Omaha Public Power District

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

June 13, 1979

Director
Division of Reactor Operations Inspection
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Reference: Docket No. 50-285

Gentlemen:

The Omaha Public Power District received IE Bulletin 79-01, dated February 8, 1979, requesting that certain actions be taken to assess environmental qualification of safety related electrical equipment inside containment at the Fort Calhoun Station. The enclosure to this letter provides a comprehensive response to the bulletin.

Sincerely,

T. E. Short
Assistant General Manager

TES/KJM/BJH:jmm

Enclosure

cc: Mr. K. V. Seyfrit, Director
U. S. Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region IV
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ENCLOSURE #1

Environmental Design Conditions

When considering the Design Basis Events of a LOCA and high energy pipe breaks, the following adverse environments are postulated:

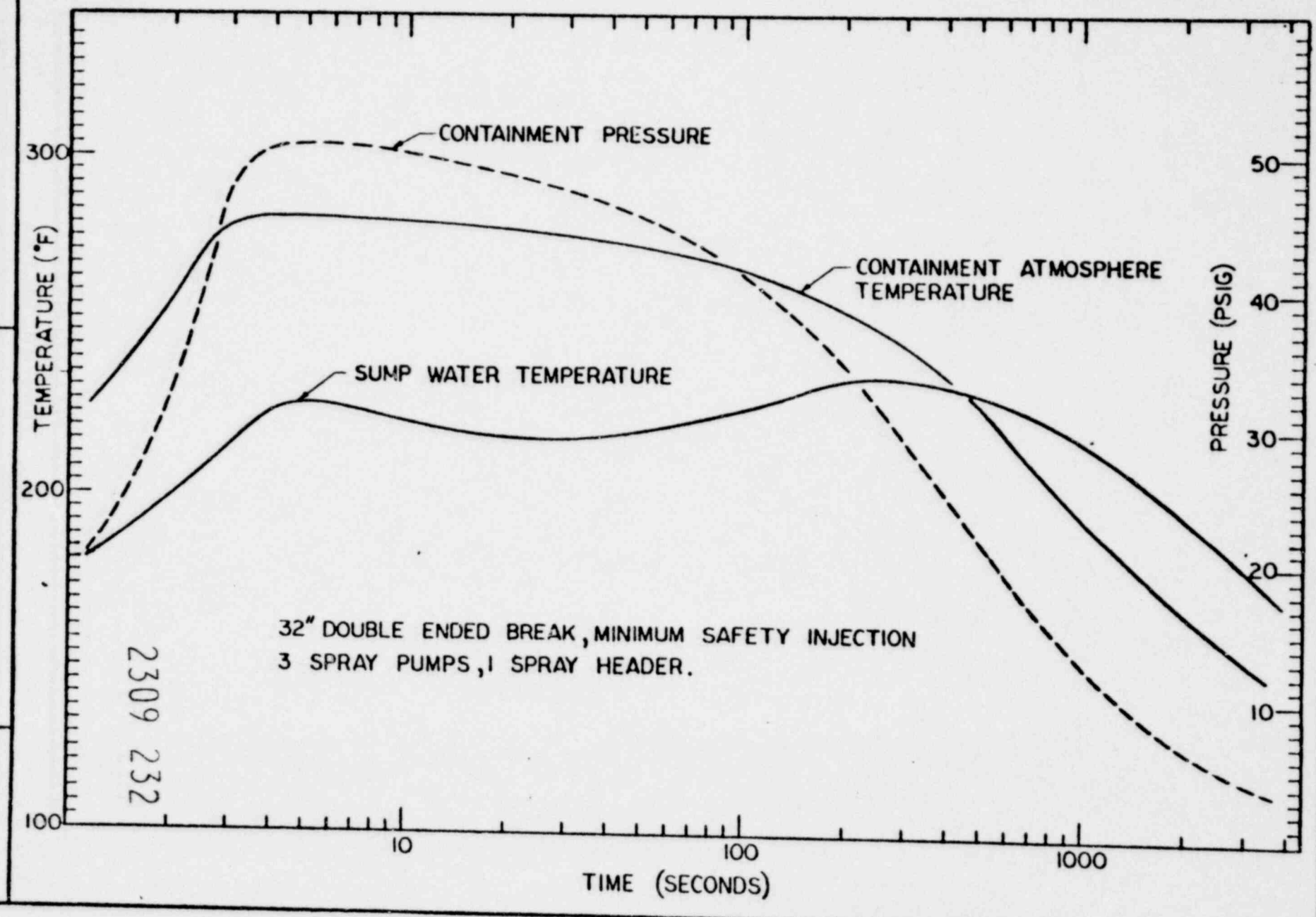
Environment No. 1 - Containment

Temperature: *Figure 1 - 288°F
Pressure: *Figure 2 - 60 psig
Humidity: 100% R.H.
Chemical Spray: Chemical spray of boric acid solution of at least 1700 ppm boron (minimum concentration specified per Technical Specification 2.3)
Radiation: **3×10^6 rads

*From "Containment Pressure Analysis", Section 14.16 of FSAR and from "Design Evaluation", Section 6.2.5 of FSAR. The temperature transient is based on a large primary coolant system pipe break. As can be seen from Figures 1 and 2 (attached), "the maximum containment pressure is 57 psig at a temperature of 285°F. If it is assumed that hydrogen does not burn as it is produced but accumulates and reacts at the containment peak pressure, the effect is to increase the peak pressure by approximately 2.4 psi."

**Section 6.1.3, page 6.1-3, of the FSAR states "Engineered safeguards system control electrical equipment located within containment is specified at a gamma level of 1R/Hr for 40 years." This is approximately 3.417×10^5 rads. The 40 year integrated dose plus LOCA dose (3×10^6 rads), as specified for the Franklin Institute Cable Tests, is used for conservatism.

FIGURE No. 1



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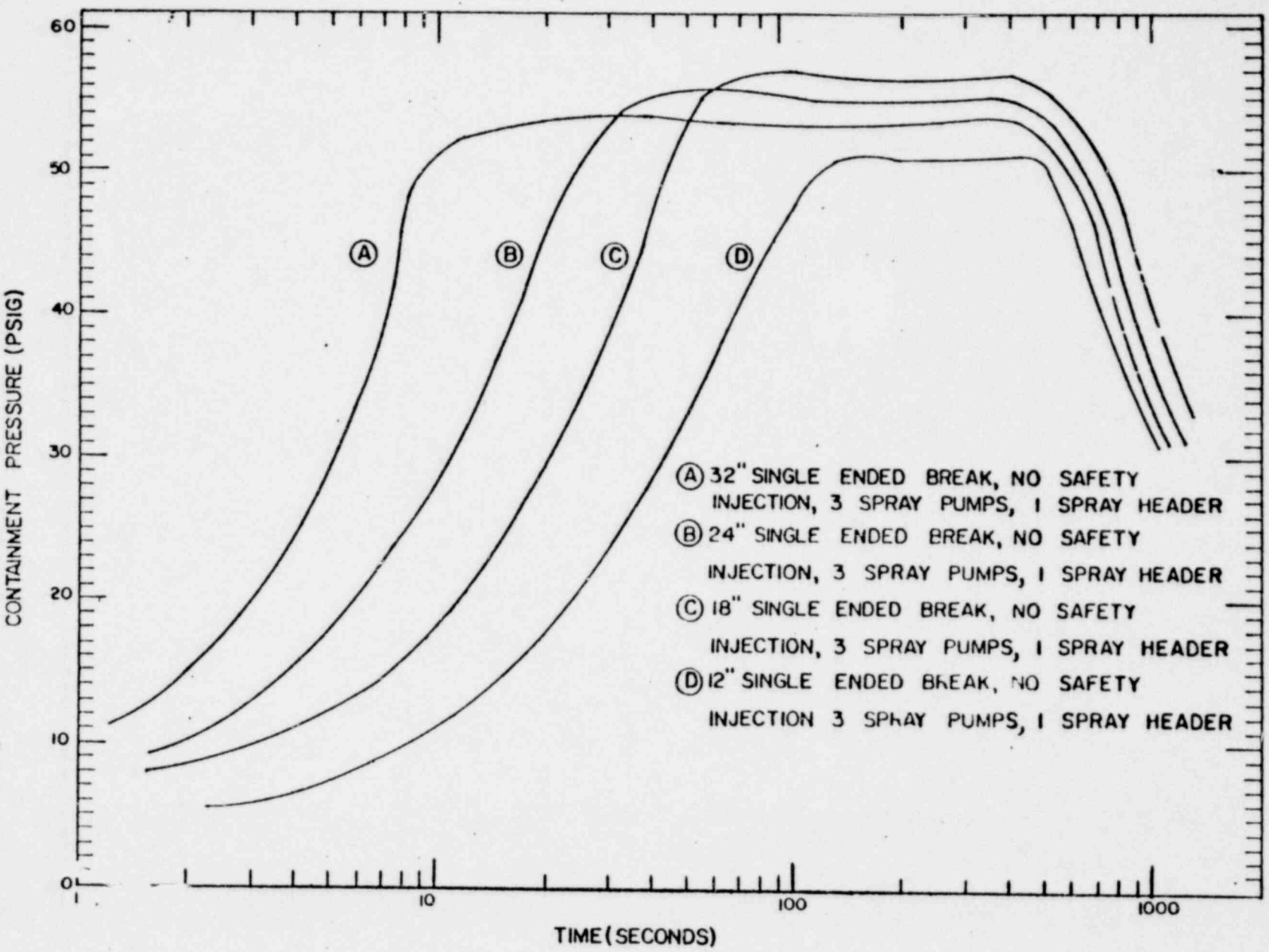
Omaha Public Power District
Fort Calhoun Station
Unit No. 1

Containment Temperatures Following LOCA - Minimum Safeguards

Fig. 6.2-6

FIGURE NO 2



CONTAINMENT PRESSURE — TIME CURVES — SHEET NO. 1

OMAHA PUBLIC POWER DISTRICT
FORT CALHOUN STATION-UNIT NO. 1

FIG. 14.16-2

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ENCLOSURE #2

Document References

Reference 1 - A) For environmental qualification, refer to Joy Manufacturing Test Report X-377A, dated September 3, 1970.
B) See also FSAR Section 1.4.8.1, pages 1.4-9 through 1.4-14.

Reference 2 - A) Environmental qualification per Franklin Institute Research Laboratory Test (see Test Report F-C2232-1, dated November, 1968).
B) Radiation qualification per Limitorque Test (see Test Report B0003 of Limitorque Project No. 600461. Test performed November 13, 1974, to January 23, 1975).

Reference 3 - A) Environmental qualification per Foxboro Tests of similar transmitters (i.e., tests were performed on standard E11 and E13 models). For test results, refer to Foxboro Test Report Q9-6005, dated April, 1971.
B) Radiation qualification per Foxboro Test Report T2-1075, dated August, 1973, and T3-1097, dated November, 1973.
C) See also FSAR Section 1.4.8.5 and Section 6.1.3.

Reference 4 - A) For environmental qualification, refer to Franklin Institute Research Laboratory Test Report F-C3050, dated May, 1971.
B) See also FSAR Sections 1.4.8.2 and 8.5.

Reference 5 - A) For environmental qualification, refer to Conax Corporation Test Report IPS-37, Revision A, dated March 8, 1971.
B) Conax Corporation Test Report IPS-435, approved May 31, 1979.

Reference 6 - A) For environmental qualification, refer to Franklin Institute Research Laboratory Final Report F-C3348, dated April, 1972.

ITEM	EQUIPMENT DESCRIPTION	Manufacturer	ENVIRONMENT (LOCATION) PARAMETER	SPEC.	QUAL.	QUAL. METHOD*	DOC. REF**	REMARKS
1	Containment cooler & re-			Environment 1				
	circulation fan motors	Reliance Motor	Temp. (^{o}F)	288^{o}F	>288^{o}F	Synergistic	Ref. #1	For radiation qualification clarification refer also to footnote 1. For chemical analysis, refer to footnote 4.
	(VA-3A, 3B, 7C, 7D) Reliance	(by Joy Manufacturing)	Press. (psia)	60 psig	70 psig	Synergistic		
	motor for Joy axivane fan		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		
	model 60-30-1200		Radiation	3 x 10^{6} rads	>1 x 10^{8} rads	Separate Analysis		
			Chem.	Boric acid In conc. of at least 1700 ppm	1000 ppm boron solution	Synergistic		
2	High pressure safety in-	Reliance Motor						
	jection valve motor &	(purchased from	Temp. (^{o}F)	288^{o}F	325^{o}F	Synergistic	Ref. #2	Test was performed on valve with Fort Calhoun type SMB operator.
	operator combinations and	Limitorque Corp)	Press. (psia)	60 psig	90 psig	Synergistic		
	low pressure safety in-		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		
	jection valve motor and		Radiation	3 x 10^{6} rads	2 x 10^{7} rads	Separate Tests		
	operator combinations		Chem.	Boric acid in conc. of at least 1700 ppm	1.5% solution (by weight) of boric acid, pH of 7.6	Synergistic		
	Limitorque type SMB-0-40							
	and SMB-0-25 type operators							
	(HCV-311, 312, 314, 315,							
	317, 318, 320, 321, 327,							
	329, 331, 333)							
3	Steam generator and pres-	Foxboro Model						
	surizer pressure trans-	E11GM (equipped	Temp. (^{o}F)	288^{o}F	318^{o}F	Synergistic	Ref. #3	For chemical analysis refer to footnote #2.
	mitters (transmitters	with MCA modi-	Press. (psia)	60 psig	90 psig	Synergistic		
	PT-902A/B/C/D and PT-905	fication)	Rel. Hum.	100% R.H.	100% R.H.	Synergistic		
	A/B/C/D and PT-102A/B/C/D		Radiation	3 x 10^{6} rads	1 x 10^{7} rads	Separate Test		
			Chem.	Boric acid in conc. of at least 1700 ppm	Boric acid of at least 1700 ppm	Material Analysis		

*ie, separate effects, sequential, etc.
**See attached list of reference documents

ITEM	EQUIPMENT DESCRIPTION	Manufacturer	ENVIRONMENT (LOCATION) PARAMETER	SPEC.	QUAL.	QUAL. METHOD*	DOC. REF**	REMARKS
4	Safety injection flow	Foxboro Model						
	transmitters (FT-313,	E13DH	Temp. (^{o}F)	288^{o}F	318^{o}F	Synergistic	Ref. #3	For chemical analy-
	316, 319, 322)		Press. (psia)	60 psig	90 psig	Synergistic		sis refer to foot-
			Rel. Hum.	100% R.H.	100% R.H.	Synergistic		note #2.
			Radiation	3 x 10^{6} rads	1 x 10^{7} rads	Separate Test		
			Chem.	Boric acid in conc. of at least 1700 ppm		Material Analysis		
5	Cable leads to cont. cooler	Cerro Wire &						
	& recirculating fan motors	Cable Company	Temp. (^{o}F)	288^{o}F	286^{o}F	Synergistic	Ref. #4	For discussion of
	(W10 - 1/C 300 MCM stranded		Press. (psia)	60 psig	60 psig	Synergistic		cables tested refer
	power, 2/C #10 stranded		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		to footnote #3.
	control, 2/C #12 stranded		Radiation	3 x 10^{6} rads	3 x 10^{6} rads	Sequential		
	control)		Chem.	Boric acid in conc. of at least 1700 ppm	Boric acid of 1900 ppm boron, pH of 9.0	Synergistic		
6	Cable leads to all steam	Cerro Wire &						
	generator, pressurizer, &	Cable Company	Temp. (^{o}F)	288^{o}F	286^{o}F	Synergistic	Ref. #4	For discussion of
	safety injection flow trans-		Press. (psia)	60 psig	60 psig	Synergistic		cables tested refer
	mitters (W57 - 2/C #14		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		to footnote #3.
	shielded twisted pair)		Radiation	3 x 10^{6} rads	3 x 10^{6} rads	Sequential		
			Chem.	Boric acid in conc. of at least 1700 ppm	Boric acid of 1900 ppm boron	Synergistic		
7	Cable leads to HPSI & LPSI	Cerro Wire &						
	valves/motors (W21 - 3/C	Cable Company	Temp. (^{o}F)	288^{o}F	286^{o}F	Synergistic	Ref. #4	For discussion of
	#10 stranded power, W33 -		Press. (psia)	60 psig	60 psig	Synergistic		cables tested refer
	2/C #10 stranded control,		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		to footnote #3.
	W42 - 12/C #12 stranded		Radiation	3 x 10^{6} rads	3 x 10^{6} rads	Sequential		
	control)		Chem.	Boric acid in conc. of at least 1700 ppm	Boric acid of 1900 ppm boron	Synergistic		

*ie. separate effects, sequential, etc.
**See attached list of reference documents

ITEM	EQUIPMENT DESCRIPTION	Manufacturer	ENVIRONMENT (LOCATION) PARAMETER	SPEC.	QUAL.	QUAL. METHOD*	DOC. REF**	REMARKS
8	Containment electrical pen-	Conax Corp.						
	etration assemblies low		Temp. (^{o}F)	288^{o}F	305^{o}F	Synergistic	Ref. #5	For discussion of
	voltage power, control, &		Press. (psia)	60 psig	60 psig	Synergistic		test results, refer
	instrumentation; medium		Rel. Hum.	100% R.H.	100% R.H.	Synergistic		to footnote 5.
	voltage power; thermocouple		Radiation	3 x 10^{6} rads	1 x 10^{7} rads	Separate Test		
	coaxial & triaxial		Chem.	Boric acid in conc. of at least 1700 ppm	Boric acid of at least 1900 ppm	Synergistic		
9	Cable splices for #10 AWG	AMP Solistrand						
	(W21), #12 AWG (W42), &	Butt Splices	Temp. (^{o}F)	288^{o}F	286^{o}F	Sequential	Ref. #6	All cable splices per
	#14 AWG (W59 thru W63) #18	Penntube Plastics	Press. (psia)	60 psig	60 psig	Sequential		GHDR Splicing Proce-
	AWG uninsulated drain wires.	Co. Neoprene	Rel. Hum.	100% R.H.	100% R.H.	Sequential		dure XA-545-E-450 &
	Only those cables (above)	Tubing	Radiation	3 x 10^{6} rads	3 x 10^{6} rads	Material Analysis		XA-545-E-454.
	are required under DBA environment		Chem.	Boric acid in conc. of at least 1700 ppm	Solution of 1% boric acid - P.H. to 9.5	Sequential		(These splices are for penetration con- ductors & for sole- noid leads.)
10	Solenoid valves - ASCO	Automatic						
	solenoid valves located on	Switch Co.	Temp. (^{o}F)	288^{o}F	Not qualified		N/A	Refer to attached
	containment isolation		Press. (psia)	60 psig				solenoid valve dis-
	valves		Rel. Hum.	100% R.H.				cussion (ENCLOSURE
			Radiation	3 x 10^{6} rads				#3).
			Chem.	Boric acid in conc. of at least 1700 ppm				
11	Limit switches - limit	NAMCO D2400X						
	switches located on con-	NAMCO D1200G-2	Temp. (^{o}F)	288^{o}F	Not qualified		N/A	Refer to attached
	tainment isolation & LOCA	Fisher Type 304	Press. (psia)	60 psig				limit switch dis-
	required valves		Rel. Hum.	100% R.H.				cussion (ENCLOSURE
			Radiation	3 x 10^{6} rads				#4).
			Chem.	Boric acid of conc. of at least 1700 ppm				

*ie, separate effects, sequential, etc.
**See attached list of reference documents

ITEM	EQUIPMENT DESCRIPTION	Manufacturer	ENVIRONMENT (LOCATION) PARAMETER	SPEC.	QUAL.	QUAL. METHOD*	DOC. REF**	REMARKS
12	Terminal blocks	States Company						
		NT-type models	Temp. (^{o}F)	288^{o}F	See remarks	Per Alabama	N/A	For discussion on
		M-25106, M-25108,	Press. (psia)	60 psig		Power/GE Test		terminal blocks see
		M-25112	Rel. Hum.	100% R.H.		Reports		ENCLOSURE #5.
			Radiation	3 x 10^{6} rads				
			Chem.	Boric acid in conc, of at least 1700 ppm				
13	Containment vent fan	Dow Corning						
	motor splices	3144 RTV	Temp. (^{o}F)	288^{o}F	>288^{o}F	Material	Manufacturers	See ENCLOSURE #6.
		Scotch #88	Press. (psia)	60 psig	60 psig	Analysis	Specs.	
		#70 tape	Rel. Hum.	100%	100%			
		Bishop #3 tape	Radiation	3 x 10^{6} rads	50 x 10^{6} rads			
			Chem.	Boric acid in conc. of at least 1700 ppm	5% solution			
			Temp. (^{o}F)					
			Press. (psia)					
			Rel. Hum.					
			Radiation					
			Chem.					
			Temp. (^{o}F)					
			Press. (psia)					
			Rel. Hum.					
			Radiation					
			Chem.					

*ie, separate effects, sequential, etc.
**See attached list of reference documents

ENCLOSURE #2

Footnotes

1. The radiation qualification data cited in these sections is the result of vendor contact or purchase specification requirements. In no case is it evident that the equipment was actually tested to failure. Thus, it is felt that in all cases the radiation levels cited are the minimum levels with unspecified margin to failure.

2. The pressure transmitters listed were described as having cast aluminum top covers. Corrosion of aluminum in a slightly caustic and boric acid spray environment will occur and has been addressed in the FSAR under hydrogen generation in containment (Section 14.17). The location of these transmitters provides them with shielding from the spray by the 1045' elevation and the 1013' elevation floor slabs. For similarly located aluminum, i.e., ductwork, mounting brackets, etc., the FSAR assumed negligible corrosion for hydrogen generation.

   Those transmitters needed for post-LOCA monitoring which may be submerged are the H.P. Safety Injection Flow Transmitters, FT-313, FT-316, FT-319, and FT-322. Even though this type of transmitter was not subjected to a boric acid spray during the environmental type tests done prior to installation, later tests done on similar transmitters (see test report Foxboro T3-1013) proved the transmitters capability to withstand a boric acid spray with a 100% air/steam MCA atmosphere for at least a 24 hour duration. It is OPPD's engineering judgment that these transmitters will then also be capable of withstanding submergence for at least 24 hours with no adverse effects.

3. As previously stated in the FSAR, the only cables which are required to be operable during and after the design basis accident were manufactured by Cerro Wire & Cable Company. These cables which must be operable during and after the design basis accident are:

   a. the containment cooler motor leads
   b. the safety injection motor leads
   c. the safety injection flow transmitters' cables
   d. the pressurizer pressure transmitters' cables
   e. the steam generator pressure transmitters' cables

   The qualification testing performed by Cerro covers all cables mentioned above by testing the largest and the smallest gauge of wire for each type used at the Fort Calhoun Station. Refer to the Franklin Institute Research Laboratories Final Test Report F-C3050.

   For the cables listed in ENCLOSURE #2, the known exterior (jacket) materials are Cross-Linked Polyethylene. A search was made in Perry's Chemical Engineers Handbook for an indication of the relative corrosion or chemical resistance of polyethylene in slightly alkaline solutions and dilute boric acid. This reference described polyethylene as being resistant to dilute alkali and mineral acid solutions. Therefore, it is inferred that this material would not undergo chemical attack by the boric acid spray water.

ENCLOSURE #2

Footnotes
(Continued)

3. (Continued)

Some additional cables, purchased from Anaconda and Boston Insulated Wire & Cable Company, which are not required to operate under and subsequent to a design basis accident, were also type tested in a fashion similar to that of the Cerro cable. This was the case for all reactor protective system and engineered safeguard system cables inside and outside the containment not mentioned previously in ENCLOSURE #2. For copies of these test reports, refer to the Franklin Institute Research Laboratory Final Test Report F-C2525 (Anaconda) and Boston Insulated Wire & Cable Test Report B901.

4. The protective casings for the containment cooler and recirculation fan motors are made of painted steel. Considering these steel protective casings in conjunction with the location of these fan motors (i.e., under ductwork), it is believed that these motors will not be subjected to adverse chemical spray conditions of a LOCA. These fan motors were tested prior to installation (per Joy Manufacturing Test, see Report X-377A) to withstand a chemical environment of approximately 1000 ppm boron, i.e., 2.5 lbs of boric acid dissolved in 50 gallons of water. 1000 ppm boron is below the 1700 ppm boron minimum specified by the Fort Calhoun Technical Specifications. However, it appears that this difference is negligible due to the aforementioned facts.

Refer also to Consumers Power Company submittal concerning environmental qualification of electrical equipment, dated February 24, 1978, Docket No. 50-255.

5. The Conax electrical penetration modules were tested under a chemical/steam environment consisting of a boric acid solution of 1900 ppm. This is underneath the minimum boron concentration of the SIRWT tank, which is 1700 ppm boron or approximately 10,000 ppm boric acid solution. However, the portions of the penetrations which could be exposed to the adverse chemical spray are made of painted carbon steel or FEP teflon. A search through Perry & Chilton's Chemical Engineers' Handbook has revealed these materials to have strong resistance to dilute boric acid solutions. It is therefore concluded that the boron concentration difference between the solution used in the electrical penetration environmental tests and the Fort Calhoun SIRWT tank is insignificant as far as the Conax electrical penetrations are concerned.

ENCLOSURE #3

Solenoid Valves

ASCO solenoid valves were previously reported to the Nuclear Regulatory Commission as being environmentally unqualified in LER 79-014 and by letters dated May 15, 1979, and May 29, 1979. This enclosure contains a safety analysis justifying continued operation as well as a proposed solenoid valve replacement schedule.

Listed below are the solenoid valves which function to operate safety-related equipment within the Fort Calhoun reactor containment. Also listed is pertinent information relating to the function of each of the valves.

NOTE: Those valves 1 through 19 (below) were previously listed in LER 79-014, since these valves contain plastic internals which may degrade due to radiation and high temperature, possibly resulting in repositioning of safety-related valves without a signal for repositioning, provided an air source is available for the valves. ASCO solenoid valves 20 through 44 were not listed in LER 79-014, since these solenoid valves did not contain plastic or degradable internals and in the manufacturer's opinion would be capable of initially attaining its fail-safe/de-energized position and remaining in this position throughout the duration of a LOCA.

	Valve No.	Drawing	Solenoid Normal State	Energize to:	Accident Position	Fail-Safe Position	Solenoid Model
1)	PCV-742A	GHDR 11405-M-1	ND	Open	Closed	Closed	LB-8316B15
2)	PCV-742C	GHDR 11405-M-1	ND	Open	Closed	Closed	LB-8316B15
3)	HCV-2504A	GHDR 11405-M-12	ND	Open	Closed	Closed	8320A26
4)	HCV-2506A	GHDR 11405-M-12	ND	Open	Closed	Closed	8320A26
5)	HCV-2507A	GHDR 11405-M-12	ND	Open	Closed	Closed	8320A26
6)	PCV-2909	CE 23866-210-130	ND	Open	Closed	Closed	8320A7
7)	PCV-2929	CE 23866-210-130	ND	Open	Closed	Closed	8320A7
8)	PCV-2949	CE 23866-210-130	ND	Open	Closed	Closed	8320A7
9)	PCV-2969	CE 23866-210-130	ND	Open	Closed	Closed	8320A7
10)	HCV-724A	GHDR 11405-M-1	ND	Close	Closed	Open	8320A42
11)	HCV-724B	GHDR 11405-M-1	ND	Open	Open	Closed	8320A42
12)	HCV-725A	GHDR 11405-M-1	ND	Close	Closed	Open	8320A42

Solenoid Valves
(Continued)

	Valve No.	Drawing	Solenoid Normal State	Energize to:	Accident Position	Fail-Safe Position	Solenoid Model
13)	HCV-725B	GHDR 11405-M-1	ND	Open	Open	Closed	8320A42
14)	HCV-1107A	GHDR 11405-M-253	NE	Close	Open	Open	8320A8
15)	HCV-1108A	GHDR 11405-M-253	NE	Close	Open	Open	8320A8
16)	HCV-881	GHDR 11405-M-1	NE	Close	Closed	Open	8320A102
17)	HCV-882	GHDR 11405-M-1	NE	Close	Closed	Open	8320A102
18)	HCV-883A	GHDR 11405-M-1	NE	Close	Closed	Open	8320A86V
19)	HCV-884A	GHDR 11405-M-1	NE	Close	Closed	Open	8320V86V
20)	HCV-1387A	GHDR 11405-M-253	NE	Open	Closed	Closed	*
21)	HCV-1388A	GHDR 11405-M-253	NE	Open	Closed	Closed	*
22)	HCV-2603B	GHDR 11405-M-42	NE	Open	Closed	Closed	*
23)	HCV-2604A	GHDR 11405-M-42	NE	Open	Closed	Closed	*
24)	HCV-438A	GHDR 11405-M-40	ND	Close	Closed	Open	*
25)	HCV-438C	GHDR 11405-M-40	ND	Close	Closed	Open	*
26)	HCV-467A	GHDR 11405-M-40	NE	Open	Closed	Closed	*
27)	HCV-467C	GHDR 11405-M-40	NE	Open	Closed	Closed	*
28)	PCV-742E	GHDR 11405-M-1	NE	Open	Closed	Closed	*
29)	PCV-742G	GHDR 11405-M-1	NE	Open	Closed	Closed	*
30)	HCV-746A	GHDR 11405-M-1	ND	Open	Closed	Closed	*
31)	TCV-202	CE 23866-210-120	NE	Open	Closed	Closed	*
32)	HCV-241	CE 23866-210-120	NE	Open	Closed	Closed	*
33)	HCV-545	CE 23866-210-130	ND	Open	Closed	Closed	*
34)	HCV-2916	CE 23866-210-130	ND	Open	Closed	Closed	*
35)	HCV-2936	CE 23866-210-130	ND	Open	Closed	Closed	*
36)	HCV-2956	CE 23866-210-130	ND	Open	Closed	Closed	*

Solenoid Valves
(Continued)

	Valve No.	Drawing	Solenoid Normal State	Energize to:	Accident Position	Fail-Safe Position	Solenoid Model
37)	HCV-2976	CE 23866-210-130	ND	Open	Closed	Closed	*
38)	HCV-238	CE 23866-210-120	ND	Close	---	Open	*
39)	HCV-239	CE 23866-210-120	ND	Close	---	Open	*
40)	HCV-240	CE 23866-210-120	ND	Open	---	Closed	*
41)	HCV-425A	GHDR 11405-M-40	NE	Open	Closed	Closed	*
42)	HCV-425C	GHDR 11405-M-40	NE	Open	Closed	Closed	*
43)	HCV-204	CE 23866-210-120	NE	Open	Closed	Closed	*
44)	HCV-208	CE 23866-210-120	ND	Close	---	Open	*

*Indicates ASCO Model WP-HT-831429 form "F" solenoid valve.
---Indicates the valve has no automatically initiated accident position.

As mentioned previously in LER 79-014, the Fort Calhoun plant operators have been instructed to fail instrument air to containment during post-LOCA conditions, if solenoid failure is detected, which could potentially cause solenoid failures. Failure of instrument air will ensure that these safety-related valves are maintained in their safety position. It is emphasized that failure of instrument air to containment will not jeopardize the ability to safely shutdown the plant and maintain it in a safe shutdown condition.

New environmentally qualified solenoid valves will be ordered, and replacement of these valves will begin upon receipt and be completed during the 1980 refueling outage. A test program will be initiated if necessary to determine qualification of these new valves.

For all those valves (1 through 44) listed above, with the exception of the Containment Recirculating Fan damper valves, HCV-724A/B and HCV-725A/B, redundant isolation valves outside of containment have been provided.

Certification of environmental qualification for the new solenoid valves to be installed will be forwarded to the Commission as soon as it is received by the District.

ENCLOSURE #4

Limit Switches

Stem-mounted limit switches (NAMCO D2400X SNAP-LOCK limit switches) were reported to the Nuclear Regulatory Commission as being environmentally unqualified for an adverse LOCA environment by letters dated March 16, 1979, and March 29, 1979, and by LER 79-007. At the time these limit switches were reported, their function was considered as non-safety related due to the fact that they did not function to provide the lock-in/lock-out feature of the valve control circuitry mentioned as the subject of IE Bulletin 78-04. Rather, all limit switches reported in response to IE Bulletin 78-04 function solely to provide contacts in external position indicator light circuitry. For convenience, listed below are the valves in which the limit switches (NAMCO D2400X limit switches) were installed:

1. HCV-426C
2. HCV-427C
3. HCV-428C
4. HCV-429C
5. PCV-2909
6. PCV-2929
7. PCV-2949
8. PCV-2969
9. PCV-103-1
10. PCV-103-1
11. LCV-101-1
12. LCV-101-2
13. HCV-2500
14. HCV-2501
15. HCV-2502
16. HCV-2503
17. HCV-2504A
18. HCV-2506A
19. HCV-2507A

NOTE: Each valve listed above has two limit switches.

A follow-up inspection was performed by the NRC/Region IV. During this inspection, the inspector informed OPPD representatives of the NRC position that such limit switches should be qualified for operation under LOCA conditions if they provide position indication of valves which are used for primary containment isolation. The following valves using NAMCO D2400X SNAP-LOCK limit switches perform a containment isolation function:

1. PCV-2909
2. PCV-2929
3. PCV-2949
4. PCV-2969
5. HCV-2504A
6. HCV-2506A
7. HCV-2507A

Several more limit switches were identified in the Fort Calhoun Station reactor containment as being unqualified for service in a LOCA environment, in response to IE Bulletin 79-01. These limit switches were reported as such to the Nuclear Regulatory Commission. The following safety analysis justifies continued operation. Also contained within this enclosure is a schedule for replacing unqualified limit switches with qualified limit switches.

For convenience, a list is provided (below) indicating all limit switch/limit switch models contained on safety-related valves which could possibly be subjected to adverse LOCA conditions. It should again be

pointed out that these limit switches function to provide valve position indication only.

Valve No.	Limit Switch
PCV-2909	NAMCO D2400X
PCV-2929	NAMCO D2400X
PCV-2949	NAMCO D2400X
PCV-2969	NAMCO D2400X
HCV-2504A	NAMCO D2400X
HCV-2506A	NAMCO D2400X
HCV-2507A	NAMCO D2400X
HCV-881	NAMCO D1200G-2
HCV-882	NAMCO D1200G-2
HCV-883A	NAMCO D1200G-2
HCV-884A	NAMCO D1200G-2
HCV-438A	NAMCO D1200G-2
HCV-438C	NAMCO D1200G-2
HCV-467A	NAMCO D1200G-2
HCV-467C	NAMCO D1200G-2
HCV-425A	NAMCO D1200G-2
HCV-425C	NAMCO D1200G-2
TCV-202	NAMCO D1200G-2
HCV-238	NAMCO D1200G-2
HCV-239	NAMCO D1200G-2
HCV-240	NAMCO D1200G-2
HCV-241	NAMCO D1200G-2
HCV-1387A	FISHER TYPE 304
HCV-1388A	FISHER TYPE 304
HCV-2603B	FISHER TYPE 304
HCV-2604A	FISHER TYPE 304
HCV-1107A	FISHER TYPE 304
HCV-1108A	FISHER TYPE 304
PCV-742E	FISHER TYPE 304
PCV-742G	FISHER TYPE 304
HCV-746A	FISHER TYPE 304
HCV-545	FISHER TYPE 304
HCV-2916	FISHER TYPE 304
HCV-2936	FISHER TYPE 304
HCV-2956	FISHER TYPE 304
HCV-2976	FISHER TYPE 304

As previously discussed in LER 79-007, four possible modes of limit switch failure were postulated. These modes of limit switch failure are listed below, along with the postulated consequences corresponding to each of the failure modes:

Mode 1) Limit Switch Short Circuits - this would result in possible indication of both "open" and "closed" position of the valve, i.e., both lights could possibly be lit. If such is the case, the Fort Calhoun operators have been instructed to rely upon related process instrumentation for indication of true valve position.

Mode 2) Limit Switch Open Circuits - this would result in a complete loss of position indication. Again, operators have been instructed to be aware of this condition and if necessary rely upon the appropriate process instrumentation for valve indication.

Mode 3) Grounding of the power supply through limit switch failure - again, as stated in the previous submittal, the Fort Calhoun instrument buses are designed to operate with a ground. The circuit design is such that only one line-to-ground fault would occur, i.e., the negative bus would be grounded and the other line is held above ground by the resistance of the light indication circuitry, (refer to Figure 1 attached). It was previously stated that in the event both lines, positive and negative, were grounded, the control fuses located in the individual containment isolation valve circuit would "blow" and the valve would assume its fail-safe position. This statement should be clarified by saying that it is unlikely that the grounding of the positive and negative leads of the limit switch would cause the fuse to "blow" since the resistance of the light indicator circuitry would tend to hold the voltage of the circuit above ground, (refer to Figure 1). It is our belief that since the light bulb resistance makes up the major portion of the total circuit resistance, it would be extremely unlikely that the grounding of the limit switches would cause the control fuses to "blow".

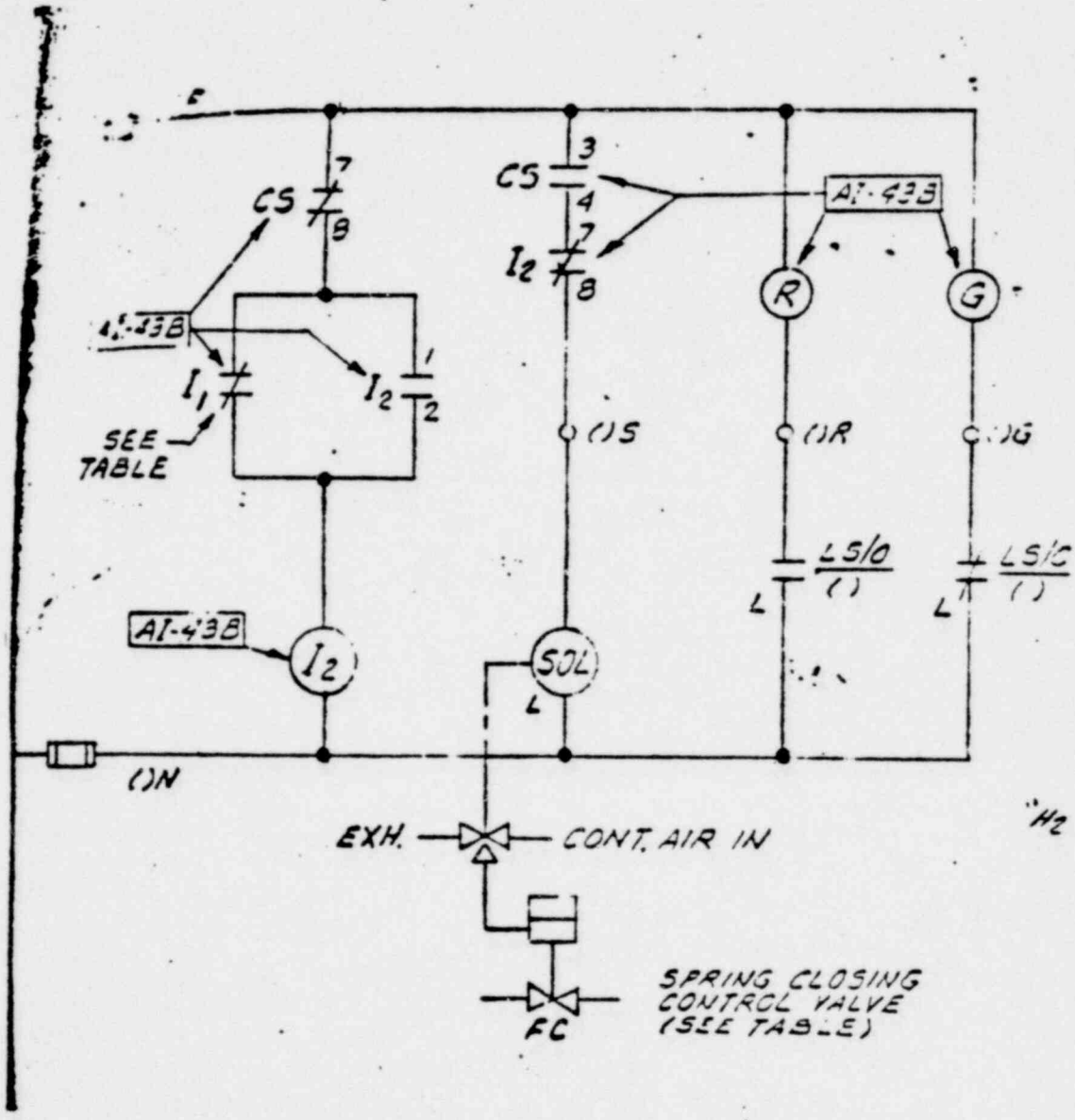
However, if the fuses were to blow, the valve would go to its fail-safe position. In the extremely unlikely event that the fuses to a particular valve were to blow, the limit switch leads may be disconnected, thus eliminating them from the circuit. Upon doing so, the fuses will then be changed and operability of the valve will be restored. It is pointed out as a reminder that in certain circumstances, if a control circuits' fuses were blown causing the valve to go to its fail-safe position, the desired or accident position may not be attainable. In such circumstances redundant (outside containment) valves provide the necessary isolation. For example, HCV-881 - this valve's accident position is closed but its fail-safe position is open. If the control circuit fuses to this valve were blown immediately following a LOCA, the valve would go to its fail-safe (open) position until operability to the valve could be restored. During the interim, however, isolation may still be provided by valves located outside the containment.

Mode 4) Tracking to the solenoid valve - as discussed per previous submittal, it was concluded that the occurrence of "tracking" will not cause any malfunction or loss of valve operability and will not inhibit any valve from carrying out its intended design function. In addition, tracking would not cause the malfunction of any other safety-related equipment.

Limit Switches
(Continued)

Lastly, all unqualified limit switches will be replaced with environmentally qualified limit switches during the next two refueling outages.

FIGURE NO. 1
TO ENCLOSURE #4



TYPICAL ISOLATION VALVE CIRCUIT

ENCLOSURE #5

Terminal Blocks

The terminal blocks provided for the Fort Calhoun Station reactor containment are States Company NT-type terminal blocks. Specifically, the States model numbers M-25104, M-25106, M-25108, and M-25112 terminal blocks are prevalent in the Fort Calhoun reactor containment. As mentioned previously in response to IE Bulletin 78-02, none of the terminal blocks located inside the containment have been left unprotected. Rather, all terminal blocks have been covered with Dow Corning 3144 RTV adhesive/sealant and installed in protective junction boxes.

The District is presently in negotiations with the General Electric Company and the Alabama Power Company in an effort to attain environmental qualification documentation corresponding to the States NT-type block. It is our engineering judgment that upon completion of these negotiations, OPPD will have attained applicable data which will qualify our States NT-type terminal blocks for operation in a post-LOCA environment.

The Nuclear Regulatory Commission will be forwarded documentation verifying environmental qualification of these States NT-type terminal blocks by August 15, 1979. If negotiations or documentation provided in the future do not provide adequate environmental qualification data, as intended, the Commission will be notified immediately.

ENCLOSURE #6

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 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%.

   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.

ENCLOSURE #7

ADDITIONAL AREAS OF CONCERN

Connectors

Several different types of connectors were found in "safety circuits" (i.e., RPS, nuclear instrumentation channels as well as certain triaxial/coaxial containment feedthroughs and rod drive units). However, as pointed out previously in OPPD's response to IE Bulletins 77-05 and 77-05A, none of the connectors found were located in circuits that need to be qualified for post-LOCA conditions.