A-52
50-348/364-CIVP
2/20/92

APCo Exhibit 52

0063872

RESPONSE TO
E.Q. ACTION ITEMS 018 AND 067, TERMINAL BLOCKS/
LOOP ACCURACY AND IEC 78-08/IEN 84-47

Westinghouse as documented in WCAP-11658 performed an evaluation of the impact of cable and terminal block leakage currents during Containment MSLB/LOCA design basis environments on RPS/ESFAS and ERP setpoints for Farley Nuclear Plant (FNP) Units 1 and 2.

To Assist Westinghouse in performing this evaluation, Bechtel performed a cable leakage current calculation for each of the required instrument loops (Ref. Bechtel Calculation E-87, Rev. 2). The lowest values of insulation resistance per unit length of cable measured during qualification testing as documented in Appendix I of Calculation E-87 were used to calculate the loop leakage currents. The resulting percent of span errors due to the calculated leakage currents for each loop were provided to APCo by Bechtel letter AP-13600 dated October 1, 1987, and this data was provided to Westinghouse by APCo for preparation of the WCAP-11658 evaluation. Bechtel provided APCo and Westinghouse by telecopy on October 29, 1987 and November 2, 1987 with a table of Unit #1 and Unit #2 ERP, RPS/ESFAS instruments which indicated the manufacturer of the installed instruments and the type and location of in containment terminations used for each loop (see Attachment #1).

To complete the data required by Westinghouse for this evaluation, Bechtel also provided a value of 1E7 ohms to be used for the insulation resistance of each loop termination inside the containment (Ref W-2244, 11/5/87).

SELECTION OF 1E7 ohms:

- Conax Corporation performed an environmental qualification (E.Q.) test for North Anna Power Stations 1 and 2 as documented in "Test Report on Electrical Terminations Subjected to Design Basis Accident Environment," Conax Report No. IPS-107, approval dated 10/5/73. This test was performed to determine qualification of prototype electrical penetration assembly junction boxes, cable entrance configurations, termination and splicing materials and techniques, and conductors for in containment service. The test included various test specimens consisting of #10AWG thru #16 AWG conductor (wire) samples terminated on Connectron, Inc, Cat. No. NSS3, terminal blocks, and inline splices for a range of conductor sizes. The terminal blocks were contained in two enclosure boxes as described in Sect. 4.4 of the report, and shown in photographs on Pg 13 of 29 in Appendix F, IPS-107. A selection of test items (Sect. 5.3.1) were subjected to an integrated gamma dose of 2.5 E7 rads prior to assembly into the enclosures, and one enclosure was subjected to a 22 year simulated life (aging) after installation of all terminations and conductors (Sect. 6.5).

NUCLEAR REGULATORY COMMISSION

Docket No. 50-348/364-CivP Official Exh. No. 52

In the matter of Alabama Power Company

Staff V IDENTIFIED 3:40 p.m. 2/20/92

Applicant RECEIVED 3:41 p.m. 2/20/92

Intervenor REJECTED

Cont'g Off'n DATE 2/20/92

Contractor WITNESS

Other

Reporter L Stein

The test operations (Sect. 6.0) describes the phases of the test sequence during which insulation resistance (IR) measurements were made. Readings of IR were taken during the Phase I and II LOCA environment testing. Sect. 6.6 describes the LOCA environment test operation. Peak chamber pressure during Phase I testing reached 57.5 PSIG (290°F) at 120 seconds, and Phase I peak chamber temperature reached 300°F (56 PSIG) at 10 minutes from introduction of steam (Time 0). At 60 seconds from Time 0, chamber chemical sprays were initiated. Phase I LOCA conditions continued for 30 minutes. Phase II LOCA testing began at 30 minutes, 45 PSIG (294°F), and at 30 minutes, 35 seconds, the pressure was reduced to 0 and temperature was ramped down to 144°F and was maintained between 140 and 150°F for 240 hours. During this time, chemical sprays were continually introduced into the chamber. IR measurements were taken on each test item during the Phase I and II LOCA tests (Sect. 6.6.12), IR Test Nos. 6 thru 16 of Appendix B (IPS-107).

Appendix E of IPS-107 provides a compilation of the IR Test Data. Graph No. 1 of Appendix E provides a plot of the minimum IR data points for the #16 AWG test conductor and terminal blocks which were recorded during the DBA and Post DBA testing for aged and unaged specimens. From this graph, it can be seen that the minimum IR point recorded for a #16 AWG conductor and block was 3E7 ohms for aged specimens, and 1.5E8 ohms for the unaged specimens.

- Similarity of IPS-107 LOCA test conditions to FNP DBE - the peak inside containment MSLB calculated surface temperature for a terminal box enclosure is 300°F, and the peak calculated containment LOCA/MSLB pressure is 48 PSIG. As discussed above, these peak conditions were satisfied or were exceeded in the test (IPS-107) conditions. The radiation and thermal aging applied did not match the 40 year normal plus DBE design basis for FNP. However, as stated in NRC IEN 84-47 and NUREG/CP-0048 (Vol. 5), Sandia tests have shown that accelerated aging (thermal, radiation) processes and seismic aging do not significantly affect the terminal block IR performance.

- Physical Similarity of the IPS-107 Tested Terminal Blocks to FNP Installed Terminal Blocks - For the subject instrument loops (Attachment #1), three types of qualified terminal blocks have been used, States, G.E. CR151 Type B (CR151B), and Foxboro.

  States 600V terminal blocks mounted in metal enclosures were qualified for in containment at FNP by WYLE Report 44354-1. Attachment #2, AP-9097 dated 4/5/84, and E.Q. Action Item 088 Response dated 11/9/87, discuss the qualification of the installed configuration of States terminal blocks used in E.Q. applications at FNP.

  CR151B 600V terminal blocks were provided in the G.E. Series 100 LV Containment penetration junction boxes at FNP as covered in G.E. Qualification Report (Farley Document Control #U-406155).

  WYLE Report 45592-4 provides environmental qualification documentation supporting the qualification of the Foxboro terminal blocks and junction boxes installed in E.Q. instrument loops at FNP.

Attachment #3 contains physical and dimensional information for the Connectron NSS3, CR151B, States, and Foxboro terminal blocks. With regard to leakage currents in instrument and control applications, NUREG/CP-0048, Vol. 5, indicates that the surface leakage currents induced by surface moisture films are the primary mechanism by which terminal blocks contribute to instrumentation and control circuit IR degradation. Therefore, the significant characteristics among the blocks to be examined relative to surface leakage currents are the center-to-center spacing between poles, and the presence of an insulating barrier between poles (applicable only to States, CR151B, and NSS3). The relative sizes of the blocks are also noted below.

	Center-To-Center Spacing at Poles	Barrier Between Poles	Height of Block With Barrier	Width of Block With Barrier
Connectron NSS3	0.320 in.	Yes	1.328 in.	1.25 in.
CR151B	0.5625 in.	Yes	1.1563 in.	1.625 in.
States NT, ZWM	0.625 in.	Yes	1.4375 in.	3 in.
Foxboro N0148PQ (Round)	0.9375 in. To Test Pole 1.875 in. Between Poles	N/A	Approx. 1 in.	>2 in. Diameter

As shown above, all of the installed instrument loop terminal blocks have superior significant characteristics to the NSS3. Therefore, they should when installed in an equivalent enclosure exhibit equivalent or superior performance in regard to IR and resulting leakage currents during design basis event environments.

- Physical Similarity of the IPS-107 Terminal Block Enclosures and Tested Configuration to FNP Installations - As shown in Figures 13, 14 and Sect. 4.4 of IPS-107, the tested enclosures were sheetmetal with gasketed screw covers and were provided with a 1/2 inch drain pipe. The NSS3 blocks were mounted horizontally in the enclosures, and numerous cable cutouts were made in both sides of the enclosures adjacent to the terminal blocks. No conduit was used for cable entrances. Cable fittings were used to bring the test specimen cables into the test specimen enclosures apparently to simulate cable entrances from field cable tray rather than conduit. Due to the type of fittings and cable utilized in the test configuration, numerous leak paths for the test chamber environment existed between the outside and inside of the test enclosures exposing the terminal blocks and conductors to LOCA test chamber conditions.

The configuration of installed junction box enclosures containing States terminal blocks is described as stated above in E.Q. Action Item 088, and Attachment #2. It should be noted that qualified States blocks were also used in limited applications in the Westinghouse Electrical Containment Penetration Assemblies B009 & B011 and were installed in the Penetration Termination Enclosure. (Ref. U-216925A) The FNP E.Q. enclosure configurations for States blocks do not subject the blocks to possible submergence, and provide equal or superior protection to the configuration tested in IPS-107.

The G.E. Series 100 low voltage containment electrical penetration enclosures which house the qualified CR151B blocks have removable gasketed covers in the front and sides to allow access to the terminations. Conduit and cable access is designed to be in the top and bottom of the enclosures. The terminal blocks are mounted vertically, and the bottom of the enclosures have openings for drainage of condensate. (See Attachment #3) The majority of all conduit and cable entrances are thru the bottom of the enclosures and there are no conduits entering the sides of the enclosures. The FNP E.Q. enclosure configurations for the CR151B electrical penetration blocks do not subject the blocks to possible submergence, and provide equal or superior protection to the configuration tested in IPS-107.

The Foxboro instrument terminal blocks are housed in Foxboro cylindrical cast metal enclosures with a gasketed round screw on (threaded) cast cover. (Ref. U-263438) One threaded conduit opening is provided in the center at the back of the enclosure for entry of the conduit from the transmitter (instrument). A field cable threaded conduit opening is provided on the circumference of the cast enclosure and should be oriented with the opening down for condensate drainage. The FNP E.Q. enclosure configuration for the Foxboro terminal blocks do not subject the blocks to possible submergence, and provide equal or superior protection to the configuration tested in IPS-107.

CONCLUSION:

As the FNP terminal blocks used in E.Q. instrumentation and control circuits located inside containment have superior significant characteristics to the Connectron NSS3 block tested in IPS-107, and as the FNP E.Q. enclosure configurations do not subject the FNP terminal blocks to submergence and provide equal or superior protection to that provided to the NSS3 block in the tested configuration, the use of minimum IR #16 AWG NSS3 values from the IPS-107 test report for calculation of DBE leakage currents on instrumentation terminations inside containment is acceptable.

The IR value of 1E7 ohms provided to Westinghouse for performance of the evaluation of the impact of terminal block leakage currents discussed in WCAP-11658 is conservatively below the minimum values recorded in IPS-107, for the #16 AWG, NSS3 specimens.

00063876

ATTACHMENT #1
E.Q. ACTION ITEMS 018 & 067
E.R.P. INSTRUMENTATION INSIDE CTMT.
UNIT 1 TABLE

REV.: 1
DATE: 10/27/97

TPNS NO.	MANUFACTURER	SERVICE	CABLE ERROR % SPAN	W COST/TERM BLK MANUF	PENETRATION NUMBER	PENETRATION MODULE	TERM. BLK.	TERM. BLK MANUF	REMARKS
Q1B21 PT402-P1	ROSEMOUNT	RCS PRESSURE (WR)	±0.215	SPLICE	Q1TSCB0 12-1	C	YES	G.E	
Q1B21 PT403-P4	ROSEMOUNT	" " "	±0.057	SPLICE	10-4	△ E			
Q1B31 PT455-P1	FOXBORO	PRESSURIZER PRESSURE	±0.113	FOXBORO	12-1	C			MCN N-E11GM (11/2/96)
Q1B31 PT456-P2	FOXBORO	" "	±0.093	FOXBORO	30-2	B			PCN-B-86-1-3644
Q1B21 PT457-P3	FOXBORO	" "	±0.115	FOXBORO	28-3	△ B			
Q1B31 LT 459-P1	BARTON	PRESSURIZER LEVEL	±0.114	FOXBORO	12-1	D			
Q1B31 LT 460-P2	BARTON	" "	±0.085	FOXBORO	30-2	B			
Q1B31 LT 461-P2	BARTON	" "	±0.093	FOXBORO	28-3	△ B			
Q1C22 LT 474-P1	BARTON	SG 1A LEVEL (NR)	±0.123	FOXBORO	12-1	D			
Q1C22 LT 484-P1	BARTON	SG 1B LEVEL (NR)	±0.110	FOXBORO	12-1	C			
Q1C22 LT 494-P1	BARTON	SG 1C LEVEL (NR)	±0.202	FOXBORO	12-1	D			
Q1C22 LT 475-P2	BARTON	SG 1A LEVEL (NR)	±0.170	FOXBORO	30-2	B			
Q1C22 LT 485-P2	BARTON	SG 1B LEVEL (NR)	±0.106	FOXBORO	30-2	B			
Q1C22 LT 495-P2	BARTON	SG 1C LEVEL (NR)	±0.432	FOXBORO	30-2	B			
Q1C22 LT 476-P3	BARTON	SG 1A LEVEL (NR)	±0.140	FOXBORO	28-3	△ B			
Q1C22 LT 486-P3	BARTON	SG 1B LEVEL (NR)	±0.136	FOXBORO	28-3	△ B			
Q1C22 LT 496-P3	BARTON	SG 1C LEVEL (NR)	±0.441	FOXBORO	28-3	△ B			
Q1N11 LT 477-A	BARTON	SG 1A LEVEL (WR)	±0.100	FOXBORO	09-A	B		SPLICE	PCN B-84-1-2756
Q1N11 LT 487-A	BARTON	SG 1B LEVEL (WR)	±0.095	FOXBORO	09-A	B			
Q1N11 LT 497-B	BARTON	SG 1C LEVEL (WR)	±0.180	FOXBORO	11-B	B			
Q1B21 TE 410-P2	ROSEMOUNT	RCS COLD LEG (WR)	-0.038	STATES ZWM	30-2	B		G.E.	
Q1B21 TE 420-P2	ROSEMOUNT	" " " "	-0.083	STATES ZWM	30-2	B			
Q1B21 TE 430-P4	ROSEMOUNT	" " " "	-0.060	STATES ZWM	10-4	B			
Q1B21 TE 413-P1	ROSEMOUNT	RCS HOT LEG (WR)	-0.036	STATES ZWM	12-1	C			
Q1B21 TE 423-P1	ROSEMOUNT	" " " "	-0.045	STATES ZWM	12-1	C			
Q1B21 TE 433-P3	ROSEMOUNT	" " " "	-0.984	STATES ZWM	28-3	△ B			
N1B13 TE 412B-P1	ROSEMOUNT	RCS T AVG	-0.190	STATES ZWM	12-1	C			
N1B13 TE 422B-P2	ROSEMOUNT	" " "	-0.440	STATES ZWM	30-2	B			
N1B13 TE 432B-P3	ROSEMOUNT	" " "	-0.607	STATES ZWM	28-3	△ B			
N1B13 TE 412D-P1	ROSEMOUNT	" " "	-0.110	STATES ZWM	12-1	C			
N1B13 TE 422D-P2	ROSEMOUNT	" " "	-0.270	STATES ZWM	30-2	B			
N1B13 TE 432D-P3	ROSEMOUNT	" " "	-0.455	STATES ZWM	28-3	△ B			
Q1E11 LT 3594R-A	GEMS	CTMT POST ACCIDENT SUMP LEVEL	-0.1.1	[illegible]	06-A	D			
Q1E11 LT 3594B-B	GEMS	" " " " "	-0.8.3	[illegible]	20-5	E			

ATTACHMENT #1
E.Q. ACTION ITEMS 018 & 067

E.S.F. INSTRUMENTATION INSIDE CTMT.
UNIT 1 TABLE

REV. :0
DATE: 10/23/87
PG. 2 OF 2

TPNS NO.	MANUFACTURER	SERVICE	CABLE ERROR % OF SPAN	J BOX/TERM. BLK. MANUF.	PENETRATION NUMBER	PENETRATION MODULE	PENETRATION TERM. BLK	PENETRATION TERM. BLK. MANUF.	REMARKS
Q1C22FT474-P3	FOXBORO	STM. GEN. 2A DISC. FLOW		FOXBORO	Q1T52B028-3	B(CONAX)	YES	G.E.	
Q1C22FT475-P4		2A			Q1T52B010-4	E(CONAX)			
Q1C22FT484-P3		2B			Q1T52B028-3	B(CONAX)			
Q1C22FT485-P4		2B			Q1T52B010-4	E(CONAX)			
Q1C22FT494-P3		2C			Q1T52B028-3	B(CONAX)			
Q1C22FT495-P4		2C			Q1T52B010-4	E(CONAX)			
N1B13TE412A-P1	ROSEMOUNT	RCS T AVG. (SPARE)		STATES-ZMR	Q1T52B012-1	C(CONAX)	YES	G.E.	SPARE FOR E.S.F. OR E.S.A.
N1B13TE412C-P1					Q1T52B012-1	C(CONAX)			
N1B13TE422A-P2					Q1T52B030-2	B(CONAX)			
N1B13TE422C-P2					Q1T52B030-2	B(CONAX)			
N1B13TE432A-P3					Q1T52B028-3	B(CONAX)			
N1B13TE432C-P3					Q1T52B028-3	B(CONAX)			

ATTACHMENT #1
E.Q. ACTION ITEMS 018 & 067

0063878

E.R.P. INSTRUMENTATION INSIDE CTMT.

REV.: 1
DATE: 10/27/87

UNIT 2 TABLE

TPNS NO.	MANUFACTURER	SERVICE	CABLE ERROR % OF SPAN	"S" BOX/TERM BLK. MANUF.	PENETRATION NUMBER	PENETRATION MODULE	TERM. BLK.	TERM. BLK MANUF.	REMARKS
Q2B21PT402-P1	ROSEMOUNT	RCS PRESSURE (WR)	+0.101	STATES-IWM	Q2TS2B0 12-1	C	YES	G.E.	
Q2B21PT403-P4	ROSEMOUNT	RCS PRESSURE (NR)	+0.225	STATES-IWM	10-4	E			
Q2B31PT455-P1	BARTON	PRESSURIZER PRESS (NR)	+0.297	STATES-IWM	12-1	C			
Q2B31PT456-P2	BARTON	PRESSURIZER PRESS (NR)	+0.275	STATES-IWM	30-2	B			
Q2B31PT457-P3	BARTON	PRESSURIZER PRESS (NR)	+0.254	STATES-IWM	28-3	B			
Q2B31LT459-P1	BARTON	PRESSURIZER LEVEL	+0.297	STATES-IWM	12-1	D			
Q2B31LT460-P2	BARTON	PRESSURIZER LEVEL	+0.276	STATES-IWM	30-2	B			
Q2B31LT461-P3	BARTON	PRESSURIZER LEVEL	+0.254	STATES-IWM	28-3	B			
Q2C22LT474-P1	BARTON	SG LEVEL (NR)	+0.275	STATES-IWM	12-1	D			
Q2C22LT484-P1	BARTON	SG LEVEL (NR)	+0.313	STATES-IWM	12-1	C			
Q2C22LT494-P3	BARTON	SG LEVEL (NR)	+0.097	STATES-IWM	12-1	D			
Q2C22LT475-P2	BARTON	SG LEVEL (NR)	+0.403	STATES-IWM	30-2	B			
Q2C22LT485-P2	BARTON	SG LEVEL (NR)	+0.170	STATES-IWM	30-2	B			
Q2C22LT495-P2	BARTON	SG LEVEL (NR)	+0.137	STATES-IWM	30-2	B			
Q2C22LT476-P3	BARTON	SG LEVEL (NR)	+0.275	STATES-IWM	28-3	B			
Q2C22LT486-P3	BARTON	SG LEVEL (NR)	+0.297	STATES-IWM	28-3	B			
Q2C22LT496-P3	BARTON	SG LEVEL (NR)	+0.127	STATES-IWM	28-3	B			
Q2N11LT477-A	BARTON	SG LEVEL (WR)	+0.258	STATES-IWM	09-A	B		STATES CO.	
Q2N11LT487-A	BARTON	SG LEVEL (WR)	+0.157	STATES-IWM	09-A	B			
Q2N11LT497-B	BARTON	SG LEVEL (WR)	+0.090	STATES-IWM	11-B	B			
Q2B21TE410-P2	ROSEMOUNT	RCS COLD LEG (WR)	-0.087	STATES-IWM	30-2	B		G.E.	
Q2B21TE420-P2	ROSEMOUNT	RCS COLD LEG (WR)	-0.075	STATES-IWM	30-2	B			
Q2B21TE430-P4	ROSEMOUNT	RCS COLD LEG (WR)	-0.043	STATES-IWM	10-4	B			
N2B21TE413-P1	ROSEMOUNT	RCS HOT LEG (WR)	-0.094	STATES-IWM	12-1	C			
N2B21TE423-P1	ROSEMOUNT	RCS HOT LEG (WR)	-0.122	STATES-IWM	12-1	C			
N2B21TE433-P3	ROSEMOUNT	RCS HOT LEG (WR)	-0.068	STATES-IWM	28-3	B			
N2B13TE412B-P1	ROSEMOUNT	RCS TAVG	-0.503	STATES-IWM	12-1	C			
N2B13TE422B-P2	ROSEMOUNT	RCS TAVG	-0.380	STATES-IWM	30-2	B			
N2B13TE432B-P3	ROSEMOUNT	RCS TAVG	-0.430	STATES-IWM	28-3	B			
N2B13TE412D-P1	ROSEMOUNT	RCS TAVG	-0.410	STATES-IWM	12-1	C			
N2B13TE422D-P2	ROSEMOUNT	RCS TAVG	-0.310	STATES-IWM	30-2	B			
N2B13TE432D-P3	ROSEMOUNT	RCS TAVG	-0.340	STATES-IWM	28-3	B			
Q2E11LT3574A-A	GEMS	CTMT POST-ACCIDENT SUMP LEVEL	-0.011	PART OF LT	06-A	D			
Q2E11LT3574B-B	GEMS	CTMT POST-ACCIDENT SUMP LEVEL	-0.013	PART OF LT	20-B	E			

ATTACHMENT #1
E.Q. ACTION ITEMS 018 & 067

0063879

E.S.F. INSTRUMENTATION INSIDE CTMT.

REV.: 0
DATE: 10/23/87

UNIT 2 TABLE

TPNS NO.	MANUFACTURER	SERVICE	CABLE ERROR % OF SPAN	J BOX/TERM. BLK. NUMBER	PENETRATION NUMBER	PENETRATION MODULE	PENETRATION TERM. BLK.	PENETRATION TERM. BLK. MANUF.	REMARKS
Q2C22FT474-P2	BARTON	STM. GEN. 2A DISC. FLOW		STATES-ZHM	Q2T52B028-3	B	YES	G.E.	
Q2C22FT475-P4	BARTON	STM. GEN. 2A DISC. FLOW		STATES-ZHM	Q2T52B010-4	C			
Q2C22FT484-P3	BARTON	STM. GEN. 2B DISC. FLOW		STATES-ZHM	Q2T52B028-3	B			
Q2C22FT485-P4	BARTON	STM. GEN. 2B DISC. FLOW		STATES-ZHM	Q2T52B010-4	E			
Q2C22FT494-P3	BARTON	STM. GEN. 2C DISC. FLOW		STATES-ZHM	Q2T52B028-3	B			
Q2C22FT495-P4	BARTON	STM. GEN. 2C DISC. FLOW		STATES-ZHM	Q2T52B010-4	E			
N2BITE412A-P1	ROSEMOUNT	RCS T AVG. (SPARE)	-0.503 *	STATES-ZHM	Q2T52B012-C	D	YES	G.E.	SPARE FOR E.R.P. OR E.S.F.
N2BITE412C-P1	ROSEMOUNT	RCS T AVG. (SPARE)	-0.410 *	STATES-ZHM	Q2T52B012-V	C			
N2BITE422A-P2	ROSEMOUNT	RCS T AVG. (SPARE)	-0.680 *	STATES-ZHM	Q2T52B030-2	A			
N2BITE422C-P2	ROSEMOUNT	RCS T AVG. (SPARE)	-0.310 *	STATES-ZHM	Q2T52B030-2	B			
N2BITE432A-P3	ROSEMOUNT	RCS T AVG. (SPARE)	-0.430 *	STATES-ZHM	Q2T52B028-3	A			
N2BITE432C-P3	ROSEMOUNT	RCS T AVG. (SPARE)	-0.340 *	STATES-ZHM	Q2T52B028-3	B			

* - CABLE ERRORS ARE THE SAME AS THE PTD IT IS THE SPARE FOR, ie. THE CABLE ERROR FOR TE412C IS THE SAME AS FOR TE41[illegible] BECAUSE THE CABLE LENGTH AND CODE ARE THE SAME.

ATTACHMENT #2
E.Q. ACTION ITEMS 018 & 067

Bechtel Power Corporation

Engineers — Constructors

15740 Shady Grove Road
Gaithersburg, Maryland 20877-1454
301 — 258-3000

APR 5 1984

In reply refer to AP-9097

0063880

Mr. O. D. Kingsley, Jr.
Alabama Power Company
Post Office Box 2641
Birmingham, Alabama 35291

Dear Mr. Kingsley:

Joseph M. Farley Nuclear Plant Units 1 and 2
Bechtel Job 7597-011
Environmental Qualification of States Type
NT Terminal Blocks Inside Containment (R.G. 1.97)
(PCR B-84-1-2595) (LS-83-066)
Bechtel Files A-78, A-91, E-91 and E-95
AP-9097

This letter has been prepared in reference to Alabama Power Company's PCR 84-1-2595 and various telephone conversations, with R. L. George, B. D. McKinney, Jr., and M. A. Lalor.

Alabama Power Company environmentally and seismically qualified States terminal blocks in a NEMA 4 enclosure (junction box). This qualification was documented in WYLE Report 44354-1 dated March 8, 1979. The model of terminal blocks qualified as documented in the referenced WYLE report is TYPE ZWM.

During the R.G. 1.97 compliance review, it was required to determine the environmental qualification of additional terminal blocks/junction boxes located in areas of the auxiliary building which would be exposed to post accident radiation. To determine the qualification of these terminal blocks/junction boxes, it was necessary to perform a walkdown to establish the make and model of the installed terminal blocks. States indicated that the color of the terminal block barrier strips on the type ZWM terminal block is tan (buff), and that the barrier strip colors for type NT blocks, also manufactured by States, vary from black to light grey in varying shades of grey. In performing the walkdowns, States terminal blocks were found to be installed in all junction boxes, but none of the terminal blocks were observed to have tan barrier strips.

This led to a reevaluation of how the test specimens (junction boxes with installed States Terminal blocks) were prepared (fabricated) and documented for qualification testing at WYLE. From this evaluation, it was determined that the junction boxes with installed States terminal blocks were fabricated at the Farley site, and sent to WYLE for qualification testing. The States terminal blocks used in the test specimens were documented as TYPE ZWM, Catalog No. M-25012 in the WYLE Qualification Plan #545/1025/ES dated October 10, 1978, and this identification was retained in the WYLE

ATTACHMENT #2

E.Q. ACTION ITEMS 018 & 067

Bechtel Power Corporation

0063881

Qualification Report 44354-1. A review of the States Company Bulletin 4-TB, Attachment 1, which describes the procedure for specifying a States terminal block indicated that Catalog No. M-25012 would be the catalog number for a TYPE NT, not a TYPE ZWM terminal block. The correct catalog number for a similar TYPE ZWM terminal block configuration would be ZWM-25012. As the States terminal block barrier strips observed during the walkdown were not tan, and due to the WYLE documentation discrepancy on the catalog number versus terminal block type, personnel involved with preparing the WYLE test specimens and test procedures were contacted to determine the basis for preparing the test specimens. From these discussions, it was verified that the test specimens were prepared to simulate the existing installed junction boxes with installed terminal blocks, and that the terminal blocks used in the test specimens were typical of those installed in Farley Units 1 and 2. It was also indicated that the color of the barrier strips on the States blocks used for the test specimens was black. (Reference Attachment 2). In reviewing the mark numbers contained in the SCS Joseph M. Farley Nuclear Plant Master Bill Index which was used by Bechtel and SCS in preparing Bill of Materials and for specifying the type of electrical components and hardware to be installed in Farley Units 1 and 2, all mark numbers associated with States terminal blocks reference a States catalog number with an M-prefix. (As discussed previously, the M-prefix specifies a TYPE NT block). From this evaluation, it has been concluded that the States terminal blocks qualified by WYLE Report #44354-1 were not States TYPE ZWM but States TYPE NT terminal blocks.

During the course of this evaluation, it was determined that States manufactured the TYPE NT blocks with two types of barrier strip materials. (Reference States letter dated March 14, 1984, Attachment 3 and States letter dated April 3, 1984, Attachment 4). From approximately 1926 until 1973, the TYPE NT block was manufactured with a barrier strip constructed of C-501 Phenolite. After 1973, the TYPE NT block has been manufactured with a molded barrier strip made from polypropylene, Allied Chemical Grade FP-1080. With the exception of the barrier strip material change, all other block components have been manufactured basically the same within the standards of States Quality Control requirements since 1926, and the material properties and physical dimensions have been maintained.

The TYPE NT blocks qualified in the referenced WYLE report and test plan were identified in these doucments as having a barrier strip material of Allied Chemical Grade FP-1080 polypropylene. As visually discernable differences exist between the molded polypropylene barrier strip used on the newer TYPE NT blocks and the stamped C-501 Phenolite barrier strip used on the older TYPE NT blocks, a black and white photograph was obtained from WYLE of the test specimen which was taken prior to environmental qualification testing. A visual examination of this photograph confirms that the barrier strip of the tested TYPE NT terminal blocks was a molded barrier. Therefore, it has been concluded that the States TYPE NT terminal block qualified by WYLE Report 44354-1 was the newer TYPE NT block with a molded polypropylene barrier strip.

As the potential existed for the installation of both the old and new TYPE NT blocks in Farley Plant, and as only the newer TYPE NT block was determined to be qualified by the referenced WYLE report, a containment walkdown was conducted on Unit 1 between March 24 and March 28, 1984, to determine if the older TYPE NT blocks were installed. Attachment 5 contains a listing of the junction boxes/terminal blocks which were walked down in the Unit 1 containment, and indicates the junction boxes which were found to contain the older TYPE NT blocks.

Since the walkdown resulted in the determination that some installed junction boxes contained States TYPE NT blocks with the older C-501 Phenolite barrier strips, an evaluation was conducted to establish the environmental qualification significance of the older barrier strip material. General Electric (G.E.) had performed LOCA testing of States TYPE NT blocks as documented in the letter dated November 27, 1973 with enclosed Test Report entitled "Terminal Block LOCA Test for Electrical Penetration Assemblies" dated November 6, 1973. (This letter and enclosed report are enclosed with this letter as Attachment 6). The G.E. test was conducted for a period of approximately 9 days with a maximum temperature of 340°F and a peak pressure of 103 PSIG. For Farley Units 1 and 2, it has been established (Reference Farley Mechanical Calculation #18.11) that for a MSLB inside containment, the peak surface temperature of the junction boxes containing the terminal blocks is 300°F. It has also been established for Farley Unit 1 and 2 that the peak accident pressure inside containment would be 48.4 PSIG resulting from a LOCA. As the March 14, 1984, States letter, Attachment 3, indicates that the older TYPE NT blocks with C-501 Phenolite barrier strips were manufactured until 1973, it is assumed that the TYPE NT blocks which were LOCA tested in 1973 and documented by the referenced G.E. report, Attachment 6, were the older TYPE NT terminal blocks. Based on this assumption, and the G.E. report conclusion that no significant deterioration of the blocks was observed in the G.E. LOCA test which exceeded the Farley accident temperature and pressure profiles, it can be concluded that use of the older C-501 Phenolite barrier strips on the TYPE NT terminal blocks will not significantly affect the LOCA/MSLB pressure-temperature environmental qualification of the TYPE NT blocks. To further substantiate this conclusion, data concerning the heat resistance properties of C-501 Phenolite material was obtained from the material manufacturer National Vulcanite Fiber. (Reference Attachment 7). C-501 Phenolite has a continous heat resistance rating of 250°F and a short time heat resistence rating of 300°F. Based on the established MSLB accident temperature profile, Attachment 8, which was used for determination of the junction box/terminal block peak surface temperature of 300°F inside containment, the junction boxes/terminal blocks would be exposed to a temperature above 250°F for a period of less than 40 minutes.

The referenced G.E. test did not subject the terminal blocks to radiation testing; therefore, to determine the affects of radiation on the older C-501 Phenolite barrier strips, a materials search in the EPRI document entitled "Radiation Effects on Organic Materials in Nuclear Plants", EPRI NP-2129, dated November 1981 was conducted. The C-501 Phenolite used to fabricate the barrier strip is classified as a phenolic base laminate.

Page 3-3 of EPRI NP-2129 states that phenolic laminates exhibit very good stability in radiation fields and that electrical properties are generally stable to high doses. Table 4-1 on Page 4-6 of the referenced EPRI report indicates that certain phenolic laminates such as asbestos phenolic laminates have been identified with a lowest reported threshold of 10^9 rads. In Farley Units 1 and 2 containments, a total operating and accident integrated radiation dose of $5x10^7$ rads has been determined for radiation qualification requirements. Based on the known radiation properties of phenolic laminates discussed in the referenced EPRI report, in our engineering judgement, the C-501 Phenolite barrier strips will have no significant radiation degradation when exposed to a total integrated dose of $5x10^7$ rads.

Based on the temperature - pressure, and radiation evaluations performed for the C-501 Phenolite barrier strips outlined above, and due to the similarity of the older TYPE NT terminal blocks to the newer TYPE NT terminal blocks, the environmental qualification of the newer TYPE NT terminal blocks documented in WYLE Report 44354-1 can be extended to include the older TYPE NT terminal blocks with C-501 Phenolite barrier strips. It should also be noted that based on States letter dated March 14, 1983, Attachment 3, the TYPE NT and the TYPE ZWM blocks are manufactured to the same Quality Assurance program and the new TYPE NT and the TYPE ZWM blocks are manufactured from the same materials with the exception of the clamp screws which are a rust proof Everdur bronze clamp screw on the TYPE ZWM. Therefore, the environmental qualification of the States TYPE NT terminal blocks documented in WYLE Report 44354-1 can also be extended to environmentally qualify the States TYPE ZWM terminal blocks for use in Farley Units 1 and 2. As States considers the TYPE ZWM terminal block as a Class IE terminal block for use outside containment by their qualification requirements, and due to the statement in Item 2.a of Attachment 3, it is recommended that for future design changes to Farley Units 1 and 2 States TYPE ZWM terminal blocks be specified.

During the March 1984 walkdown of the Unit 1 containment junction boxes/ terminal blocks to establish the installed States block types, it was observed that various junction box types were used to enclose the States TYPE NT terminal blocks. The junction boxes used in the WYLE environmental and seismic qualification testing documented by WYLE Report 44354-1 were NEMA TYPE 4, continuous hinge, clamp cover boxes, Hoffman Engineering Cat No. A-1412 CHNF. The March 1984 walkdown data on the installed boxes indicate that approximately 50 percent of the junction boxes walked down are identical in construction to the junction boxes qualified by the referenced WYLE report. The other types of junction boxes observed differed primarily in the method of box cover attachment to the junction boxes. Junction boxes were observed of the lift - off hinge, clamp cover design similar to Hoffman Cat No. A-1412LP, and with gasketed screw covers similar to Hoffman Cat No A-12126GSC. For the lift - off hinge, clamp cover boxes, the number of cover attachment clamps varied. The other basic box construction details (steel gauge, continuously welded seams, and neoprene gasketing to seal the cover) were similar to the NEMA 4 junction boxes qualified by the referenced WYLE report.

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In the installed configuration, the junction boxes are vented through conduit entrances which will equalize the pressure in the junction boxes for a postulated LOCA design basis event. (Reference AP-3647 dated May 30, 1979). The differences in the attachment of the covers on the junction boxes should not affect the ability of the boxes to withstand the LOCA pressure profile. Therefore, the environmental qualification of the junction boxes/terminal blocks documented in WYLE Report 44354-1 can be extended to cover the other types of junction boxes observed in the March 1984 containment walkdown. Due to the differences in the box cover attachment methods, Bechtel is proceeding with additional seismic analysis of the various typical box configurations observed in the containment walkdown to verify the seismic qualification of the boxes.

If you have any questions or comments, please contact us.

Yours very truly,

Jene E Love for

K. C. Gandhi
Project Engineer

KCG/JEL/DGB:ls
Enclosures:
See List of Attachments
cc J. R. Crane, w/l
L. B. Long, w/l
J. M. Wheless, w/l
R. P. McDonald
R. L. George, w/l
B. D. McKinney, Jr., w/l
M. A. Lalor, w/l
D. H. Jones, w/l
V. C. Valekis
W. G. Hairston, II.

bcc R. Poland
J. E. Love, w/l
D. G. Butani, w/l
R. J. Puhl, w/l ✓

AP-9097

LIST OF ATTACHMENTS

0063885

ATTACHMENT #1	The States Company Bulletin 4-TB
ATTACHMENT #2	Bechtel I.O.M. dated March 9, 1984 from Sterling Creamer to Jesse Love
ATTACHMENT #3	The States Company letter dated March 14, 1984 from W. C. Wright to K. C. Gandhi (Bechtel)
ATTACHMENT #4	The States Company letter dated April 3, 1984 from W. C. Wright to K. C. Gandhi (Bechtel)
ATTACHMENT #5	Results of walkdown performed by Bechtel during period March 24, 1984 to March 28, 1984 to determine old and new type NT blocks.
ATTACHMENT #6	General Electric letter dated November 27, 1973 along with qualification report "Terminal Block LOCA Test for Electrical Penetration Assembers" dated November 6, 1973.
ATTACHMENT #7	National Vulcanite Fiber Company Communication dated April 4, 1984 from J. Brabson to O. D. Kingsley (APCo) regarding C-501 Phenolite Laminate Sheets.
ATTACHMENT #8	Main steam line break temperature verus time profile for FNP

Attachment #1

The States Company
A Division of Multi-Amp Corporation
An Indian Head Company
4271 Bronze Way Dallas, Texas 75237 USA Telephone (214) 333-3201 TWX 910-861-9052

0063886

STATES® TYPE NT AND ZWM TERMINAL BLOCKS

Catalog No. M-25036 with Raised Marker Strip

TERMINAL BLOCKS ARE AVAILABLE WITH 2 THROUGH 73 POLES

APPLICATION

This is the popular terminal block so widely acclaimed for its unique disconnect feature. Designed to provide a junction between switchboard wiring and cable wires, the States Terminal replaces the standard stud and straight-strap type of connection with its sliding link connection.

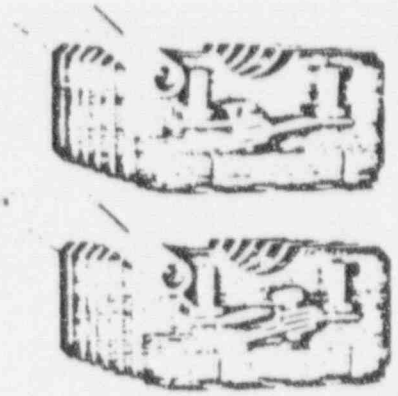
Easily and quickly operated, the sliding link provides the means for inserting an indicating instrument or artificial load into the circuit without removing any wiring. States® Terminal Blocks greatly simplify systems checkout by the test technician and eliminate the possibility of error in reconnection.

FEATURES

1. Sliding link—quickly opens and closes circuit to permit testing without disturbing any wiring.
2. Unit pole construction—up to 73 poles available.
3. Space saving—5/8" center-to-center between poles
4. High barrier between poles
5. Rated 600 volts, 30 amperes
6. Marking strips or tags available—make coding of each circuit fast and easy.
7. Available as either front-connected or back-connected blocks
8. Heavy nickel-plated, brass contacts
9. Covers available

SLIDING LINK DISCONNECT

Checkout circuits without disturbing permanent wiring. Simply connect instruments to terminal posts, loosen and slide link open — take reading — slide link back and tighten. Photo illustrates marker strip swung out of way for testing.



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INSTALLATION

States Terminal Blocks can be mounted in any convenient manner; however, they are usually installed on the back of a switchboard panel either vertically or horizontally. In applications where it is desired to mount the blocks on the front of the panel, they can be provided with feed-through studs for connection to the wiring on the rear of the panel. To save the time of removing terminal nuts, this hardware is shipped loose in a bag. The nuts take a standard 5/16" socket wrench. For drilling dimensions of both back- and front-connected blocks, see page 6.

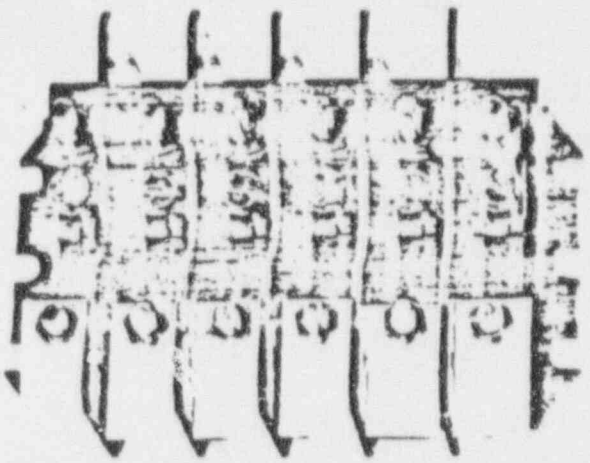
OPERATION

States Terminal Blocks are safe, convenient and simple to use. Barriers prevent shorting between poles, and there are no parts or wires to remove. To insert an indicating instrument or artificial load, the test leads are first attached to the terminal studs of the block; then the normal circuit is opened by loosening the clamping screw in the sliding link. The clamping screw may be operated with either a screwdriver or the same socket wrench used on the terminal nuts.

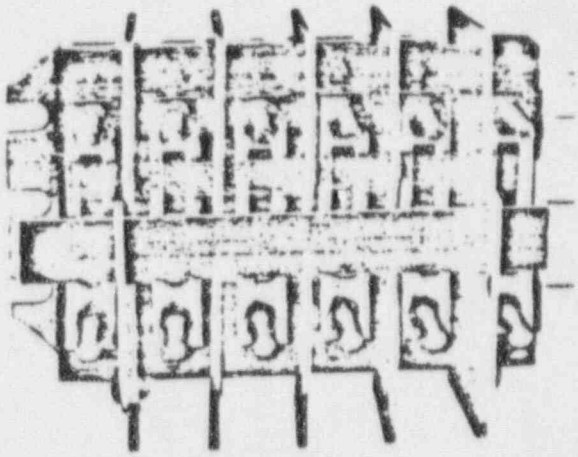
MARKER STRIPS OR TAGS PERMIT EASY CODING OF CIRCUITS

To provide a ready means of coding each circuit running through the terminal block, a marker strip or individual marker tags can be provided. The marker strip can be furnished on any block having 3 or more poles, and is a strip 7/16" wide. The strip is hinged to the barrier and can be easily swung out of position so that the sliding link can be operated. Marker strips are available with a white surface or, for etching purposes, as a black surface with white center. If desired, individual marker tags for each pole are available in place of a marker strip. Available in red or white, marker tags are mounted on the studs of the terminal.

FRONT-CONNECTED BLOCKS

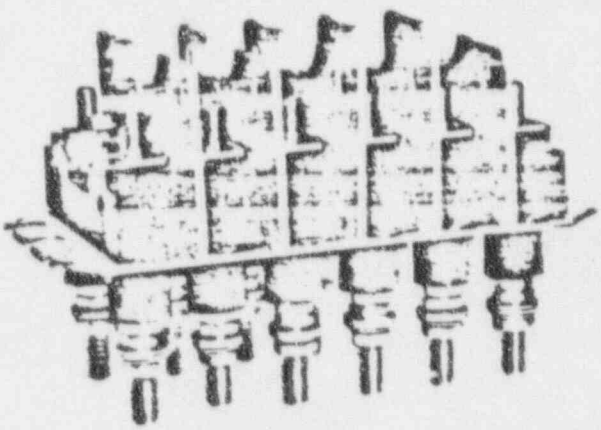


Terminal Block with Marker Tags

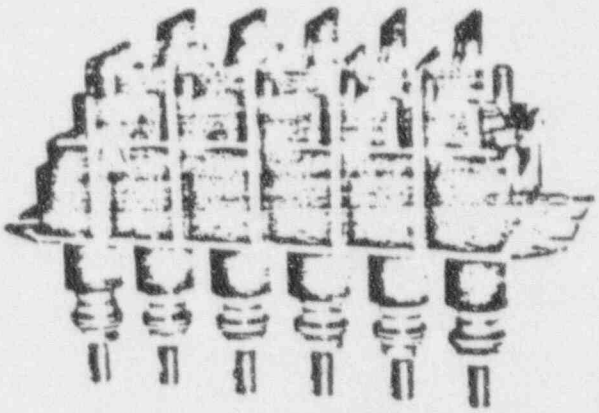


Terminal Block with Marker Strip in Operating Position

BACK-CONNECTED BLOCKS



Back-Connected Block



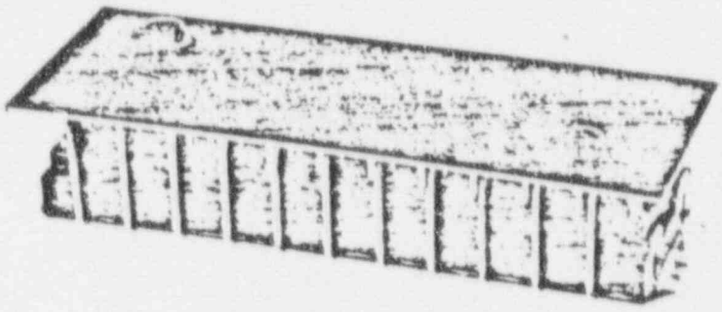
Front- and Back-Connected Block

The back-connected blocks are constructed the same as front-connected blocks except that the studs penetrate to the rear of the panel. Nuts and washers are supplied for use with the stud at the rear of the panel, and a terminal stud for connecting a test clip is at the front of the block. If your application requires, these blocks can be provided for front-connection at one side of each pole and back-connection at the other side.

COVERS

Covers are available for either front- or back-connected terminal blocks. Covers are a flat phenolic laminated sheet that covers the entire face of the block. The covers are fastened to studs in the end poles of the block by two captive, insulated knobs.

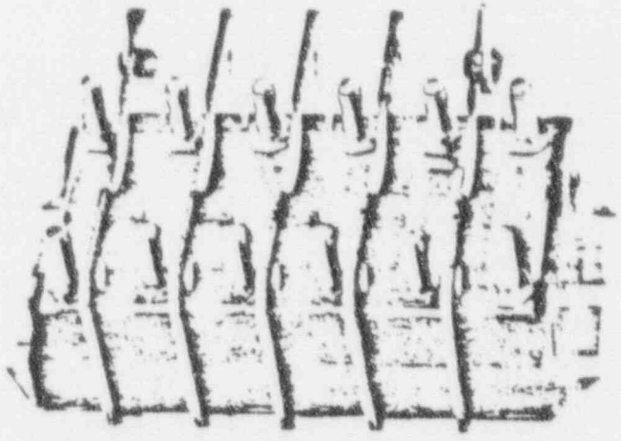
Front-Connected
Block With Cover



STRAIGHT STRAP

When the disconnect feature of the sliding link is not required, the blocks can be provided with a straight-strap connection. These blocks have the same construction and dimensions as the standard blocks. Poles with straight-strap connection can be combined on the same block with poles having the sliding link.

Block With
Straight Strap



NOTE

In special applications where flame retardant properties are desired, States Terminal Blocks can be provided with self-extinguishing barriers and marker strips. Designated by the prefix "ZWM", these blocks also include an Everdur bronze clamping screw in the sliding link. Self-extinguishing covers are available as an optional feature.

Continued . . .

SPECIFYING STATES TERMINAL BLOCKS

As this Bulletin illustrates, States Terminal Blocks are available in a wide variety of configurations and with many optional features to suit your specific applications and requirements.

All blocks are specified by a catalog number consisting of five digits, which may be preceded by any of several letters to designate desired features. Use the following code to determine the catalog number of blocks having the features you desire.

SPECIFYING CODES

PREFIXES—

- M: White Marker Strip
- K: Black Marker Strip with White Center (for engraving)
- SM: Individual White Marker Tag
- FM: Individual Red Marker Tag
- B: Cover
- ZWM: Self-extinguishing barriers and Marker Strip; Everdur Bronze Clampir Screws

FIRST 3 DIGITS—

- 250 = Sliding Link, Front-Connected
- 251 = Straight Strap, Front-Connected
- 252 = Sliding Link, Front-Connected on Top, Back-Connected on Bottom, Long Studs for Insulated Panel Mounting
- 253 = Sliding Link, Back-Connected, Long Studs for Insulated Panel Mounting
- 254 = Sliding Link, Back-Connected on Top, Front-Connected on Bottom, Long Studs for Insulated Panel Mounting
- 255 = Sliding Link, Back-Connected, with Bushings
- 256 = Sliding Link, Back-Connected Top, Front-Connected Bottom, Short Studs and Bushings
- 257 = Sliding Link, Front-Connected Top, Back-Connected Bottom, Short Studs & Bushings

FOURTH DIGIT AND FIFTH DIGIT—Number of Poles in Block

EXAMPLES

M-25012: Designates a 12 pole block with sliding link and white marker strip.
In this case, M = White Marker Strip; 250 = Sliding Link Front-Connected; 12 = 12 poles

BSM-25506: Designates a 6 pole, back-connected block with cover and white marker tags.
In this case, B = Cover; SM = Individual White Marker Tag; 255 = Sliding Link, Back-Connected; 06 = 6 poles

Continued . . .

DIMENSIONS

NUMBER OF POLES	A	B	C	COVER LENGTH D	E
1	1 3/8	31/32	31/64		1/8
2	2	1 29/32	1 31/64	1 3/8	1 1/4
3	2 7/8	2 7/32	1 31/64	2 3/8	1 3/8
4	3 1/4	3 7/32	3 31/64	3	2 1/2
5	3 5/8	3 15/32	3 31/64	3 3/8	3 1/8
6	4 1/4	4 3/32	3 63/64	4 1/8	3 3/4
7	4 5/8	4 7/32	4 31/64	4 3/8	4 3/8
8	5 3/8	5 1/32	4 63/64	5 1/8	5
9	6 3/8	5 15/32	5 63/64	6 1/8	5 5/8
10	7	6 13/32	6 31/64	6 3/8	6 1/8
11	7 3/8	7 7/32	6 63/64	7 3/8	6 7/8
12	8 1/4	7 29/32	7 31/64	8	7 1/2
13	8 7/8	8 5/32	8 3/64	8 7/8	8 1/8
14	9 1/8	9 3/32	8 63/64	9 1/8	8 3/4
15	10 1/8	9 29/32	9 31/64	9 7/8	9 3/8
16	10 3/4	10 7/32	9 63/64	10 1/4	10
17	11 3/8	10 29/32	10 31/64	11 1/8	10 5/8
18	12	11 13/32	11 31/64	11 3/4	11 1/4
19	12 3/8	12 5/32	11 63/64	12 3/8	11 7/8
20	13 1/4	12 29/32	12 31/64	13	12 1/2
21	13 7/8	13 13/32	12 63/64	13 5/8	13 1/8
22	14 1/2	14 5/32	13 31/64	14 1/4	13 3/4
23	15 1/8	14 29/32	14 31/64	14 7/8	14 3/8
24	15 3/4	15 7/32	14 63/64	15 1/2	15
25	16 3/8	15 29/32	15 31/64	16 3/8	15 5/8
26	17 1/8	17 1/32	16 31/64		
27	18 1/4	17 25/32	17 31/64		
28	18 7/8	18 17/32	17 63/64		
29	19 1/2	19 9/32	18 31/64		
30	20 1/8	19 23/32	19 31/64		
31	20 3/4	20 1/32	19 63/64		
32	21 3/8	20 25/32	20 31/64		
33	22	21 17/32	21 31/64		
34	22 5/8	22 9/32	21 63/64		
35	23 1/4	22 27/32	22 31/64		
36	23 7/8	23 19/32	22 63/64		
37	24 1/2	24 3/32	23 31/64		
38	25 1/8	24 23/32	24 31/64		
39	25 3/4	25 15/32	24 63/64		
40	26 3/8	25 31/32	25 31/64		
41	27	26 19/32	26 31/64		
42	27 5/8	27 7/32	26 63/64		
43	28 1/4	27 27/32	27 31/64		
44	28 7/8	28 21/32	28 31/64		
45	29 1/2	29 3/32	28 63/64		
46	30 1/8	29 23/32	29 31/64		
47	30 3/4	30 17/32	29 63/64		
48	31 3/8	30 31/32	30 31/64		
49	32	31 19/32	31 31/64		
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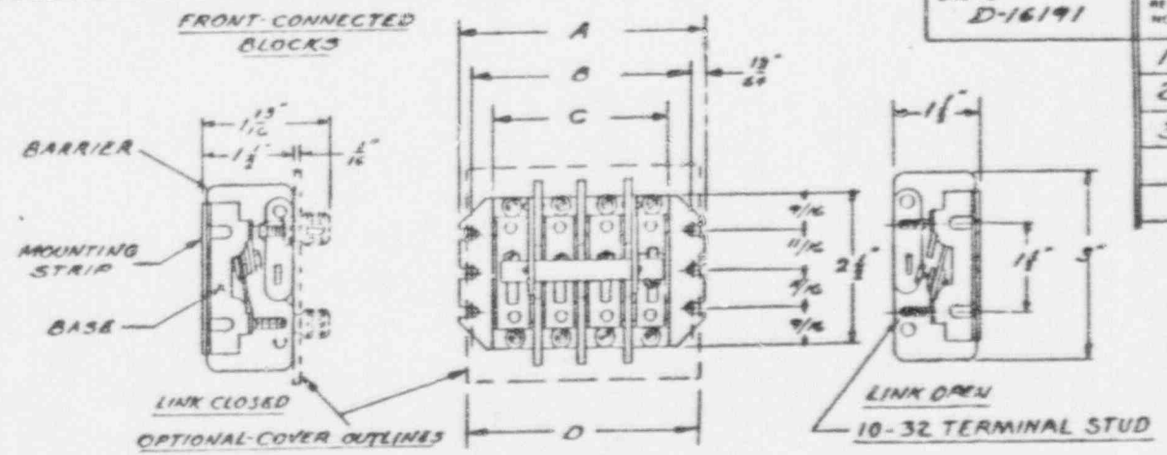
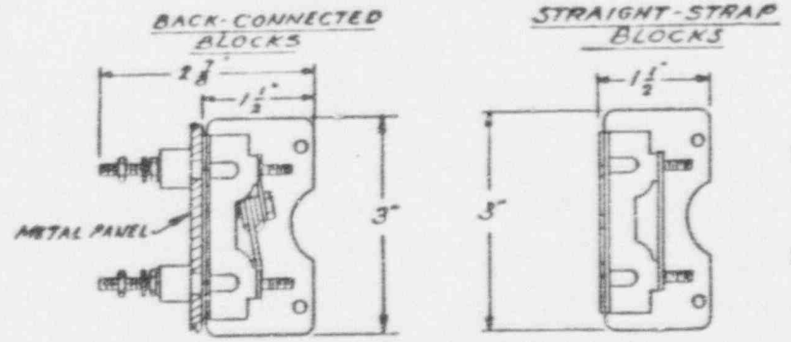
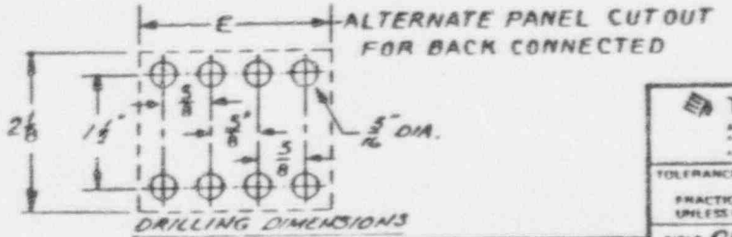
52	34 1/8	33 3/32	33 31/64		





NOTES:

1. Both the Sliding Link and straight strap types have same dimensions.
2. To provide extra mounting support, at 26 poles one blank space is added; at 51 poles, two blank spaces are added.



DWG NO	REV NO	ECN NO
D-16191	1	3425
	2	3888 10-6-77
	3	3557

The States Company

TOLERANCES	DRN JWB	NO 174	SCALE NONE
FRACTIONAL ±1/64 UNLESS NOTED	CHK'D.	DATE 7-20-77	SHT 1 OF 1

TITLE DIMENSIONS OF THE NT, IWM & STRAIGHT STRAP TYPE TERMINAL BLOCKS, FRONT & BACK CONNECTED.

PART NO. | DWG NO D-16191 | REV 3

0063891

ATTACHMENT #2

Bechtel Power Corporation

Interoffice Memorandum

To Jessie Love

Date March 9, 1984

Subject S.V. Junction Box Qualifications
Farley Nuclear Project

From Sterling Creamer

Of

0063892

Copies to

At

The S.V. Junction Boxes tested at Wiley Lab. for the Farley Nuclear Project were typical of the boxes approved for use in the containment at that time. The terminal blocks were also the approved type as manufactured by States. The terminal blocks were black with black barrier strip. At the time the only reason for the test was to qualify the existing installation. All existing installations at that time used only the black with black barrier strips. Farley at that time did not use any States blocks with an off color barrier strip.

I checked with Floyd Averill, Electrical Superintendent at the time and his recollection is the same as mine. He remembers the block numbers to be 25012 with 12 designating the number of terminal points.

Sterling Creamer

Sterling Creamer

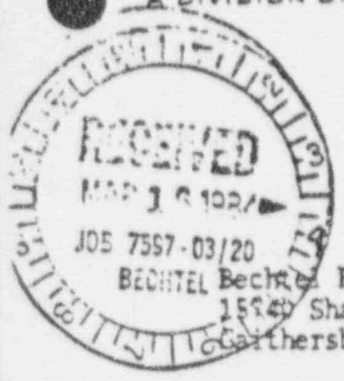
8024 (10-72)

ATTACHMENT #3

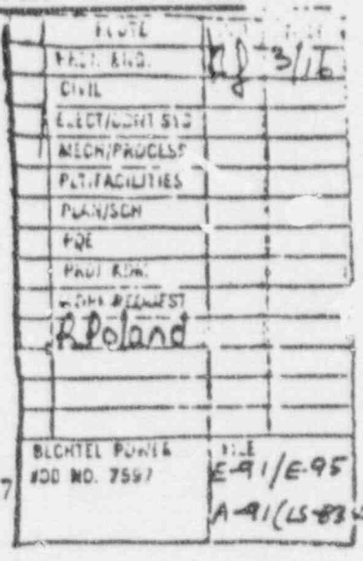
THE **states** COMPANY
A DIVISION OF MULTI-AMP CORPORATION

0063893

4271 Bronze Way Dallas Texas 75237 U.S.A. (214) 333-3201 TWX 910-861-9052



March 14, 1984



Bechtel Power Corporation
15740 Shady Grove Road
Gaithersburg, Maryland 20877-1454

Attention: Mr. K. C. Gandhi
Project Engineer

SUBJECT: Joseph M. Farley Nuclear Plant Units 1 & 2
Bechtel Job 7597-038, States Blocks
(LS-83-066) Bechtel Files A-91 & E-91 V-4087

Gentlemen:

The following is sent in response to your telecopy and questions therein sent on March 12, 1984.

1. NT blocks were first manufactured in Hartford, Connecticut starting around 1926. The barrier used at that time and continued to be used until about 1973 was of a stamped canvas base bakelite material - black.

   a. Barriers on present day NT blocks will have a color varying from black to dark and lighter grey depending on the color mix that the molder employs.

   b. Old barrier - canvas base bakelite, Grade C semi-gloss finish. New barrier - polypropylene Allied Chemical Grade FP-1080 flame retardant. Enclosed is a materials list for ZWM Terminal Blocks. NT is the same except for black (grey) barrier and Everdur bronze clamp screw.

      Material change occurred when it became cost prohibitive on stamped parts. We took a look at polypropylene as an alternative because it offers superior breakdown protection as well as being flame retardant. This quality is a necessity for the ZWM and is used in a black color for NT.

   c. Blocks have been manufactured basically the same since about 1926. Materials and tools have been consistently upgraded through the years. Terminal Blocks are manufactured under a quality control manual and must meet strict standards within the manual guidelines.

- continued -

2. The actual date when ZWM Terminal Blocks were first manufactured is difficult to pin down exactly. It would have been late 1949 to early 1950's. The original specifier was Con-Edison Company of New York. They wanted an NT block with flame-proof barrier and a clamp screw that didn't rust. The original barrier on ZWM was stamped glass melamine. Because of glass melamine fibers causing skin problems and the difficulty of obtaining good stampings we again decided to go with tan (buff) colored polypropylene molded barriers for ZWM.

   a. As outlined above both black NT and tan ZWM barriers are made of polypropylene which is flame-retardant. We guarantee that ZWM barriers will be flame-retardant. We may choose to go with a less expensive barrier without flame-retarding on NT blocks if it works to our advantage to do so. This probably won't happen but since it is not in the NT specification that all parts be flame-retardant the option is there.

   b. NT and ZWM blocks are manufactured to the same Quality Assurance program.

Comment: We are well aware that other panelboard builders, utilities and engineering service companies have had the NT blocks qualified for nuclear applications. We chose to have our ZWM block qualified for Class 1E application-outside containment because it has flame-retardant barrier as well as rust proof Everdur bronze clamp screws.

I hope that the information given herein is sufficient. If we have omitted something critical to your problems solution let me know. We have a big gap of years to cover when discussing prior manufacturing procedures and materials, but I feel that I've answered as accurately as possible.

Yours very truly,

THE STATES COMPANY Division of
MULTI-AMP CORPORATION

W. C. Wright
Product Manager

WCW/ih
enclosures

0063895

4271 Bronze Way Dallas Texas 75237 • (214) 333-3201 • TWX 910-861-9052

STATES
Division of multi-amp Corporation

ZNN TERMINAL BLOCK MATERIALS

METAL PARTS

All current carrying parts are made of copper alloy. They are nickel plated to standard commercial thickness.

The current carrying parts are mounted on a base of molded phenolic to make up a terminal element or pole.

The poles are attached by nickel plated steel screws to galvanized steel strip to make a terminal block assembly.

Barriers between terminal elements are made of flame retardant grade polypropylene.

CONTINUOUS USE TEMPERATURE RATINGS

Molded Base - Material: General Purpose Durez #791 Black
Temperature UL Rating 150°c
Flammability Classification: UL-94 VI, ASTM D-635-56T-Self Extinguishing

Barrier - Material: Polypropylene, Allied Chemical Grade FP-1080 Flame Retardant.
Continuous Use Temperature Rating - 105°c
Flammability - UL-94 VO, ASTM D-635 Non Burning
or Novamont Corp. Moplen Grade CRVO-8

Sealing Compound - Mitchell Rand Mfg. Corp., Grade R-5770-FR-4
Flammability - UL94-VO

Marker Strip - Material: Laminated Melamine, - Grade 100 Low Glare

Rivet - Material: Nylon, Black
Max. Service Temperature 250 to 300°F

MOPLEN® POLYPROPYLENE DATA SHEET

manufactured at Neal, West Virginia
by NOVAMONT CORPORATION
a subsidiary of MONTEDISON

Novamont Corporation
1114 Avenue of the Americas
New York, NY 10036
Telephone: (212) 730-2650

0063896

MOPLEN CRVO-8
Heat-Resistant Flame-Retardant Grade

PROPERTIES	TYPICAL DATA	METHOD*
GENERAL		
Flow Rate, g/10 min	8.0	D 1238, L
Density, 23C, g/cm^3	1.30	D 792, A-2
Water Absorption, %	< 0.05	D 570
Mold Shrinkage, in./in.	0.010-0.020	D 955
MECHANICAL		
Tensile Yield Strength, psi	2750	D 638, Speed C
Yield-Point Elongation, %	3.5	D 638, Speed C
Izod Impact Strength, 23C, notched, ft-lb/in.	0.4	D 256, A
Elastic Modulus in Flexure, 1% Secant, psi	360,000	D 790, 1,A
Rockwell Hardness, R Scale	93	D 785, B
THERMAL		
Deflection Temp. Under Flexural Load, 66 psi, deg C	116	D 648
Melting Point, deg C	168	D 2117
UL-94 Flammability Classification	94V-0	
UL-Temperature Index	Pending	
ELECTRICAL		
Dielectric Constant, 1 MHz	2.5	D 150
Dissipation Factor, (X 10^{-4}), 1 MHz	5	D 150

* Latest ASTM Revision

N 376

Durez® MOLDING MATERIAL 791 BLACK PHENOLIC

Durez® 791 Black Phenolic is a two-stage, asbestos-free, general purpose molding material. It exhibits a balance of mechanical and electrical properties plus versatile moldability which account for its widespread use or many diverse applications. Durez® 791 Black is an "industry standard" for GP phenolic molding materials.

0063897

MATERIAL PROPERTIES:	
Bulk Factor	2.3
Apparent Density (g/cc)	0.58
Form of Material	granular
Feeding and Preforming	good
Storage Life	one year

MATERIAL TYPE:

General Purpose
ASTM Type 2
U.L. Temperature Index of 150°C

Plasticities available for compression and transfer molding.

MOLDED PROPERTIES:

	Conventional Units		International System of Units	
	Typical Compression		Typical Compression	
Specific Gravity	1.36		1.36	
Molding Shrinkage §	0.008	in/in	0.008	m/m
Tensile Strength	7,000	psi	48	MPa
Flexural Strength	11,000	psi	76	MPa
Compressive Strength	32,000	psi	221	MPa
Tensile Modulus	1.3×10^6	psi	9.0	GPa
Izod Impact	0.30	ft lb/in	16	J/m
Deflection Temperature	330	°F	166	°C
Water Absorption	0.70	%	0.70	%

Compression properties determined with test specimens compression molded at 340°F.

Refer to introduction for ASTM test methods.

§Typical transfer-molded shrinkage is 0.010 in/in or m/m.

0063898

791 BLACK PHENOLIC

ELECTRICAL PROPERTIES:

	Conventional Units		International System of Units	
	Typical Compression		Typical Compression	
Dielectric Strength				
Short Time	350	V/mil	13.8	MV/r
Step by Step	275	V/mil	10.8	MV/r
Dissipation Factor				
@ 60Hz	.06		.06	
@ 1KHz	.04		.04	
@ 1MHz	.03		.03	
Dielectric Constant				
@ 60Hz	5.6		5.6	
@ 1KHz	5.3		5.3	
@ 1MHz	4.6		4.6	
Volume Resistivity	1×10^{12}	ohm cm	1×10^{10}	ohm

Durez
Hooker

HOOKER CHEMICALS & PLASTICS CORP.
North Tonawanda, New York 14120

ATTACHMENT #4

0063899

THE **states** COMPANY
A DIVISION OF MULTI-AMP CORPORATION

4271 Bronze Way Dallas Texas 75237 U S A (214) 333 3201 TWX 910 861 9052

April 3, 1984

Bechtel Power Corporation
15740 Shady Grove Road
Gaithersburg, Maryland 20877-1454

Attention: Mr. K. C. Gandhi
Project Engineer

SUBJECT: Joseph M. Farley Nuclear Plant Units 1 & 2
Bechtel Job 7597-038, States Blocks
(LS-83-066) Bechtel Files A-91 & E-91 V-4087

Gentlemen:

Confirming conversations with Ron George, Doug McKinney and Mike Ialor of Alabama Power Company on April 2 and April 3, 1984 we offer additional information as follows:

According to the last available purchase history card on file we supplied States Terminal Blocks with TBT34 Barrier up to early 1973. TBT34 was stamped out of C-501 Phenolite. C-501 Phenolite has heat resistance °F short time of 275 and °F continuous of 225.

Yours very truly,

THE STATES COMPANY Division of
MULTI-AMP CORPORATION

W. C. Wright
W. C. Wright
Product Manager

WCW/lh

	ROUTE	INIT	DATE
	PROJ. ENG.	CG	4/3
	CIVIL		
/	ELECT/CONT SYS	JA	4/3
	MECH/PROCESS		
	PLT. FACILITIES		
	PLAN/SCH		
	PWR		
	QUAL ACM		
	WORK REQUEST		
BECHTEL POWER JOB NO. 7592		FILE E-91 E-95	

(A-78 MA 84 2595)

RECEIVED BY TELECOPY
APR 3 1984

ATTACHMENT #5

The following table lists the type of barriers identified on States TYPE NT terminal blocks during the walkdown conducted from March 24, 1984 to March 28, 1984.

EQUIPMENT TPNS NO.	NEW TYPE NT WITH MOLDED POLYPROPYLENE BARRIER	OLD TYPE NT BLOCK C-501 PHENOLITE BARRIER
11TB001		X
002		X
003		X
004		X
21TB001		X
002	X	
003		X
004		X
005		X
31TB001		X
002	X	
A1TB007	X	
B1TB025	X	
Q1B13G001-B		X
Q1B13SV2213A-A/JB	X	
SV2213B-B/JB	X	
SV2214A-A/JB	X	
Q1B13SV2214B-B/JB	X	
N1B13SV0444BA-B/JB		X
0445AA-A/JB		X
8047-B/JB	X	
Q1E12SV3999A-A/JB	Not walked down	
3999B-B/JB	Not walked down	
N1E21SV8149AA-A/JB		X
8149BA-A/JB		X
8149CA-A/JB	X	
8871-A/JB	X	
Q1G21SV3376-B/JB	X	
N1G21SV1003A-A/JB		X
7126-A/JB		X
Q1P13SV2867D-B/JB	X	
2866D-B/JB	X	
3196-B/JB		X
3197-B/JB		X

ATTACHMENT #5 (continued)

0063901

EQUIPMENT TPNS NO.	NEW TYPE NT WITH MOLDED POLYPROPYLENE BARRIER	OLD TYPE NT BLOCK C-501 PHENOLITE BARRIER
Q1P15SV3103-A/JB	X	
3104-A/JB	X	
3179A-A/JB	X	
3179B-A/JB	X	
Q1P15SV3179C-B/JB	X	
3180A-A/JB	X	
3180B-A/JB	X	
3180C-B/JB	X	
3181A-A/JB	X	
3181B-A/JB	X	
3181C-A/JB	X	
3765-A/JB	X	
3766-A/JB	X	
Q1P17SV3184-B/JB	X	
3443-A/JB	X	

0063902

GENERAL ELECTRIC

ATTACHMENT 6
NUCLEAR ENERGY DIVISION

NUCLEAR ENERGY MARKETING DEPARTMENT

GENERAL ELECTRIC COMPANY, 175 CURTNER AVENUE, SAN JOSE CALIFORNIA 95114
Phone (408) 287-3000, TWX No. 910-338-0118

November 27, 1973

W. H. Castner - Columbia

Mr. D. T. Jones
Bechtel Power Corporation
P. O. Box 607
Gaithersburg, Maryland 20760

Subject: E. I. Hatch Nuclear Plant Unit 2
Terminal Block Environmental Test

Reference: Bechtel Letter dated August 31, 1973

Dear Mr. Jones:

Enclosed are two copies of the Terminal Block LOCA Test Report you requested. As you can see, the results more than meet your requirements, as expected.

Approval of this document will enable General Electric to ship penetrations X-102A and X-103A when completed. Penetrations X-105A and X-105C will remain on hold until the short circuit test, scheduled in December, is completed.

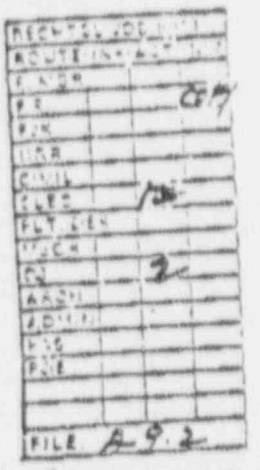
If you have any questions, please contact me.

Very truly yours,

W. E. Olson

W. E. Olson
Application Engineer
Mail Code 623

WEO:al
Enclosure



55-6903-303
55-2102-303

Terminal Block
LOCA Test
For Electrical Penetration Assemblies

By
R. M. Schuster
11-6-73

General Electric Company
BWRSD - C&I Engineering
Peripheral Equipment Engineering

1.0 PURPOSE

The purpose of this test is to determine the effect of the high temperature, pressure and humidity experienced during a LOCA on G.E. and States type terminal blocks.

2.0 REFERENCES

Letter from Bechtel Power Corporation to Mr. W. E. Olson dated August 31, 1973.

3.0 SUMMARY OF RESULTS

3.1 Results

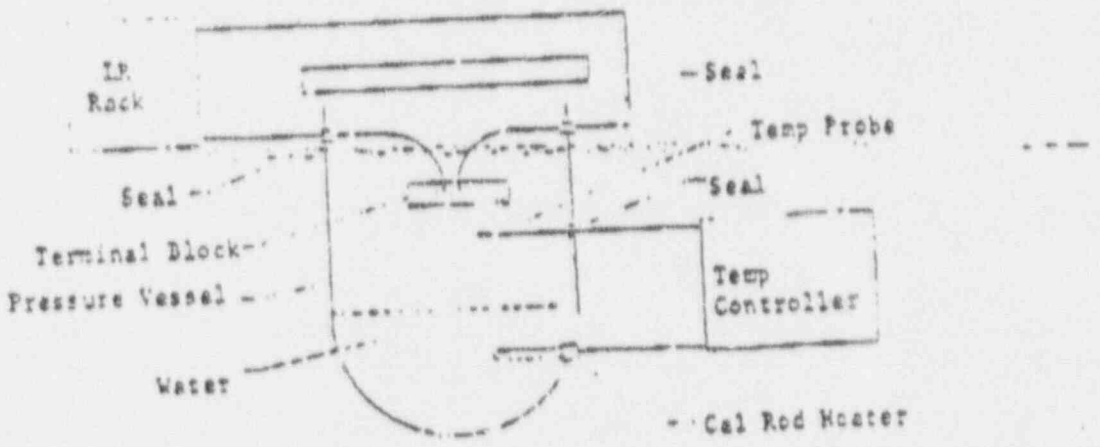
This test demonstrated that during LOCA conditions the insulation resistance on both types of terminal blocks would decrease from greater than 10^{10} ohms to approximately $2x.0^4$ ohms. After completion of testing the insulation resistance was $4.0x10^9$ ohms.

3.2 Conclusions

The results of this test showed that if the terminal blocks were subjected to LOCA conditions their insulation resistance can be expected to drop to approximately $2.0x10^4$ ohms. However the terminal blocks will almost fully recover to their initial values of insulation resistance once the steam environment is removed. Each type of block showed no deterioration after testing except for some slight discoloration of the phenolic material.

4.0 TEST PROCEDURE

4.1 Test Circuit Diagram



4.2 Description of Test

Two adjacent terminals of each terminal block were connected to an IR rack with #16AWG wire passing through two sealed ports in the pressure vessel. (See Test Circuit Diagram).

The insulation resistance was measured between the 2 terminals with 500 vdc power supply at ambient condition. The terminal blocks were then subjected to the LOCA condition as shown in Table 1. The insulation resistance was recorded at least once a day and at each significant temperature condition during the test. After completion of the 10 day test the cover was removed and the vessel was left open for 36 hours before final insulation resistance measurements were recorded. See Test Data Sheet for specific values.

TABLE 1

TEMPERATURE °F	260	320	340	320	260
PRESSURE PSIG	21	75	103	75	21
RELATIVE HUMIDITY %	100	100	100	100	100
DURATION	1.5 days	1.5 hrs	3 hrs	4.5 hrs	8 days

4.3 Test Equipment

Pressure Vessel
IR Rack
Chromel Alumel temperature probe
Temperature Controller
G.E. Terminal Block CR 151
States Co. Terminal Block type N.T.

0063906

TERMINAL BLOCK
TEST DATA SHEET

DATE	TIME	TEMP °F	PRESSURE PSIG	INSULATION RESISTANCE OHMS G.E.	INSULATION RESISTANCE OHMS STATES
10-10	Pretest	70°	0	>10^{10}	>10^{10}
				Start Test	
10-10	@20:15 hr	260°	21	2.2×10^{4}	2.4×10^{4}
10-11	@08:10 hr	260°	21	2.2×10^{4}	2.4×10^{4}
10-12	@09:30 hr	320°	75	2.2×10^{4}	2.6×10^{4}
10-12	@11.04 hr	340°	103	1.9×10^{4}	2.4×10^{4}
10-12	@14:04 hr	340°	102	1.9×10^{4}	2.4×10^{4}
10-12	@15.10 hr	320°	75	1.9×10^{4}	2.4×10^{4}
10-12	@18:30 hr	320°	75	2.2×10^{4}	2.4×10^{4}
10-13	@07:00 hr	260°	22	2.2×10^{4}	2.4×10^{4}
10-14	@08:00 hr	260°	21	2.2×10^{4}	2.4×10^{4}
10-15	@08:00 hr	260°	22	2.4×10^{4}	2.5×10^{4}
10-16	@08:00 hr	260°	22	2.2×10^{4}	2.4×10^{4}
10-17	@08:00 hr	260°	22	2.4×10^{4}	2.5×10^{4}
10-18	@08:00 hr	260°	22	2.4×10^{4}	2.5×10^{4}
10-19	@08:00 hr	260°	22		
10-20	@20:15 hr	260°	22	End Test	
10-22	Post Test	70°F	0	3.5×10^{9}	4.4×10^{9}

ATTACHMENT #7

7

0063907

WU TRAFFIC BHMA
ALA POWER FAIR
3:22PM CST
BMAD35(1543)(4-014372D095-001)PD 04/04/84 1526
ICS IPMBMAA BHM
SUSPECTED DUPLICATE: 4-0324345095 BMA D30 ICS IPMBNGZ CSP
2154442800 TDBN KENNETH SQUARE PA 57 04-04 0326P EST
PMS MR. D. D. KINGSLEY JR. (FAX)
PO BOX 2641
BIRMINGHAM AL 35203

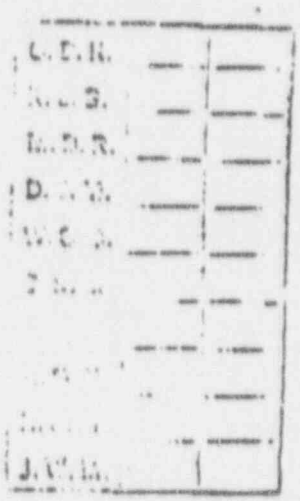
BT

DUPLICATE OF TELEPHONED TELEGRAM

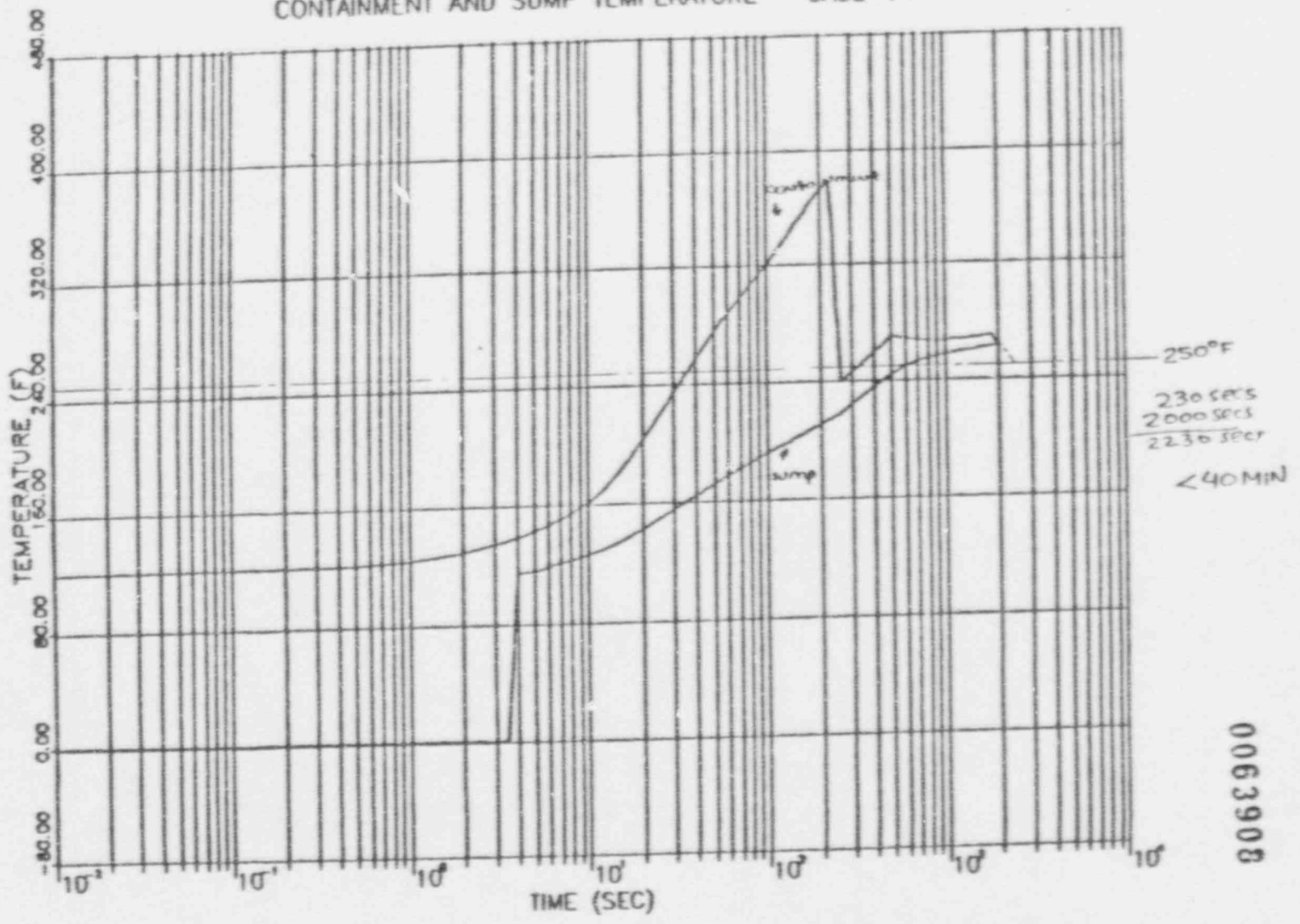
FILED 04-04 02:48 EST
5935095 04/04/84

THIS LETTER IS TO INFORM YOU THAT THE NVF COMPANY ACKNOWLEDGES THAT

SOME OF THE PROPERTIES OF CE01 ARE SIMILAR TO CE57S. AMONG THESE SIMILAR PROPERTIES IS HEAT RESISTANCE. HEAT RESISTANCE OF EITHER CE01 OR CE57S IS 300 DEGREES F SHORT TIME, 250 DEGREES F CONTINUOUS.
SINCERELY
J SRABSON PROCESS ENGINEER NVF COMPANY
NNNN
WU TRAFFIC BHMA
ALA POWER FAIR



CONTAINMENT AND SUMP TEMPERATURE -- CASE 4



8063908

ATTACHMENT #8

Alabama Power	JOSEPH M. FARLEY NUCLEAR PLANT UNIT 1 AND UNIT 2
TEMPERATURE VERSUS TIME STEAM LINE 0.645 ft^2 SPLIT 102% POWER	
FIGURE 6.2-13	

REV 1 7/83

4440 I