an Arrhenius relationship, the requirement at one time and temperature can be transferred to another set of time/temperature coordinates using the relationship

$$t_1 = t_2 \exp((E_a/k_B)(1/T_1 - 1/T_2)) \quad (3)$$

where,

t_1 = Calculated life at temperature T_1
t_2 = Expected life at T_2 (Equation 2) -120
T_1 = Accident temperature (max)
T_2 = Normal service temperature

When the expected life obtained from equation(2) at the normal service temperature (84F) exceeds the specified service life (40 years) by a conservative factor of three, equation (3) is used to calculate the equivalent life at the accident temperature from the expected life minus 120 years. The factor of three is used for conservatism to account for uncertainties such as variations in the postulated temperatures and durations.

This will demonstrate life in excess of the normal service condition (conservatively estimated to be 120 years) and provide a mechanism for comparing the remaining life of a material at the accident temperature with the postulated accident duration.

For example for Polyolefin, with a degradation parameter of 86% loss of electrical strength (Table 3, item No. 1):

Normal calculated life = $\exp((E_a/k_B)(1/T) + (\text{Intercept}))$
where, E_a = 0.86 eV
Intercept = -15.04707

For a baseline temperature of 84F (29C) (normal service condition)

$T = 29C + 273 = 302K$

$\text{life} = \exp((9980.2716)(1/302) - 15.04707)$

$\text{life} = 6.56 \times 10^7$ hours (7,496 years)

3.0 AGING EVALUATION CRITERIA (CONTINUED)

3.2 Evaluation of Susceptibility to Time/Temperature Related Mechanisms (Cont'd)

Then 7,496 years - 120 years = 7,376 years

For an accident temperature of 305F (152C) (accident service condition)

$t_1 = t_2 \exp((\text{slope})(1/T_1 - 1/T_2))$

t_1 = equivalent calculated accident life at 305F

t_2 = 7,376 years

T_1 = 152C + 273 = 425K

T_2 = 29C + 273 = 302K

then

t_1 = (7,376 years x 365 days/year) exp ((9980.2716) (1/425 - 1/362))

t_1 = 189 days

Based on the above calculation, it is demonstrated:

a) Calculated normal life of 120 years at 84F (29C)
b) Calculated accident life of 189 days at 305F (152C) in addition to 120 years normal life.

If the calculated life at the normal operating temperature does not exceed the service life (40 years) by a multiple of 3, then a case by case analysis will be carried out.

4.0 EVALUATION

4.1 Aging

An aging analysis was done to determine the susceptibility to time/temperature and radiation related mechanisms.

Damage levels and calculated lives for normal operation and DBE conditions were determined solely on the individual effects of radiation and time/temperature related mechanisms.

Contract specific materials lists were provided by The District for the purpose of evaluation.

4.1.1 TIME/TEMPERATURE EFFECTS

The Aging Matrix (Table 3) contains a list of the non-metallic materials used in each splice, the data used in this evaluation, and the calculated lives (normal and accident) for each of the splices.

A review of calculated lives, normal and accident, (Table 3) indicates insignificant thermal aging at the specified normal and accident environmental temperatures. Certainly, calculated expected life is only a theoretical life, but it demonstrates that each material will have a qualified life, for a normal service, of greater than 40 years, plus accident and post accident life.

4.1.2 RADIATION EFFECTS

4.1.2.1 Gamma Radiation Effects

The threshold levels for radiation induced damage were determined per section 3.1. The radiation threshold level of each material was compared to the required dose specified in Table 3. Where the radiation threshold level of a material is greater than the required dose by a margin of +25%, or test data exists where test conditions envelop the required dose, the effects of radiation exposure were judged to be insignificant.

A review of Table 3 indicates insignificant radiation aging.

4.1.2.2 Beta Radiation Effects

The following analysis is based on the methodology presented in the DOR Guidelines.

4.0 EVALUATION (CONTINUED)

4.1 **Aging** (Cont'd)

4.1.2.2 Beta Radiation Effects (Cont'd)

The beta dose is reduced by a factor of ten within 30 mils of the surface of electrical cable insulation. An additional 40 mils (for a total of 70 mils) results in another factor of ten reduction in dose. Any structures or other equipment in the vicinity of the equipment of interest would act as shielding to further reduce beta doses.

If the plant specific beta radiation dose is not available, the generic dose of 2×10^8 rads could be used.

It can be shown, by assuming a conservative unshielded surface beta dose of 2.0×10^8 rads and considering the shielding factors discussed above, that the beta dose to radiation sensitive equipment internals would be less than or equal to 10% of the total gamma dose to which an item of equipment has been qualified. Then that equipment may be considered qualified for the total radiation environment (gamma plus beta). If this criterion is not satisfied the radiation service condition should be determined by the sum of the gamma and beta doses.

4.1.2.2.1 Cable Splices at Transmitters

These cables splices are located inside conduits which shield them from beta radiation. Therefore, the effects of beta radiation would be insignificant.

4.1.2.2.2 Cable Splices at the 480 V Containment Vent Fan Motor Lead Wires.

These cable splices are located inside terminal boxes[20] and covered with RTV 3145 which shield them from beta radiation. Therefore, the effects of beta radiation would be insignificant.

4.1.2.2.3 The 480V Containment Vent Fan Motor Lead Splices at the Electrical Penetration

These cable splices are exempted from the effect of beta radiation because of the R.T.V. covering. Since the R.T.V is about 1/8 inch thick[2] (125 mils), the beta dose is reduced by a factor of 1000. The beta dose is then 2×10^5 rads. This beta dose is less than ten percent of the gamma dose and the effects of beta radiation are considered insignificant.

4.1.2.2.4 Original Plant Cable Splices at Electrical Penetrations

The effects of beta radiation are considered insignificant due to the RTV coating as in 4.1.2.2.3.

4.0 EVALUATION (CONTINUED)

4.1.2.2.5 TMI Modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N)

The effects of beta radiation are considered insignificant because this cable splice was tested to gamma radiation of 2.0×10^8 (Ref. 3), which is greater than the total integrated gamma plus beta dose.

4.1.2.2.6 Cable Splices at Solenoid Valves

These cable splices are located inside condulets[20] which shield them from beta radiation. Therefore, the effects of beta radiation would be insignificant.

4.2 Relative Humidity Effects

Relative humidity is not considered a significant aging mechanism for the subject splices.

For insulation systems, humidity is usually not the primary failure mechanism. As noted in Reference 25, with respect to motor insulations, "In most cases, moisture plays only a secondary role in the failure. It does not produce the damage in the insulation. The insulation wears away or cracks for other reasons. Moisture merely provides a direct electrical pathway between these matured devices and ground." Therefore, effect of humidity was considered insignificant for this application.

In addition to the above it is judged that the combination of high temperature/pressure steam and chemical spray is a more severe environment than 100% relative humidity. Original Plant Cable Splices at the Electrical Penetrations and TMI Modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N) were subjected, without failure, to a LOCA test (high temperature/pressure steam) with chemical spray environments. Therefore, immunity to relative humidity was demonstrated by more severe test conditions.

For the Cable Splices at the Transmitters, Cable Splices at the 480 V Containment Vent Fan Motor Lead Wires and the 480 V Containment Vent Fan Motor Splices at the Electrical Penetrations, the RTV coating provides an excellent seal over the splice thus causing the effects of humidity to be insignificant.

The splices at Solenoid Valves are double Pentube heat shrink tubing and are located inside a condulet system[20]. Therefore, the effects of humidity are considered insignificant.

4.0 EVALUATION (CONTINUED)

4.3 Design Basis Event (DBE)

The DBE is a Loss of Coolant Accident (LOCA).

Each splice was evaluated for the following LOCA environments:

1. Thermal Aging
2. Radiation Aging
3. Temperature
4. Pressure
5. Chemical Spray
6. Relative Humidity
7. Submergence

A summary of these evaluations is given in Tables 4 through 9.

4.3.1 THERMAL AGING

Based on the evaluation presented in Section 4.1, the effects of thermal aging during a LOCA are insignificant.

4.3.2 RADIATION AGING

Each cable splice was evaluated for the total integrated dose plus accident (LOCA), Section 4.1.2.

Based on the evaluation presented in section 4.1.2, the effects of radiation aging during a LOCA are insignificant.

TMI modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N), and Original Plant Cable Splices at Electrical Penetrations interface with teflon insulated cables. The effects of 1.12×10^6 (Table 8) and 1.36×10^7 (Table 7) rads gamma respectively on teflon must be addressed by test because the Raychem test[3] and Franklin Institute[(1)] tests were conducted without teflon insulated cables.

Because of the high radiation level, a test, in lieu of analysis, must be used to demonstrate qualification of the interface.

4.0 EVALUATION (CONTINUED)

4.3 Design Basis Event (DBE) (Cont'd)

4.3.3 TEMPERATURE

Figure 4 shows the SER Section 3.3 response 305F temperature profile. The shaded area is the MSLB 305F temperature profile, in excess of peak LOCA temperature. The estimated duration of this hypothetical condition will not be greater than 5 minutes.

A review of calculated lives for the materials used in each type of cable splice showed that each individual material is capable of withstanding 305F far longer than 5 minutes as shown in Table 3.

4.3.3.1 Cable Splices at Transmitters

As indicated in Section 4.3.5.1, these splices are covered with a LOCA qualified Dow Corning 3145 RTV adhesive/sealant[4]. This RTV has good dielectric properties over a wide temperature range and will withstand long term exposure at 482F (250C)[27].

The sealant will also withstand steam (to 200C) and has withstood a 100,000 hour aging test at 200C[4]. Dow Corning has reported "Steam at 245F could, in time, soften Dow Corning 3145, but 20 minutes would be considered a minor exposure"[4]. Because the exposure to high temperature is for only a short time, there should be no adverse effects on the Dow Corning 3145 RTV.

4.3.3.2 Cable Splices at the 480V Containment Vent Fan Motor Lead Wires

Dow Corning 3144 RTV adhesive/sealant's ability to stand up to the adverse conditions of a LOCA is documented by the Fisher Controls Company valve actuator tests[7]. Test parameters included temperatures in excess of 288F, pressure in excess of 60 psig, and a 100% saturated steam environment.

Furthermore, 3144 RTV will withstand long term exposure at 250C (482F)[27].

It is concluded that the short time exposure at high temperature will not have an adverse effect on this splice.

4.3.3.3 The 480V Containment Vent Fan, Motor Lead Splices at the Electrical Penetrations

This cable splice will withstand the short time exposure of 305F per analysis presented in section 4.3.3.1 above.

4.0 EVALUATION (CONTINUED)

4.3 Design Basis Event (DBE) (Cont'd)

4.3.3.4 Original Plant Cable Splices at Electrical Penetrations

Figure 4 includes the Franklin Test estimated average temperature of 297F. The 17F increase (305F-288F) over the calculated LOCA temperature curve is plotted as the SER Section 3.3 MSLB Temperature Curve. By inspection, it can be seen that the amount of heat added during testing was significantly greater than that required by the hypothetical SER Section 3.3, MSLB Temperature Curve (LOCA curve plus 17F). Note the logrithmatic scale and that Area B is a major increase over Area A. Therefore, the Franklin Tests are judged to be conservative compared to the DBE temperature profile with its 305F imposed peak temperature.

Some test temperatures reached 302F while others were as low as 295F. This represents a range of undershoot from 3 to 8 degrees. Since the SER Section 3.3, use of 305F was established for the upper regions of the containment, and the electrical penetation splices are in the lower-middle elevations, the 3 to 8 degree difference for about 52 seconds can be taken into account by establishing the materials capability to withstand higher temperatures.

The material evaluation in Section 4.3.1 and 4.3.3.1 shows the capability to withstand 305F temperatures so materials in the splice should withstand a short exposure at 305F.

4.3.3.5 TMI Modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N)

These splices have been tested to temperatures up to 390F which exceeds the required temperature by 85F[3].

4.3.3.6 Cable Splices at Solenoid Valves

The material evaluation in Section 4.3.1 and 4.3.3.1 shows the capability to withstand 305F temperatures so materials in the splice should withstand a short exposure at 305F.

4.3.4 PRESSURE

No accident pressure test data exists for the cables splices listed below:

a) Cable Splices at Transmitters

b) Cables Splices at the 480V Containment Vent Fan Motor Lead Wires

c) The 480V Containment Vent Fan Motor Splices at the Electrical Penetrations

d) Cables Splices at Solenoid Valves

4.0 EVALUATION (CONTINUED)

4.3 Design Basis Event (DBE) (Cont'd)

4.3.4 PRESSURE (Cont'd)

The effects of pressure are significant when chemical spray is present to cause shorting of the conductors due to voids or poor adhesive properties of the splice. The splice construction technique should minimize the possibility of voids. RTV alone exhibits excellent adhesive properties[4,7].

Original plant Cable Splices at Electrical Penetrations and TMI Modification at Containment Penetration Lead Wire Splices have been tested for a LOCA condition with a pressure equal or greater than 60 psig[1,3].

4.3.5 CHEMICAL SPRAY

4.3.5.1 Cable Splices at Transmitters

These splices are potted with Dow Corning RTV 3145 adhesive/sealant[4]. The sealant will withstand steam up to 392F (200C), and chemical spray for the DBE conditions specified in section 2.2.

Each cable splice is sealed in a condulet which prevents chemical spray from getting to the splices[20].

A chemical spray environment during a LOCA should be insignificant.

4.3.5.2 Cable Splices at the 480V Containment Vent Fan Motor Lead Wires

These splices are covered with Dow Corning RTV 3144 adhesive/sealant. Due to the RTV sealant, the splice system will not be subjected to chemical spray during a LOCA (Ref. 7).

The RTV 3144 sealant will effectively seal off all environments from the underlying Scotch brand tapes and the splice, except for radiation. The RTV 3144 also is not adversely affected by boric acid solutions in excess of 5%[7].

These splices are contained within a sealed NEMA conduit and terminal box system[20]. The physical layout of the conduit is such that chemical spray would have to travel against the direction of gravity inside the conduit to reach the splices during the 2 to 3 hours operating time requirement[20].

The effects of a chemical spray environment during a 2 to 3 hour LOCA should be insignificant.

4.0 EVALUATION (CONTINUED)

4.3.5.3 The 480V Containment Vent Fan Motor Splices at the Electrical Penetrations

These splices use G.E. RTV silicone to seal the final end tabs of the Irrasil tape. A layer of Scotch #33 tape is installed over the entire splice. An investigation of this splice indicates that its composition would allow it to withstand the effects of chemical spray during a LOCA[5].

The SPT has an outstanding resistance to steam and hot water[5]. It also has excellent resistance to acids. The silicone tape and RTV both exhibit good, high-temperature characteristics and chemical resistance.

To insure operability of the splice, the splices are coated with Dow Corning RTV 3145 adhesive/sealant[4]. This mitigates the chemical spray from attacking the splice. Therefore, the effects of chemical spray environment during a 2 to 3 hour LOCA should be insignificant.

4.3.5.4 Original Plant Cable Splices at Electrical Penetrations

The effects of chemical spray environment during the LOCA should be insignificant per Section 4.3.5.1 above.

4.3.5.5 TMI Modification at Containment Penetration Lead Wire Splices (Raychem WCSF-N)

These splices are LOCA qualified per Wyle Report No. 58442-1[3].

The tested chemical spray consisted of 6200 ppm of boron, 50 ppm of hydrazine buffered to a pH of 10.5 with trisodium phosphate.

The test conditions far exceed the required plant conditions specified in Section 2.2.

4.3.5.6 Cable Splices at Solenoid Valves

These cable splices are covered with double heatshrink tubing and are contained within a sealed NEMA condulet and conduit system[20]. The physical layout of the conduit is such that chemical spray would have to travel against the direction of gravity inside a conduit to reach the splices during the LOCA which prevents chemical spray from getting to the splice.

4.3.6 RELATIVE HUMIDITY

Based on the evaluation presented in Section 4.2, the effects of relative humidity during a LOCA are insignificant.

4.0 EVALUATION (CONTINUED)

4.3.7 SUBMERGENCE

As reported by The District, the cable splices are above flood level (SCEW Sheets p. 5-49 through 5-52), therefore no effects of submergence are considered in this report.

4.4 In-Containment Inspection

On November 5 and 6, 1981, an inspection of splices was performed for the purpose of the "as constructed" splices at Fort Calhoun[8]. The District's Licensing Action Log, Item 00266, commitment to perform the inspection during the 1981 refueling outage was completed. The significant results of the District's and Wyle's in-containment inspection are as follows:

Original Plant Cable Splices at Electrical Penetration

The inspection of a splice after disassembly verified that the pertinent design data of the "as constructed" equipment conforms to document FSK-E-329, Sheet 3, the Fort Calhoun Construction Inspection Data Report (CIDR) of 1973 and the test specimen description of Test Report F-C3348[8]. The pertinent design data which was selected to verify the assumptions of Wyle Preliminary Report[9] include, but are not limited to the following:

1. Double heat shrink tubing over butt splice
2. Drain wire has boot and associated splice in double heat shrink
3. Relative spacing betw[illegible] butt splices
4. Materials
   a. RTV
   b. GE Irrathene
   c. Scotch 33

In addition, subsequent discussions with the District's Field Maintenance Electricians on November 5, 1981, pointed out that the materials of Items 4a, b, c, were recognizable and identifiable as the proper materials. These District personnel participated in construction and start up of Fort Calhoun.

The first purpose of the cable splice disassembly was to ensure continued plant operation by demonstrating that assumptions 2, 3, 4, and 5 of Reference 9 regarding the penetration lead wires were met. Specifically, the "as constructed" penetration lead wire splices were similar to those used in the April, 1972 Franklin Institute Test, Report F-C3348, by having two layers of heat shrink over each butt splice in lieu of one layer (including the drain wire), and the drain wire had a boot of heat shrink over it. The second purpose was to gather sufficient data to assist in the evaluation/verification of the cable splice similarity analysis (tested specimens versus installed splices) of assumption 1 of Reference 9.

4.0 EVALUATION (CONTINUED)

4.5 Test Specimens Similarity Evaluation

Industry experience regarding cable splice qualification, suggests that the multiconductor cable splice is the limiting case. The sealing or pressure boundary function of keeping liquid/chemical spray out of the conductor area is more difficult to obtain for a multiconductor splice than for a single conductor or lesser number of conductors splice.

4.6 Evaluation Summary

See Tables 4 through 9 for details.

Effects of LOCA environment are considered negligible for Cable Splices at the Solenoid Valves for a one minute LOCA operating time requirement. However, the District must take exception to the one hour margin criterion of the DOR Guideline. Otherwise a test or replacement must be considered. Material analysis shows no adverse effects. Also, the solenoids fail in a safe position. Accordingly, continued plant operation is justified, and if the one hour criterion with the requirement for accident test data is envoked, then a test or replacement program must be considered.

For the Cable Splice at the Transmitter taking into account the single heat shrink tube potted with RTV inside an enclosed condulet, the LOCA operational time requirement of 1000 hours and the material analysis shows no adverse effects. Continued plant operation is justified. As no accident test data is available, a test or replacement program must be considered.

TMI Modification at Containment Penetration Lead Wire Splices, Raychem WCSF-N, meet IEEE-323-1974. The Original Plant Cable Splices at Electrical Penetrations meet the DOR Guidelines by a combination test and analysis. However, because neither was tested with Teflon insulated cable, a test program is needed to demonstrate qualification for the Teflon interface at the levels indicated in Tables 7 and 8.

Cable Splices at the 480V Containment Vent Fan Motor Lead Wires and the 480V Containment Vent Fan Motor Splices at the Electrical Penetrations evaluation shows good use of RTV to seal the splices. The material analysis shows that the individual splice components have no adverse effects from normal and accident conditions and continued plant operation is justified. As no accident test data exists, a test plan or replacement is needed.

5.0 CONCLUSIONS

1. Based upon the inspection at Fort Calhoun and the engineering evaluation done to date, it has been determined that insufficient accident test data is available to support full qualification in strict accordance with DOR Guidelines of IE Bulletin 79-01B for the cable splices listed below. The specific deficiency is lack of accident test data on the splice.

   a) Cable Splices at the 480V Containment Vent Fan Motor Lead Wires (LER 80-007)

   b) The 480V Containment Vent Fan Motor Splices at the Electrical Penetrations (LER 80-007)

   c) Cable Splices at Solenoid Valves except for HCV-238, 239, and 240)

   d) Cable Splices at Transmitters (LER 80-006)

   As presented in Section 4.0 above, from an engineering and analysis point of view, the above splices are capable of safe operation before, during, and after a LOCA for the time period required to operate. Therefore continued operation is justified.

2. Original Plant Cable Splices at containment penetration using original plant double heat shrink splices tested per April, 1972 Franklin Institute Test Report F-C3348[1] are qualified except for interface with teflon insulated cable which must be tested.

3. Containment penetration lead wire splices using Raychem splices are qualified per May, 1980, Wyle Test Report No. 58442-1[3], except for the interface with Teflon insulated cable which must be tested.

REFERENCES

1. Qualification Tests of Cable Splices Under Simulated Reactor Containment Service Conditions, Franklin Institute Final Report F-C3348, dated April 1972.

2. Fort Calhoun File No. FC-643-80, dated 6 June , 1980.

3. Environmental Qualification Test Report of Raychem WCSF-N nuclear in-line cable splice assemblies for Raychem Corporation, Menlo Park, California, Wyle Report No. 58447-1, dated 15 May, 1980.

4. Dow Corning letter dated March 24, 1980; Subject: Dow Corning 3145 RTV and adhesive/sealant integrity.

5. LER 80-007, Fort Calhoun Station, Unit 1, Docket No. 05000285, attachment No. 1.

6. Standard Handbook for Electrical Engineers, Tenth Edition.

7. Enclosure 9, Containment Fan Cooler Motor Splices. Omaha Public Power District, Fort Calhoun Station, Unit 1, Electrical Equipments Evaluation Report.

8. Wyle Quality Inspection Record by E.J. Gerloff; subject: Penetration Splice, dated November 11, 1981.

9. Wyle Report, 26333-02; subject: Preliminary Assessment Report on Cable Splices Inside Containment for Fort Calhoun Station, Unit 1, dated January 29, 1981.

10. Enclosure 8, Material Analysis of Containment Penetration Cable Splices for Radiation Effects. for Fort Calhoun Station, Unit 1, Electrical Equipments Evaluation Report.

11. Fort Calhoun Station, Unit 1, File No. 11405-E-150, 151, Cable and Conduit Schedule, Fort Calhoun.

12. "Raychem Flamtrol - Qualification to IEEE Standard 383," Library Code 281-80A

13. "Report on the Effect of Radiation on Electrical Insulating Materials," C. L. Hanks and D. J. Hamman, REIC Report No. 46, June, 1969, Battelle Memorial Institute, Library Code 299-80

14. "Thermal Aging Program for U.L. Recognition," T. C. Hampton, Dow Corning, Library Code 465-81

15. "The Effect of Nuclear Radiation on Elastomeric and Plastic Materials," R. W. King, et. al., Battelle Radiation Effects Center, REIC Report No. 21, September 1, 1961, Library Code 286-80

16. Thermal Life Data for CC 2115, 2116 Silicone Rubber Wire Insulation, Continental Wire and Cable Company, June 30, 1978, Lbirary Code 387-80A

REFERENCES (CONTINUED)

17. Varflex Corporation, U.L. File No. E63450 (Varflo Sleeving), January 17, 1979, Library Code 446-81.

18. "Wires and Cords for Original Equipment Manufacturers," General Electric Company, No. WCC-., Library Code 185-79A

19. "Raychem Corporation WCSF Thermal Aging Data," EDR-2001, Library Code 360-80

20. Omaha Public Power District, letter dated March 2, 1982. Subject: Operational time requirement of Safety Related Equipment Inside Containment; NEMA rating of Condulets at Pressure Transmitter and Solenoids and Terminal Box at Containment Vent Fan Motor, and Composition of Chemical Spray.

21. Radiation Resistance of Bishop Materials, Physical and Electrical Properties for Bishop #3 tape provided by George Foote, Manager, Inside Sales. Bishop Electric, Cedar Grove, NJ.

22. "Wires and Cords for Electrical Appliance and Equipment Manufacturers", General Electric Company, Library Code 185-79A.

23. "Insulations and Jackets for Control and Power Cables in Thermal Reactor Nuclear Generating Stations," Robert B. Blodgett and Robert G. Fisher, IEEE Transactions on Power Apparatus and Systems, Vol. PAS-88, No. 5, May, 1969, Library Code 226-79A

24. Fort Calhoun File No. FC-765-2617, dated May 18, 1972, "Insulation of "E" Cable Connection", Drawing No. XA-545-E462.

25. Industrial Motor Users Handbook of Insulation for Rewinds, L.J. Rejda and Kris Neville, Elsevier, 1977, Wyle Library Code 255-80.

26. Telecon of S. Gharakhanian, Wyle Laboratories, Norco, Ca., and George Congdon (Inside Sales), Dow Corning Corporation, Midland, Michigan, January 14, 1982. Subject: RTV 3144.

27. Information about Silicone Elastomers, 3145 RTV, Dow Corning Corporation, Form No. 61-34913-80.

28. Enclosure 11, Expected Radiation Dose Levels In-Containment Omaha Public Power District, Fort Calhoun Station, Unit 1, Electrical Equipments Evaluation Report.

29. Telecon of Jim Thompson, Wyle Laboratories, Norco, Ca., and Mike Capella, Omaha Public Power District, Omaha, Nebraska, April 21, 1982. Subject: Containment Temperatures for Fort Calhoun Nuclear Generating Station, Unit 1.

30. Omaha Public Power District, Fort Calhoun Station, Unit 1, Electrical Equipment Qualification Report, SER Section 3.4, Enclosure 1, Enclosure 6 (pages 6-49 through 6-52) and Enclosure 12.

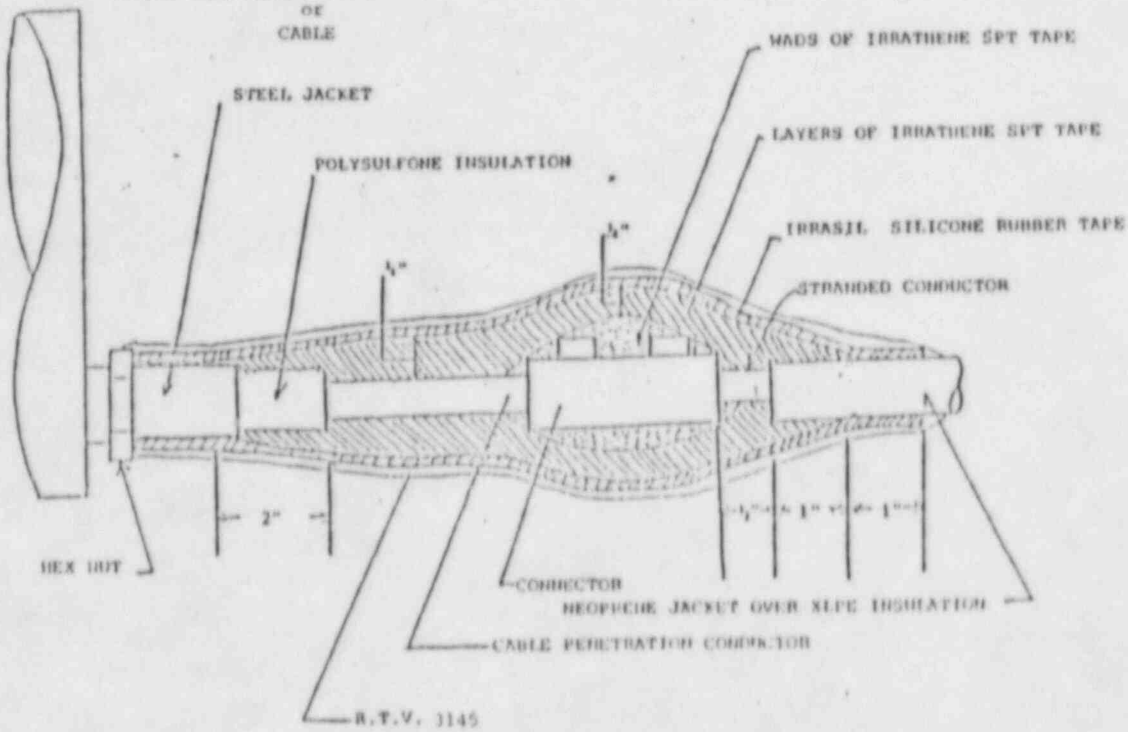

FIGURE 1

INSULATION OF "E" CABLE CONNECTIONS
FOR
CONTAINMENT VENT FAN

FIGURE 1*

INSULATION OF "E" CABLE CONNECTIONS

*Reference 24

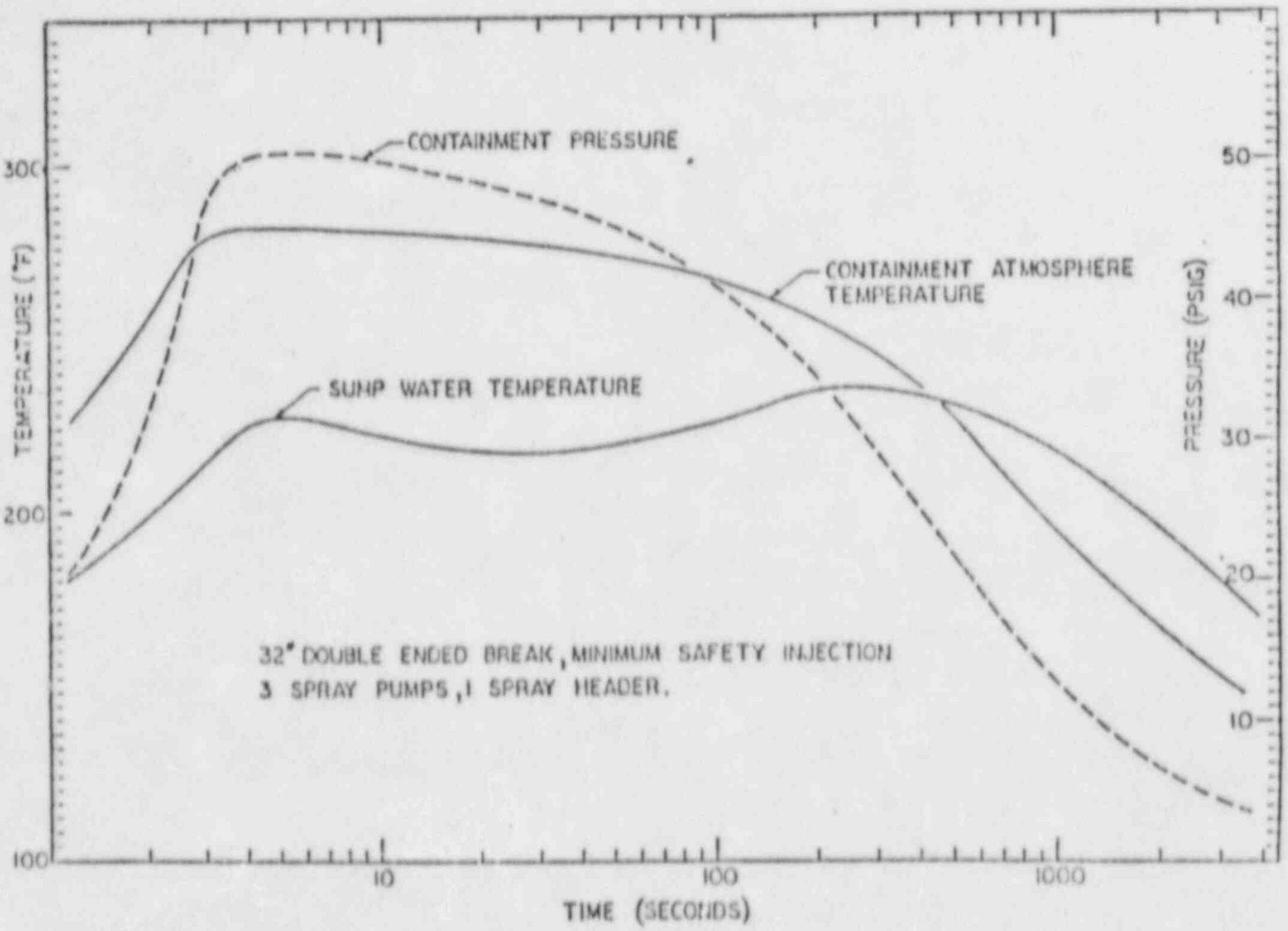

FIGURE 2

CONTAINMENT TEMPERATURES
FOLLOWING LOCA

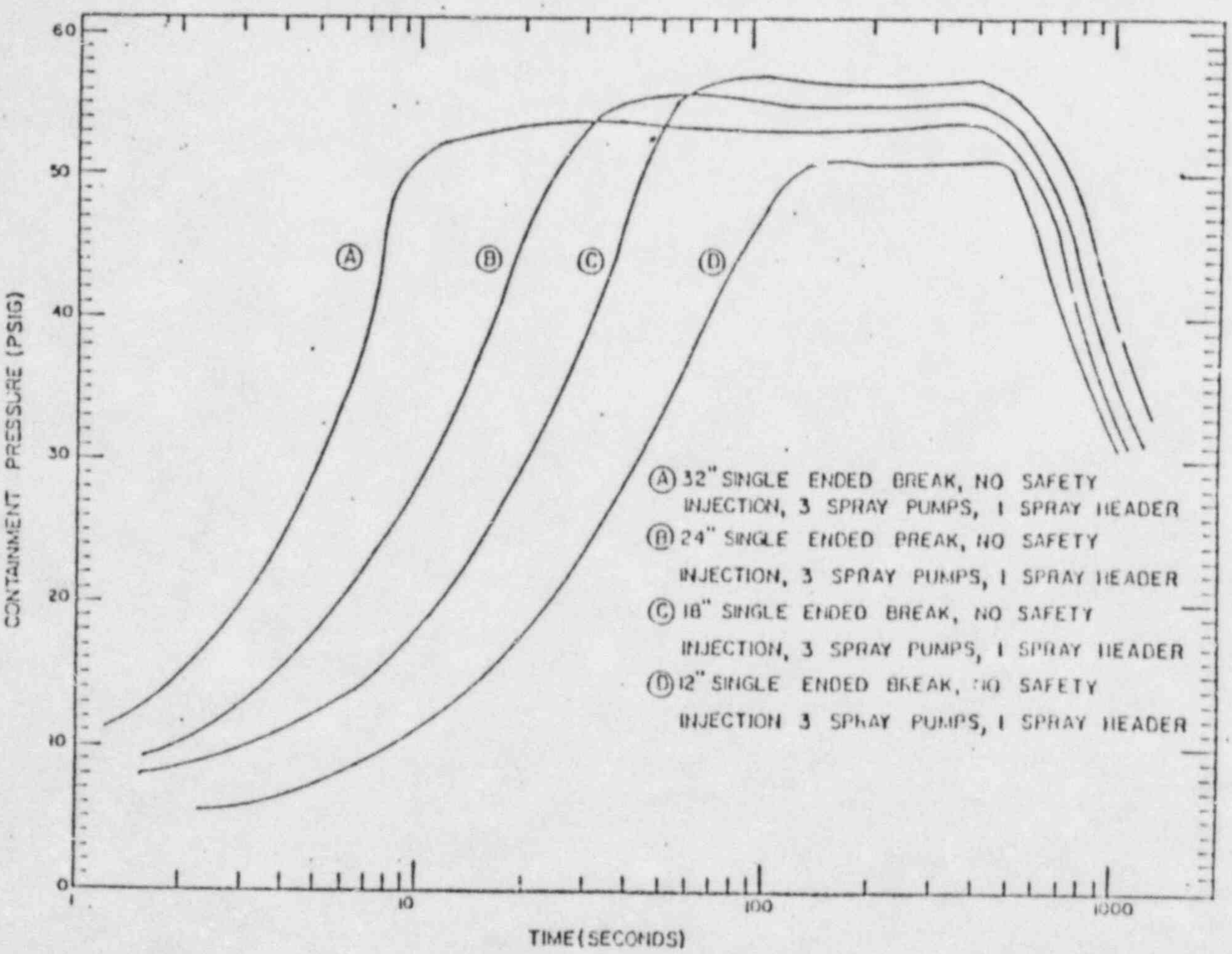

FIGURE 3

CONTAINMENT PRESSURE

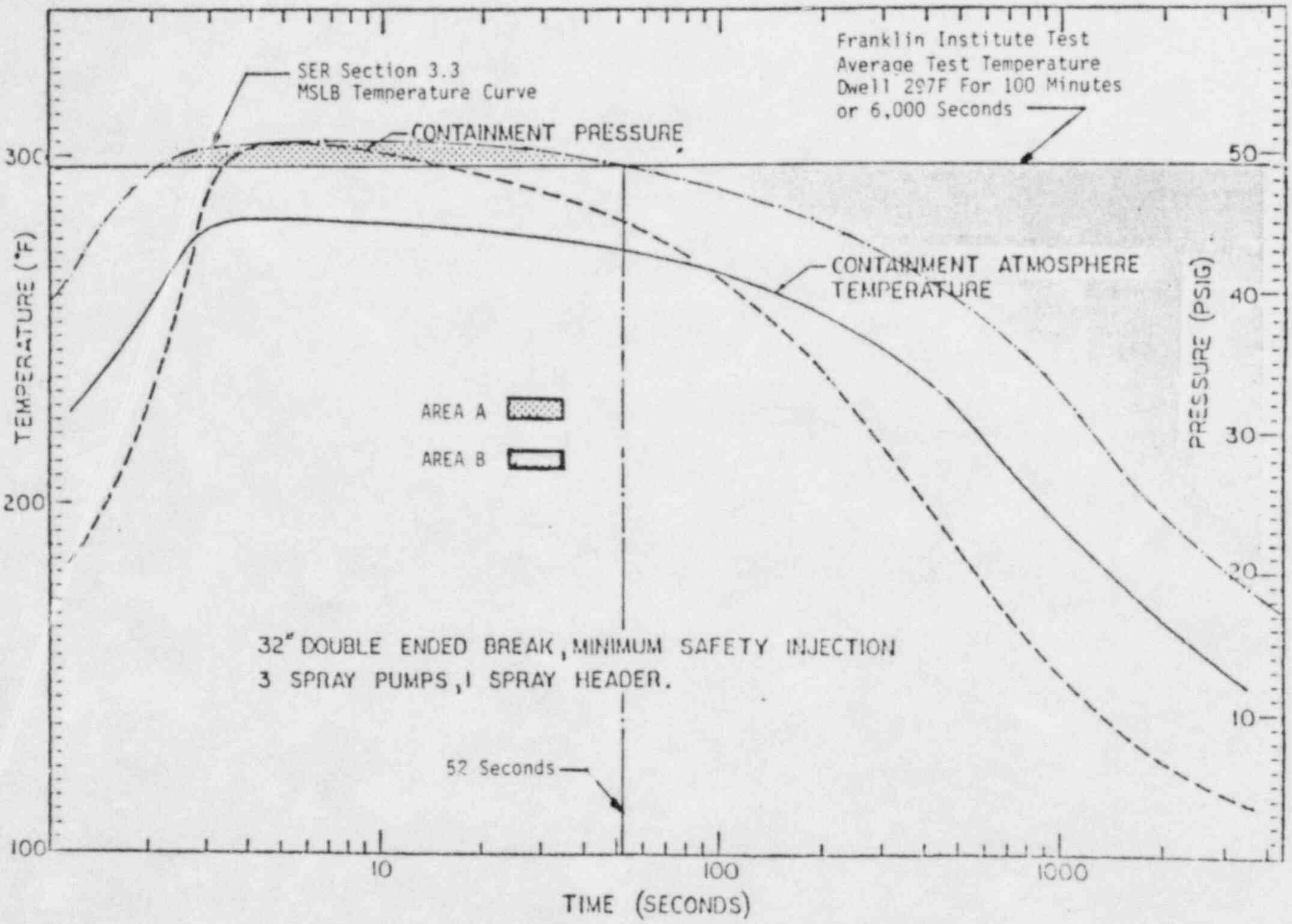

FIGURE 4

SER SECTION 3.3
MSLB TEMPERATURE CURVE

TABLE I

CABLE DESCRIPTION

I.D. No.	Cable No.	Type	Function
319	W-10	1/C 300 MCM	Containment Vent Fan Motors
325	W-21	3/C #10	480 V, 3 Ø Power for Motor Operated Valves (MOV)
328	W-38	3/C #12	120 V, 1 Ø Control for MOV and 120 VDC on PC1849
330	W-40	4/C #12	120 VDC Control to Solenoids and Limit Switches
331	W-41	7/C #12	120 V, 1 Ø Control for MOV and HCV 1107A and HCV 1108A
323	W-57	2/C #14 TS Pair	Drain Wire Using all Instruments

TABLE 2

CABLE SPLICE IDENTIFICATION

Item No.	I.D. No.	(Cable Splices) Materials	Cable No. Type	(Cable Splices) Description	(Cable Splices) Manufacturer	Exposure to Containment Atmosphere#	Screws+ Page No.	Reference No.
1	330 323	Polyolefin Dow Corning 3145 RTV Clear	W-40 4/C #12 W-57 2/C #14 TS Pair	Splices at Transmitter (Single heat shrink splice)	Amp & American Pamcor	No*	6-50	(Enc. #8, LER-30-006) 10,4
2	319A	1.Scotch Tape #70 2.Bishop Tape #3 3.Scotch Tape #88 5.Dow Corning 3144 RTV	W-10 1/C 300 MCM	Cable Splices at the 480V Containment Vent Fan Motor Lead Wires (VA-3A, 313, 7C, 7D)	3M Company & Bishop	No **	6-51	(Enc. #9) 7
3	319B	1.Irrathane SPT Tape 2.Irrasil Tape 3.Scotch Tape #33 4.Dow Corning 3145 RTV	W-10 1/C 300 MCM	The 480V Containment Fan Motor Lead Splices at the Electrical Penetration	General Electric	Yes	6-52	(LER 80-007) 5
4	325 328 330 331 323	Polyolefin Neoprene Dow Corning 3145 RTV Clea-	W-21 3/C #10 W-38 2/C #12 W-40 4/C #12 W-41 7/C #12 W-57 2/C #14 TS Pair	Original Plant Cable Splices at Electrical Penetrations, (double heat shrink)	Amp & Penntube	Yes	6-49	(Enc. #8 XA-545E-462) 10
5		Cross-linked Polyolefin S-1119 Adhesive (Hotmelt Polyethylene Copolymer)		TMI Modification at Containment Penetration Lead Wire Splices	WCSF-N Raychem	Yes	N/A	3
6		Polyolefin	W-40 4/C #12 W-57 2/C #14 TS Pain	Splices at Solenoid Valves (double heat shrink splice)	Amp & American Pamcor	No*	6-49	

* Inside Condulets
**Inside Terminal Box

#Reference 11
+System Component Evaluation Work Sheet

TABLE 3

AGING MATRIX

ITEM NO	ITEM MANUFACTURER	SERVICE CONDITIONS NORMAL	SERVICE CONDITIONS ACCIDENT	NONMETALLIC MATERIALS AND ACTIVATION ENERGIES (eV)	THRESHOLD LEVEL FOR RADIATION DAMAGE (RADS)	CALCULATED LIFE (YEARS) NORMAL	CALCULATED LIFE (YEARS) ACCIDENT	REMARKS
1	Cable splices at Transmitter AMP & American Pamcor	Temperature 84F (29C) Relative Humidity 90 ± 5% Pressure Atmospheric Radiation 3.42×10^5 rads	 305F (152C) 100% Max. 60 psig 3.0×10^7 rads	(1)Polyolefin 0.86 (Ref. 12) (2)3145 RTV 1.67 (Ref. 14)	(1)5.0×10^8 (Ref. 13) (2)2.5×10^7 (Ref. 4)	120 120	189 (days) > 120	(2)
2	Cable Splices at the 480V Containment Vent Fans Motor Lead Wires 3M Company & Bishop Electric	Temperature 84F (29C) Relative Humidity 90 ± 5% Pressure Atmoshperic Radiation 3.42×10^5 rads	 305F (152C) 100% Max. 60 psig 1.92×10^7	(1)Scotch Tape #70 (silicone rubber) 1.64 (Ref. 16) (2)Bishop Tape #3 (polyethylene base) assumed polyethylene 1.11 (Ref. 21) (3)Scotch Tape #88 Vinyl plastic (polyvinyl chloride assumed) 1.19 (Ref. 17) (4)3144 RTV (assumed clear RTV 3145) 1.67 (Ref. 14)	(1)1.0×10^6 (Ref. 15) (2)2.0×10^8 (Ref. 23) (3)1.9×10^7 (Ref. 15) (4)1.02×10^8 (Ref. 7)	120 120 120 120	> 120 52 (days) 73 (days) >120	(3) (3) (4)

TABLE 3

AGING MATRIX

ITEM NO	ITEM MANUFACTURER	SERVICE CONDITIONS NORMAL	SERVICE CONDITIONS ACCIDENT	NONMETALLIC MATERIALS AND ACTIVATION ENERGIES (eV)	THRESHOLD LEVEL FOR RADIATION DAMAGE (RADS)	CALCULATED LIFE (YEARS) NORMAL	CALCULATED LIFE (YEARS) ACCIDENT	REMARKS
3	The 480V Containment Vent Fan Motor Splices at the Electrical Penetration General Electric	Temperature 84F (29C) Relative Humidity 90 ± 5% Pressure Atmospheric Radiation 3.42×10^5 rads	305F (152C) 100% Max. 60 psig 1.12×10^6 rads	(1)Irrathene SPT Tape (Ethylene Propylene Rubber) 1.34 (Ref. 22) (2)Irrasil Silicone Rubber Tape (irradiated silicone rubber) 1.64 (Ref. 16) (3)Scotch Tape #33 Vinyl plastic (Polyvinyl chloride assumed) 1.19 (Ref. 17) (4)3145 RTV 1.67 (Ref. 14)	(1)5.0×10^7 (Ref. 23) (2)1.0×10^6 (Ref. 15) 1.6×10^7 (Ref. 15) 2.5×10^7 (Ref. 4)	120 120 120 120	34 (days) >120 73 (days) >120	(5,3)
4	Original Plant Cable Splice at Electrical Penetrations Amp. & Penntube	Temperature 84F (29C) Relative Humidity 90 ± 5% Pressure Atmospheric Radiation 3.42×10^5 rads	305F (152C) 100% Max. 60 psig 2.5×10^7	(1)Polyolefin 0.86 (Ref. 12) (2)Neoprene 1.05 (Ref. 18) (3)3145 RTV 1.67 (Ref. 14)	(1)5.0×10^8 (Ref. 13) (2)1.0×10^6 (Ref. 15) (3)2.5×10^7 (Ref. 4)	120 120 120	189 (days) 4 (days) >120	(6)
5	TMI Modification at Containment Penetration Lead Wire Splices Raychem WCSF-N	All the conditions are the same as item No. 3 above		(1)Polyolefin Crosslinked 1.29 (Ref. 19) (2)Adhesive (Hotmelt Polyethylene Copolymer) 1.11 (Ref. 21)	(1)5.0×10^8 (Ref. 13) (2)8.7×10^7 (Ref. 15)	120 120	55 (days) 52 (days)	(7)
6	Cable Splices at Solenoid Valves Amp - American Pancor	All the conditions are the same as item No. 4 above		Polyolefin 0.86 (Ref. 12)	5.0×10^8 (Ref. 13)	120	189 (days)	

TABLE 4
EVALUATION SUMMARY

EQUIPMENT: Cable Splices at Transmitters

EVALUATION RESULTS

PARAMETER	PLANT	TEST	ANALYSIS	REMARKS
Thermal Aging	40 years (Normal and DBE)	--	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging (Rads)	3.0×10^7	--	5.0×10^7	Section 4.1.2
Temperature (F)	305	--	305	Section 4.3.3
Pressure (psig)	60	--	60	Section 4.3.4
Chemical Spray	2500 ppm Boron		Protected by RTV 3145	Section 4.3.5
Relative Humidity %	100	--	100	Section 4.2
Submergence	Flood level Elev. 1000.9'	--	Above Flood Level	SCEW Sheet p. 6-50

TABLE 3 REMARKS

(1) Unless otherwise noted, Calculated Accident Life listed is in addition to 120 years Calculated Normal Life.

(2) Has shown to exhibit excellent radiation resistance when irradiated to levels of 5.0×10^7 rads, gamma (Ref. 10).

(3) Satisfactory test results were obtained when subjected to radiation fields in the neighborhood of $30\text{-}100 \times 10^6$ (Ref. 7).

(4) Dow Corning no longer manufactures RTV 3144; the replacement product is RTV 3145 clear, which is basically the same product (Ref. 26, 27).

(5) An investigation of this splice indicates that its composition would allow it to withstand the LOCA conditions (Ref. 5).

(6) Has been irradiated to levels of 5, 10, and 25×10^6 rads by the Penntube Plastics Co., with no evidence of degradation as a result of these exposures (Ref. 10).

(7) This splice system has been tested to a radiation dose up to $200\text{-}290 \times 10^6$ with satisfactory results (Ref. 3).

TABLE 5
EVALUATION SUMMARY

EQUIPMENT: Cable Splices at the 480V Containment Vent Fan Motor Lead Wires

EVALUATION RESULTS

PARAMETER	PLANT	TEST	ANALYSIS	REMARKS
Thermal Aging	40 years (Normal and DBE)	--	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging (Rads)	1.92×10^7	--	1.0×10^8	Section 4.1.2
Temperature (F)	305	--	305	Section 4.3.3
Pressure (psig)	60	--	60	Section 4.3.4
Chemical Spray	2500 ppm Boron	--	Boric acid in excess of 5%	Section 4.3.5
Relative Humidity %	100	--	100	Section 4.2
Submergence	Flood level Elev. 1000.9'	--	Above flood level	Scew Sheet p. 6-51

TABLE 6
EVALUATION SUMMARY

EQUIPMENT: The 480V Containment Vent Fan Motor Splices at the Electrical Penetrations

EVALUATION RESULTS

PARAMETER	PLANT	TEST	ANALYSIS	REMARKS
Thermal Aging	40 years (Normal and DBE)	--	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging (Rads)	1.12×10^6	--	1.6×10^6	LER 80-007 Section 4.1.2
Temperature (F)	305	--	305	Section 4.3.3
Pressure (psig)	60	--	60	Section 4.3.4
Chemical Spray	2500 ppm Boron	--	Protected by RTV 3145	Section 4.3.5
Relative Humidity %	100	--	100	Section 4.2
Submergence	Flood level Elev. 1000.9'	--	Above flood level	SCEW Sheet p. 6-52

TABLE 7
EVALUATION SUMMARY

EQUIPMENT: Original Plant Cable Splices at Electrical Penetrations

EVALUATION RESULTS

PARAMETER	PLANT	TEST	ANALYSIS	REMARKS
Thermal Aging	40 years (Normal and DBE)	--	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging*	1.36×10^7*	--	2.5×10^7	Section 4.1.2
Temperature (F)	305	285-295	305	Section 4.3.3
Pressure (psig)	60	60		Section 4.3.4
Chemical Spray	2500 ppm Boron	1% pH 9.5	Protected by RTV 3145	Section 4.3.5
Relative Humidity %	100		100	Section 4.2
Submergence	Flood level Elev. 1000.9'	--	Above flood level	SCEW Sheet p. 6-49

*Application has teflon insulated lead wires as interface. Need test to confirm splice will perform safety function under radiation.

TABLE 8
EVALUATION SUMMARY

EQUIPMENT: Containment Penetration Lead Wire Splices (Raychem WCSF-N)

EVALUATION RESULTS

PARAMETER	PLANT	TEST*	ANALYSIS	REMARKS
Themal Aging	40 years	1500 hours at 150C	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging**	1.12×10^6**	2.0 - 2.9 $\times 10^8$	5.0×10^8	Section 4.1.2
Temperature (F)	305	390	305	Section 4.3.3
Pressure (psig)	60	66		Section 4.3.4
Chemical Spray	2500 ppm Boron	6200 ppm Boron		Section 4.3.5
Relative Humidity %	100	100	100	Section 4.2
Submergence	Flood level Elev. 1000.9'	--	Above flood level	SCEW Sheet p. 6-52

*Wyle Test Report No. 58442-1 (Ref. 3)

**Application has teflon insulated lead wires as interface. Need test to confirm splice will perform safety function under radiation.

TABLE 9
EVALUATION SUMMARY

EQUIPMENT: Cable Splices at Solenoid Valves

EVALUATION RESULTS

PARAMETER	PLANT	TEST	ANALYSIS	REMARKS
Themal Aging	40 years	1500 hours at 150C	120 years at 84F plus DBE at 305F	Section 4.1.1
Radiation Aging	1.36×10^7	--	5×10^8	Section 4.1.2
Temperature (F)	305	--	305	Section 4.3.3
Pressure (psig)	60	--	60	Section 4.3.4
Chemical Spray	2500 ppm Boron	--	Protected by NEMA condulet and conduit system	Section 4.3.5
Relative Humidity %	100	--	100	Sectin 4.2
Submergence	Flood Level Elev. 1000.9'	--	Above flood level	Scew Sheet p. 6-49

ATTACHMENT 7

4/4/84 - WEM, GPB, MOG, KJM, RLJ, WGG, TJM, JCB, JKG, DDW, PMS, FAT, FFF, DJM, JJF, TRR
FCFile

Omaha Public Power District
1623 Harney Omaha, Nebraska 68102
402/536-4000

April 3, 1984
LIC-84-093

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Denton:

Environmental Qualification of
Safety-Related Electrical Equipment

Pursuant to the requirements of 10 CFR 50.49, paragraph (g), the Omaha Public Power District has been working toward the final environmental qualification of the referenced electrical equipment by the end of the second refueling outage after March 31, 1982. The Fort Calhoun Station is presently shut down for the second refueling outage after March 31, 1982, with a scheduled startup date of May 2, 1984.

Recently, the District has identified that additional time will be required to complete documentation review, verify accuracy, and complete similarity studies on a set of Foxboro transmitters installed at the Fort Calhoun Station. Attachment 1 provides more specific details on these efforts.

Attachment 2 discusses the work required in order to complete the environmental qualification of electrical penetration assemblies manufactured by Conax Corporation. This attachment also provides a summary of the history for testing the penetration assemblies over the past two years. Significant progress has been made toward demonstrating environmental qualification of these penetration assemblies; however, the completion of the remaining testing and documentation will extend beyond the end of the current refueling outage.

For the reasons stated above, as further discussed in Attachments 1 and 2, and pursuant to the provisions of 10 CFR 50.12, the District hereby requests an exemption from the scheduled requirements of 10 CFR 50.49, paragraph (g), for the electrical components identified in the referenced attachments. Specifically, the District requests an approximate five-month extension beyond the scheduled May 2, 1984 date to September 30, 1984.

Sincerely,

W. C. Jones
Division Manager
Production Operations

WCJ/KJM:jmm

Attachments

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036

Mr. E. G. Tourigny, Project Manager
Mr. L. A. Yandell, Senior Resident Inspector

ATTACHMENT 1

Foxboro Transmitters
History and Justification for Continued Operation
for Franklin TER Items 1, 2, 3 and 4

The Fort Calhoun Station is equipped with 62 Foxboro transmitters (See Table 1) which fall within the scope of 10 CFR 50.49. Some of these transmitters were reviewed by FRC as noted in Table 1. Transmitters without FRC item numbers were added to the scope of 10 CFR 50.49 mostly because of TMI requirements, and have not been reviewed by the FRC. These transmitters were procured from 1979 to 1982 to meet IE Bulletin 79-01B or TMI requirements. At the time of procurement, these were required to be qualified to IEEE 323-1971 with IEEE 323-1974 qualification pending. Testing on these transmitters to IEEE 323-1974 was completed on August 10, 1983. The District received the test reports from the vendor on March 16, 1984. Presently, the District is in the process of reviewing these test reports and have concluded that because of the complexity of testing, it will take significant effort on the District's part to complete this review to resolve any anamolies, prove qualification by similarity and to verify accuracy.

JUSTIFICATION FOR CONTINUED OPERATION

For the purpose of this justification, transmitters listed in Table 1 are divided in the following categories:

Category 1: 4-20 mA output Foxboro Model N-E13DM and N-E11GM Transmitters.

Category 2: 10-50 mA output Foxboro Model N-E11GM, N-E13DH, and N-E13DM Transmitters shipped after Dec. 1981.

Category 3: 10-50 mA output Foxboro Model N-E13DM, N-E11GH, N-E13DH Transmitters shipped prior to Jan. 1982.

Category 1 Transmitters:

There are a total of 20 transmitters which fall within this category. At the time of procurement, these transmitters were qualified to IEEE 323-1971 per Foxboro Test Report #1 TI-1059, Q9-6005, T3-1068, and T3-1097.

Subsequently, a group of utilities and Foxboro Co. have qualified these transmitters to IEEE 323-1974 Specification. The District has received a copy of this test report prepared by Wyle Labs. It has been confirmed by the vendor that Fort Calhoun transmitters falling within this category are similar to the transmitters tested (same model number). The District needs to review the test report and evaluate the test results including post accident accuracies. However, we believe that the transmitters as installed can be considered as fully qualified. This conclusion is justified because of the following:

- These transmitters were tested by a reputable test company and the testing was intended to envelop requirements for several nuclear power plants.

- The testing was done under 10 CFR 50 Appendix B QA Program and has been accepted by several utilities.

- The vendor, Foxboro Co., per their letter dated January 6, 1984, has confirmed that no hardware modifications are required to achieve full qualifications.

- These transmitters were purchased as qualified to IEEE 323-1971.

Based on the above, it can be concluded that there is adequate evidence of these transmitters being qualified. Continued operation is, therefore, justified.

Category 2 and 3 Transmitters:

There are a total of 42 transmitters which fall in Category 2 and 3. Like Category 1 transmitters, these transmitters were also procured as qualified to IEEE 323-1971. Subsequently, these transmitters have also been tested to IEEE 323-1974. The District has decided to upgrade these transmitters and has received a copy of the Test Report prepared by Wyle Labs. It has been confirmed that Fort Calhoun transmitters falling within Category 2 are identical to the transmitters tested. The vendor has also confirmed that these transmitters can be upgraded without any hardware changes.

For transmitters which fall within Category 3, the vendor has informed us that these transmitters will require some hardware changes to fully qualify to IEEE 323-1974. These hardware changes are currently in progress and are expected to be completed before plant startup from the current refueling outage. Upon completion of these hardware changes these transmitters will be identical to the one tested by Foxboro.

In the process of qualifying these transmitters by similarity and in reviewing the test report, it has been discovered that the test data needs to be supplemented by an analysis to justify full qualification for these transmitters. This is because the transmitters were tested with 65-93VDC power supplies. The existing power supplies for 36 of these transmitters is 52.5 Volts DC. A preliminary analysis has been completed and it has been concluded that these transmitters will be able to perform their intended function during normal and DBE environment with a 52.5 Volt power supply.

The vendor has already confirmed that a 52.5 Volt power supply is acceptable for normal operation. In discussions with the vendor it has been concluded that with the exception of very high radiation (10^7R), the transmitters' hardware is insensitive to anticipated post accident environmental conditions. For the Fort Calhoun Station the integrated dose for the duration for which these transmitters are required to be functional is expected to be less than 10^7R. Therefore, considering that the hardware is not expected to degrade due to post accident environment and use of a 52.5 Volt power supply is acceptable for normal operation, the District is justified in concluding that these transmitters will be able to perform their intended function during normal and DBE accident environment.

Based on the above, it can be concluded that there is adequate evidence of these transmitters being qualified. Continued operation is, therefore, justified in accordance with 10 CFR 50.49.

rh/N

TABLE 1

FOXBORO TRANSMITTERS

Transmitter	FRC#	Category
FT-313	1	2
FT-316	1	2
FT-319	1	2
FT-322	1	2
A/B/C/D PT-102	2	2
PT-103X	2	2
PT-103Y	2	2
A/B/C/D PT-902	2	2
A/B/C/D PT-905	2	2
LT-101X	3	3
LT-101Y	3	3
A/B/C/D LT-901	4	3
A/B/C/D LT-904	4	3
FT-416	-	2
FT-417	-	2
FT-418	-	2
FT-419	-	2
FT-328	-	2
FT-330	-	2
FT-332	-	2
FT-334	-	2
FT-1109	-	3
FT-1110	-	3
LT-1183	-	3
LT-1188	-	3
PT-105	-	3
PT-115	-	3
PT-783	-	1
PT-784	-	1
PT-785	-	1
PT-786	-	1
A/B/C/D LT-911	-	1
A/B/C/D LT-912	-	1
A/B/C/D PT-913	-	1
A/B/C/D PT-914	-	1

ATTACHMENT 2

Electrical Penetration Testing History
and
Justification for Continued Operation
for Franklin TER Items 85, 86, 87, 88, 89, 92, 99, 103

History:

The Fort Calhoun Station is equipped with approximately 400 electrical penetration subassemblies which are used to provide electrical paths for instrumentation, control, and power for normal plant operation, and certain accident and post-accident functions. These electrical penetration subassemblies were manufactured by the Conax Corporation using TFE teflon for the seal, and FEP teflon for the lead wire insulation. As part of the preparation of the response to IE Bulletin 79-01B, testing information as described in Section 5.9 of the USAR was reviewed.

Upon completion of a re-review of the available vendor-supplied documentation in February 1981, the District concluded that additional testing was necessary to meet a strict interpretation of the DOR Guidelines. A separate radiation test was done on the assemblies, and was not done in sequence as part of a LOCA test. This was not in full compliance the DOR Guidelines which require sequential testing if a material is known to degrade severely under a stress parameter (in this case radiation). Therefore, a purchase order for testing was issued to Wyle Laboratories on August 31, 1981.

The time between purchase order issuance and the beginning of actual testing was used to determine what fixes (RTV or Raychem sleeving) could potentially be tested and for preparing the test fixture and test samples. In preparation for final testing by Wyle, in March of 1982, a test sample consisting of seal and lead wire was irradiated to 9.9×10^6R gamma at Iowa State University. Although some material degradation was noted, the sample showed no leakage, the lead wire insulation remained flexible, and the insulation withstood a 500 VDC insulation resistance test while immersed in salt water. NOTE: After experimentation with the fixes (RTV or Raychem sleeving) it was determined that the fixes could not be acceptably implemented and were subsequently dropped.

The initial testing at Wyle Laboratories began in the fall of 1982, and consisted of the 40-year accelerated aging test. At the end of this testing, excessive leakage was found. This was reported to the Commission in a letter dated December 30, 1982. This seemed to be contrary to information contained in the District's surveillance test program which indicated no leakage.

The District then began a research effort to identify the failure mechanism. A test sample was aged using the original criteria with leakage testing conducted at more frequent intervals. Failure was found to occur between 20 and 30 years of qualified life. This was reported to the Commission in a letter dated March 8, 1983.

Contact was then made with Conax and DuPont. The problem was identified as a cold flow problem due to high accelerated aging temperatures in which the seal material "flowed" in the subassembly tubing. Conax then developed a new aging criteria to more accurately model this "cold flow". This was completed in August of 1983. A second test sample was then aged, and no leakage was measured.

The District restarted the test program with a modification such that the penetrations would be aged at the new temperature and then spliced on the already aged penetration lead wires, splice, and cable system. However, due to a communications problem, the aged cable splices were destroyed in mid-February, 1984.

Subsequent to mid-February, the District attempted to locate parts, construct new assemblies, and evaluate the impact on the schedule to determine if the overall commitment date could be met. It then became necessary to age the lead wire, splice, and cable assembly. The aging began on March 20, 1984. Testing, issuance and review of the final report, will be completed by September 30, 1984. This is after the District's commitment date of the end of the present refueling outage (early May 1984). Thus, an exemption from this deadline is requested. Continued safe operation is justified as discussed below.

Justification for Continued Operation: (Franklin TER Items 85, 86, 87, 88, 89, 92, 99, 103)

The District elected to resolve specific qualification deficiencies in the above noted Franklin TER items by testing.

Specifically, Items 85 through 89, Rockbestos Pyrotrol III cable, were cited for deficiencies related to aging, qualified life, and radiation. Item 92, cable splices at electrical penetrations, were cited for deficiencies related to aging, qualified life, radiation, and test sequence. Item 99, Conax electrical penetrations in containment, were cited for deficiencies related to radiation, test sequence, aging, and qualified life. Item 103, Raychem cable splices, lacked adequate similarity.

To summarize, the Conax penetrations (Item 99) are being re-tested to insure the proper test sequence (an elimination of separate effects) is completed. Items 92 and 103 are being tested to insure the penetration/splice system under proper test sequence is accounted for. The cables, Items 85 through 89, are being tested to account for radiation and aging in proper test sequence.

It is the District's engineering judgement that safe operation is justified until the test is completed and evaluated. Based on the information supplied by the vendor, the District believes the Pyrotrol III cable is similar to the qualified Firewall III which has a 40-year qualified life at 90°C. Since the cable is similar and operates at significantly lower than 90°C (qualification level of the Firewall III), the District expects little aging degradation.

It should be noted that the Pyrotrol III has successfully completed several LOCA tests, including radiation up to 1.79×10^8R. Based on similarity to Firewall III and the several tests, the District believes that continued operation with Pyrotrol III is justified.

The District also believes operation with the splice and penetration teflon interface is justified for Items 92 (original plant splices) and 103 (Raychem). The teflon provides a smooth surface to shrink on and seal. Both splices have completed a LOCA test. The original plant splices have been qualified by analysis for aging and radiation. The Raychem has been qualified by test.

It should also be noted that the District has irradiated a penetration sample to 9.9×10^6R at Iowa State University. The lead wire insulation was found to have degraded but should remain strong enough to insure the splice interface does not degrade.

The District believes safe continued operation is justified for the electrical penetrations, Item 99. As discussed earlier, a test sample was irradiated to 9.9×10^6R (approximate accident dose). The sample functioned properly under the limited testing. No leakage was measured at 60 psig, the insulation did not break down at 500 VDC with the lead wires immersed in salt water, and although there was some loss of structural strength, the insulation still required physical effort to remove from the wire and did not exhibit cracking when bent sharply. The District has also completed a successful aging test in which no leakage was measured after the equivalent of 40 years life. It should also be noted that the penetrations have successfully passed a LOCA test without aging or radiation.