



Omaha Public Power District

1623 HARNEY ■ OMAHA, NEBRASKA 68102 ■ TELEPHONE 536-4000 AREA CODE 402

November 1, 1982
LIC-82-299

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

Environmental Qualification of
Safety-Related Electrical Equipment
at the Fort Calhoun Station

Omaha Public Power District's letter to the Commission, dated May 18, 1982, identified three qualification reports that remained to be provided to Franklin Research Center (FRC). These qualification reports are required to provide all information requested in the Commission's letter dated February 18, 1982. One of the three reports is the Wyle Laboratories final report for electrical cable splices located inside containment. The purpose of this letter is to inform the Commission that the subject qualification report has been received by the District and that a copy has been forwarded directly to FRC, as specified by the February 18, 1982 letter.

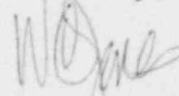
The Commission should note that the subject report concludes that, based upon an engineering and materials analysis evaluation, the Fort Calhoun Station cable splices will operate as required during and after postulated accident conditions. The report also states that insufficient accident test data exists to actually demonstrate this full qualification for several cable splices identified in Section 5.0, "Conclusions", of the report. Item 11 of Attachment 1 to the District's letter dated September 9, 1982 identified modifications and remaining testing that will be completed for the cable splices identified by Items 1(c), 1(d), 2, and 3 in Section 5.0 of the report to eliminate this splice concern. However, the District believes the containment vent fan motor lead wire

A048

Mr. Robert A. Clark
LIC-82-299
Page Two

and electrical penetration cable splices (Items 1(a) and 1(b) of Section 5.0) are fully environmentally qualified and no further action is planned. Justification for this conclusion is provided in the attachment. A copy of the subject Wyle report is also enclosed for reference and use by the Commission.

Sincerely,



W. C. Jones
Division Manager
Production Operations

WCJ/TLP:jmm

Attachments

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

Mr. Cyril J. Crane
Franklin Research Center
The Parkway at Twentieth Street
Philadelphia, Pennsylvania 19103

Attachment

ENVIRONMENTAL QUALIFICATION OF THE CONTAINMENT VENTILATION FAN MOTOR (VA-3A, VA-3B, AND VA-7D) CABLE SPLICES LOCATED AT THE MOTOR LEADS AND ELECTRICAL PENETRATIONS

Based on the results of the 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 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 (a copy of this enclosure is attached for convenience). A description of the cable splice system at the electrical penetrations is provided as Figure 1, page 22 of the enclosed Wyle Laboratories report.

To substantiate the District's engineering judgment, each of the applicable environmental stress parameters (pressure, humidity, steam, temperature, chemical spray, radiation, and aging) were evaluated to determine their 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. Humidity: 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.)
3. Steam: The District believes the protection provided by the RTV is an adequate barrier to steam.

4. Temperature: 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 3050F. 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 cannot be exposed to chemical spray. Nevertheless, RTV is not affected by mild basic solutions and should preclude 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:

	<u>Maximum Exposure at O.D. of RTV (Rads)</u>	<u>Maximum Exposure at I.D. of RTV & O.D. of Splice Insulation (Rads)</u>
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)	2.148×10^8	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 by 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 attenuates 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. 26333-26 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 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 indicates that no aging related failures should be encountered. Please refer to Section 3.0 of the subject report for details.

Conclusion

The District believes these splices are fully protected and qualified based on the results of the testing completed for RTV and the fact that RTV protects the electrical insulation. Based on this analysis and the supporting documents, no further action is required.

ENCLOSURE 9

Containment Fan Cooler Motor Splices

The containment cooler 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 $50-100 \times 10^6$ 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 102×10^6 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%.

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.

ELASTOMER RADIATION RESULTS

MINI 4000

FROM
DOW-CORNING
A.C. 517-496-4550
BUD SMITH

MAT'L	COND	DOSE (MR)	DURO	BASHORE	TEARSILE PSI	ELONG %	DOSE (MR)	20% COMPRESS PSI	4% SET DURING COMPRESS
732 CLEAR	R	0	27	66	250	380	0		
		35	45	68	176	70	16	88.8	3.5
		100	60	81	95	<20	28	97.7	2.6
		158	69	75	40	10	51	136.2	-0-
		198	75	78	220	<20	100	235	-0-
							199	604	1.10
140	R	0	25	55	290	450	0		
		31	40	61	320	110	14	53.3	-0-
		93	64	77	135	<20	25	89.3	2.6
		152	73	75	—	—	51	148.5	-0-
		203	82	79	200	<10	109	379.7	5.60
							196	592	6.50
3140	R	0	27	56	340	390	0		
		34	51	71	410	100	16	88.7	-0-
		102	66	76	147	10	29	119.8	2.6
		150	77	77	157	<10	52	198.4	1.5
		205	82	79	280	<10	101	376	1.0
							202	1211	4.10
3141	R	0	29	61	480	450	0		
		31	48	74	390	90	14	91.4	3.2
		94	68	76	232	10	25	119.7	4.8
		154	80	75	114	<10	51	230.5	2.5
		206	79	75	280	<10	109	535	6.6
							196	1108psi	CRASHED @ 15.5
3144	R	0	28	40	490	650	0		
		34	54	63	345	120	15	122.2	6.9
		102	69	69	147	10	28	149.8	4.1
		150	69	67	200	<10	50	221.1	4.8
		204	79	65	360	20	98	464	-0-
							194	1184	.70

RADIATION EFFECTS ON SEALANTS

Material	Dose Megarads	Stress for	(%)
		20% Compression (PSI)	Dynamic Comp. Set at 20% Comp.
3145	0 MR	3.9 PSI	17.1%
	14	102	0
	64	298	0
	112	627	0
	455	3139 (shattered)	100
3102	0	9.2 PSI	3.1%
	14	119	0
	65	231	0
	113	362	0
	459	2334 (shattered)	100
3110	0	8.7 PSI	5.2%
	13	107	0
	63	246	0
	110	372	0
	447	2062 (shattered)	100
Sylgard 170	0	19	2.5%
	14	206	0
	68	396	0
	119	652	0
	486	2756 (shattered)	100

Sample: 1.125" Dia. x 1" thick button compressed 20% @ 1 inch/min.