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50-348/364 -CIVP  
2/12/92

Staff Exh. 18

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Bechtel Eastern Power Corporation

Engineers — Constructors

OFFICE OF SECRETARY  
DOCKETING & SERVICE  
BRANCH

15740 Shady Grove Road  
Gaithersburg, Maryland 20877-1454  
301-258-3000 JUL 21 1987



In reply refer to AP-13169

Mr. W. G. Hairston, III  
Alabama Power Company  
600 North 18th Street  
Post Office Box 2641  
Birmingham, Alabama 35291-0400

Dear Mr. Hairston:

Joseph M. Farley Nuclear Plant Units 1 & 2  
Bechtel Job 7397-011  
EQ Solenoid Valve Splices - Justification for  
Continued Operation  
Bechtel File E-91  
AP-13169

In a telephone call on July 21, 1987 APCo (Mr. J. E. Garlington) requested Bechtel provide justification of continued operation for EQ solenoid valves which are deenergized to perform their accident mitigation function, and for EQ solenoid valve coil pigtail splices (terminations) located in the Main Steam Valve Room.

The requested justification for continued operation is attached.

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

Yours very truly,

*Jewel L. Zure Jr.*

K. C. Gandhi  
Project Engineer

KCG/AJD/DGB:rah

Enclosures

As stated above

cc J. R. Crane, w/1  
J. D. Woodard, w/1  
J. E. Garlington, w/1  
R. G. Berryhill, w/1

## NUCLEAR REGULATORY COMMISSION

Docket No. \_\_\_\_\_ Official Exh. No. 18  
In the matter of ALABAMA POWER CO.

Staff  IDEC, IED 2/29/82  
Att. Agent \_\_\_\_\_ RECEIVED 2/12/82  
Intervenor \_\_\_\_\_ REJECTED \_\_\_\_\_  
Com'lg Off'r \_\_\_\_\_ DATE 7-21-87  
Contractor \_\_\_\_\_ Witness \_\_\_\_\_  
Other \_\_\_\_\_  
Reporter A. L. Cope

Attachment 1 to AP-13169

Subject: Evaluation of potential deficiencies in pigtail splices (terminations) used for Safety Related Pilot Solenoid Valves in the scope of the Environmental Qualification program.

1.0 Introduction:

An evaluation has been performed to address two potential concerns. These concerns are:

- a. The safety function and associated position indication of air operated valves with pilot solenoid valves that are deenergized by the automatic actuation signal (e.g. Safety Injection, Containment Isolation, etc.) The applicable solenoid valves are listed in Appendix A.
- b. The safety function and associated position indication of air operated valves with pilot solenoid valves that are located in the main steam valve room and are energized on the automatic actuation signal (Steam Line Isolation). The applicable solenoid valves are listed in Appendix A.

2.0 Analysis

- a. Air operated valves with pilot solenoid valves that are deenergized by the automatic isolation signal.

A typical schematic of a safety related air operated valve which has its pilot solenoid deenergized following an automatic actuation signal (see Figure 1) shows that both current paths to the solenoid are interrupted. The direct path (path 1) is interrupted by the control switch contact 1A and the seal-in path (path 2) is interrupted by the contact of the automatic actuation signal (1-K605 contact 9-10, which opens). As a result no current path can be established regardless of the condition of the solenoid pigtail splices (terminations). It is noted that no other splices are present in the conduit system that contains the solenoid pigtail splices.

Page 2 of 4.

Since a current path cannot be established the solenoid will remain deenergized. Further, any postulated fault (e.g. short circuit) at the splice cannot affect the function of the position indication circuit since there is no potential available.

- B. Pigtails splices (terminations) for solenoids that are energized on receipt of automatic shutdown signal and are physically located in the Main Steam Valve Room:

A typical arrangement used for providing electrical conduit and junction boxes necessary for terminating the control wiring to the environmentally qualified solenoid valves located in the main steam valve room is shown in Figure 2. The solenoid valve coil is provided with qualified pigtails conductors which in some instances may not be of sufficient length to reach the solenoid valve junction box for termination to the qualified field control wiring. It is suspected that in these cases, qualified single conductor #12 AWG (Cable Code J02, JA2) was spliced/terminated using a detail similar to Figure 3. The splice (termination) to the coil pigtails is contained in a conductel or small junction box located in the conduit run between the solenoid valve junction box and the solenoid valve body conduit entrance. As shown in Figure 2, the solenoid pigtail conductor, the pigtail splice (termination) when used, and the field control cable and terminal block terminations are enclosed in the conduit and junction box raceway system.

The design basis accident environmental and flooding effects postulated to occur in the main steam valve room are addressed in FSAR Appendix 3K.4.1.1.8 and 3K.4.1.2.7. As shown in U-416797C and U-416798B, all environmentally qualified solenoid valves in system N11, N12, and N13 which are required to be energized for accident mitigation and their associated junction boxes (conductels), conduit and fittings are located above the maximum postulated flood level of

elevation 130' 5". As shown in FSAR Appendix 3K, Figures E-1A and E2, the postulated worst case temperature and pressure transient conditions predicted for a steam or feedwater line rupture are mitigated in less than two seconds with resulting predicted steady state temperature of 212 °F and pressure of 15.8 psia.

The materials and construction of the subject splices at Farley Nuclear Plant are expected to be able to withstand the conditions previously described as discussed below.

Okonite T-95 tape is rated for continuous use at 90 °C (194 °F) and emergency use at 130 °C (266 °F). Okonite product data sheet indicates that T-95 can be used at 130 °C emergency duty for five 100 hour cycles without loss of physical and electrical integrity. The solenoid coil circuit carries less than 0.5 ampere and conductor/splice is likely to run well below 90 °C limit.

Okonite test report NQRN-3 Rev. 1 documents acceptable qualification tests performed on 5 KV in-line splices using T-95 tape for insulation and T-35 tape for jacket. Splices were subjected to LOCA/HELB temperatures in excess of 308 °F for 10 hours.

Wyle test report 17859-02 coated V-configuration splices with T-95 tape for insulation & T-35 tape for jacket with no insulation tape in the crotch. All specimens except one passed LOCA/HELB test with peak temperature of 360 °F. The failure of the specimen was attributed to likely flashover to enclosure ground due to accumulation of chemical spray at bottom of test enclosure.

### 3.0 Conclusion:

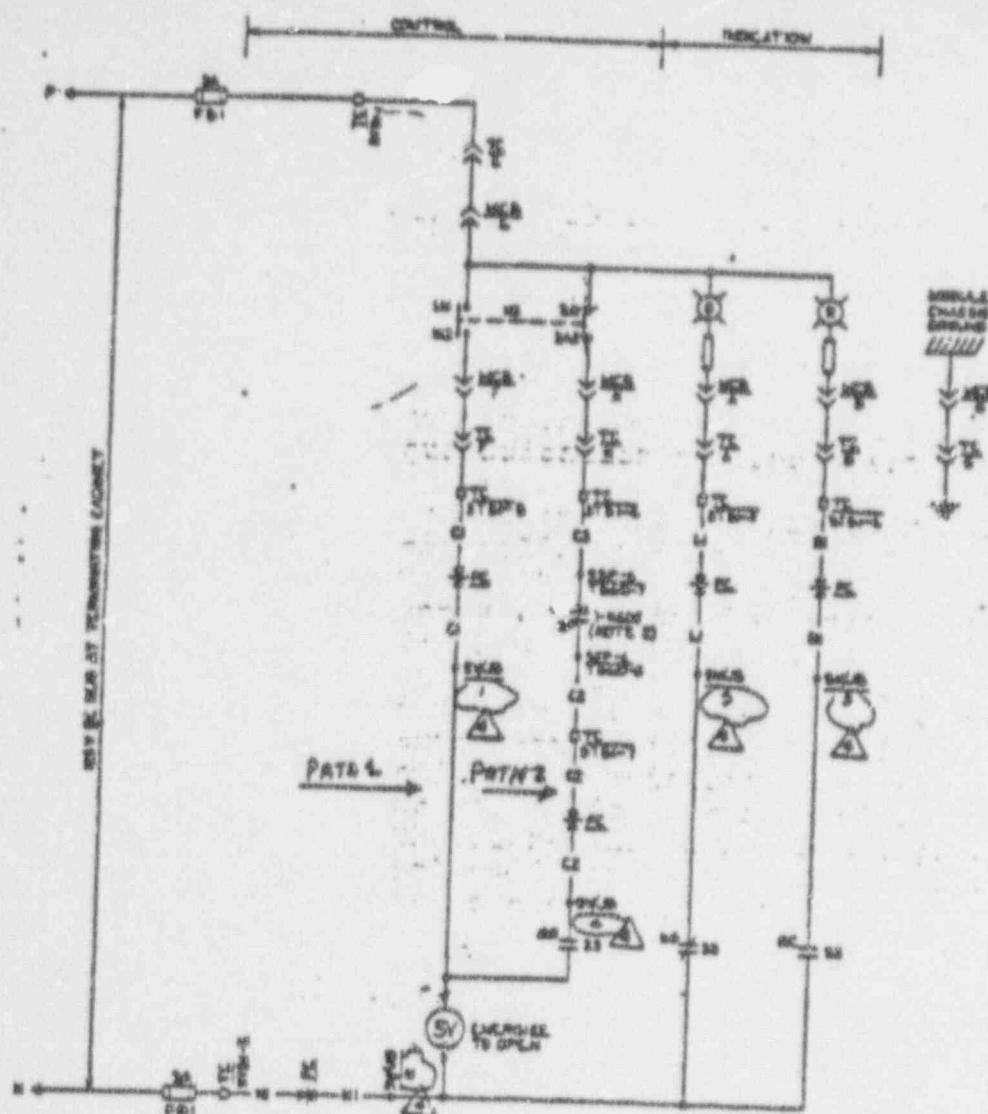
- a. Air operated valves with pilot solenoid valves that are deenergized by the automatic isolation signal.

The solenoid coil will remain deenergized and the position indication will function as designed on an automatic actuation signal regardless of the condition of the pigtail solenoid splice (termination).

- b. Pigtail splices (terminations) for solenoids that are energized on receipt of an automatic actuation signal and are physically located in the Main Steam Valve Room:

As indicated above, the T-95 tape has been qualified to more severe environmental temperature than anticipated to occur in the design basis condition for the main steam valve room. From qualification testing a similar V-splice conductor configuration, the only failure mode observed was due to an assumed flashover between the crotch of the splice and ground during LOCA/HELB testing where the test specimen was exposed to chemical sprays. Due to the enclosed configuration of the V-splice located in main steam valve room at Farley Nuclear Plant Units 1 and 2, and the short duration and nature of the worst case anticipated transient conditions, it is very unlikely that sufficient moisture would exist to cause a failure of the splice during accident mitigation. Therefore the required energized state of the solenoids and the function of the position indication will be maintained.

FIGURE 1



WIRING ROUTING SHEET	
CONTACT	WIRE NO.
NO. 1	1
NO. 2	2
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## CALCULATION SHEET

BEMO-2706 Rev. A/1

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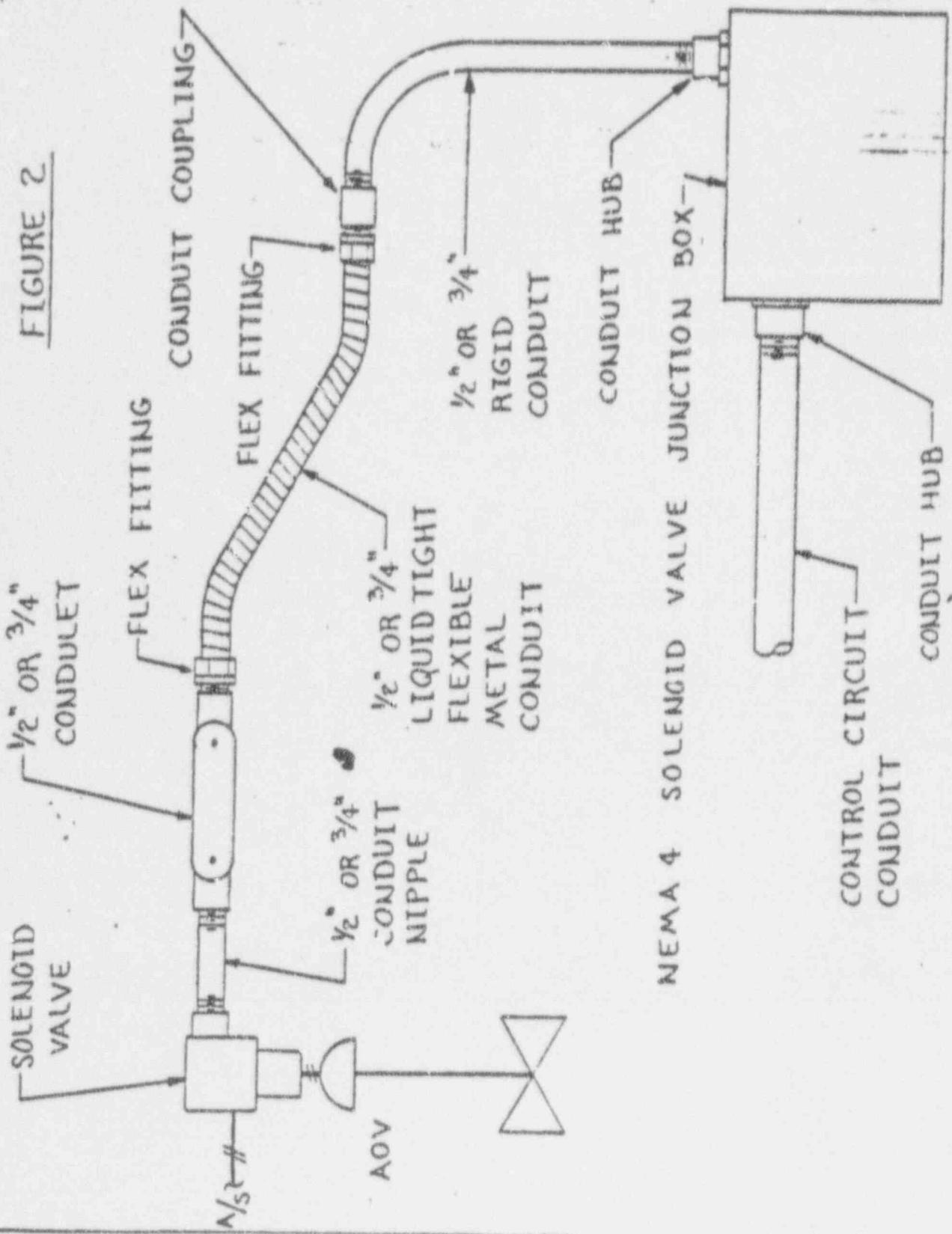
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FIGURE 2



## CALCULATION SHEET

BEPG-2700 Rev. 5/95

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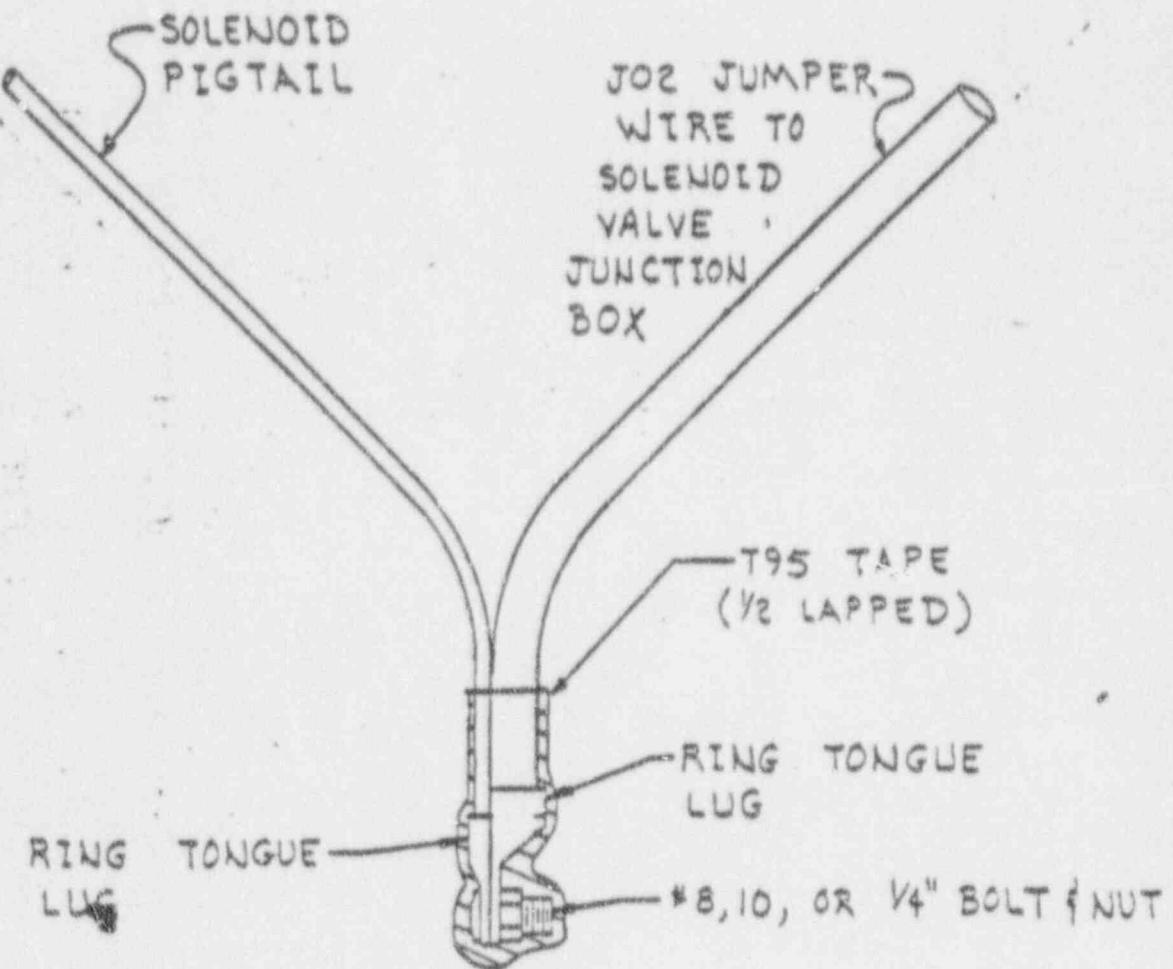
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FIGURE 3

## APPENDIX A

EQ SOLENOID DATA

PF 11

PLANT ID NO.	MANUFACTURER & MODEL	SERVICE	SCHEME NO	AUTO ACTUATION SIGNAL	VALVE POSITION FOLLOWING THE AUTO ACT.316	SOLENOID STATUS FOLLOW AUTO ACT. SIG.	REMARKS
		REACTOR COOLANT SYSTEM - PRESSURIZER					
WEDNESDAY 8047	ASCO, NP2556747	PRESS RELIEF TANK TO REACT. WIRE-UP WTR SPST ISDNH BY BOLT	197793	CIA	CLOSED	DEENERGIZED	
WEDNESDAY 8048A 044623	ASCO, NP2556747	PRESS POWER RELIEF VALVE	879381	HIGH PRESSURIZER PRESSURE	OPEN	ENERGIZED	
WEDNESDAY 8048B 044528	ASCO, NP2556747	PRESS POWER RELIEF VALVE	879381	HIGH PRESSURIZER PRESSURE	OPEN	ENERGIZED	

NOTE: SOLENOID VALVES ENCLOSED BY A BOX ARE ENERGIZED BY THE AUTO ACTUATION SIGNAL

PLANT ID NO	MANUFACTURER & MODEL	SERVICE	SCREW NO	AUTO ACTUATOR SIG-NRL	VALVE POSITION FOLLOWING THE SCREW AUTO ACT. SIR.	SOLENOID SCNS PNDN AUTO ACT. SIS	REMARKS
NICESTY D478A D478B	ASCO BY-206-381-26	FEEDWATER CONTROL SYSTEM MAIN FEED WATER CONTROL VALVE FCV 478	197913	SI & FI	CLOSED	DEENERGIZED	ONE OF THE TWO SOLENOIDS REQUIRED TO BE DEENERGIZED FOR VALVE TO CLOSE BOTH COIL'S PARALLEL
NICESTY D478A D478B	ASCO BY-206-381-26	MAIN FEED WATER CONTROL VALVE FCV 478	197916	SI & FI	CLOSED	DEENERGIZED	— * —
NICESTY D478A D478B	ASCO BY-206-381-26	MAIN FEED WATER CONTROL VALVE FCV 478	197917	SI & FI	CLOSED	DEENERGIZED	— * —
NICESTY D478A D478B	ASCO BY-206-381-412	MAIN FEED WATER BYPASS VALVE FCV 478	197915	SI & FI	CLOSED	DEENERGIZED	— * —
NICESTY D478A D478B	ASCO BY-206-381-212	MAIN FEED WATER BYPASS VALVE FCV 478	197916	SI & FI	CLOSED	DEENERGIZED	— * —
NICESTY D478A D478B	ASCO BY-206-381-412	MAIN FEED WATER BYPASS VALVE FCV 478	197917	SI & FI	CLOSED	DEENERGIZED	— * —

FI - Feedwater Isolation Signal  
(HI-HI steam generator level)

Plant ID no.	Supervising of valves	Valve ID	Sequence no.	Auto ACU/VAL	Auto ACU/VAL	Auto Position for switch pos	Auto ID/ID status, posn	Remarks
<u>Emergency Control of valves</u>								
Q11338 20093	A5C01 NP03104E	CY1149	111109	CY1149 H1 FAB (E 748)	Closed	Emergency		
Q11338 10013	A5C02 NP03104E	CY1149	111109	CY1149 H1 FAB (E 748)	Closed	Emergency		
Q11338 30013	A5C03 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C04 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C05 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C06 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C07 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C08 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C09 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C10 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C11 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C12 NP03104E	CIA	111109	CIA	Closed	Emergency		
Q11338 31113	A5C13 NP03104E	CIA	111109	CIA	Closed	Emergency		

PLANT ID NO	MANUFACTURER & MODEL	DESCRIPTION	PHONE NO	AUTO ACTUATION SIGNAL	VALVE POSITION FOLLOWING THE AUTO ACT.SIG.	SOLENOID STATUS FOLLOWING THE AUTO ACT.SIG.	REMARKS
		<u>Liquid Waste Isolation System</u>					
REACTOR 2976	ASCO INTEGRATOR	Containment Sump Isolation Valve HV 3376	197362	CIA	CLOSED	DEENERGIZED	
REACTOR 3976 3978	ASCO 206-281-487	Reactor Coolant Drain Tank Pump Isolation Valve LCV 1003	197388	CIA	CLOSED	DEENERGIZED	
REACTOR 3976	ASCO 477016847	Reactor Coolant Drain Tank Inlet HV 4126	197389	CIA	CLOSED	DEENERGIZED	
		<u>MAIN STEAM</u>					
QUARANTINE 3369AC	ASCO 4770168367	Main Steam Isolation Valve HV 3369A	197863	SLI	CLOSED	ENERGIZED	
QUARANTINE 3369BC	ASCO 4770168367	Main Steam Isolation Valve HV 3369B	197863	SLI	CLOSED	ENERGIZED	
QUARANTINE 3369CC	ASCO 4770168367	Main Steam Isolation Valve HV 3369C	197863	SLI	CLOSED	ENERGIZED	

SLI - STEAM LINE ISOLATION SIGNAL

PLANT ID NO	MANUFACTURER & MODEL	SERVICE	SCHEME NO	AUTO ACTUATION SIGNAL	VALVE POSITION FOLLOWING THE AUTO ACT.SIG.	SOLENOID STATUS FOLLOW AUTO ACT.SIG.	REMARKS
		<u>MAIN STEAM ISOLATION</u>					
GENESIS 3370AC	ASCO NPB316E36V	MAIN STEAM ISOLATION VALVE HV 3370A	PT7847	SLI	CLOSED	ENERGIZED	
GENESIS 3370BC	ASCO NPB316E36V	MAIN STEAM ISOLATION VALVE HV 3370B	PT7847	SLI	CLOSED	ENERGIZED	
GENESIS 3370CC	ASCO NPB316E36V	MAIN STEAM ISOLATION VALVE HV 3370C	PT7847	SLI	CLOSED	ENERGIZED	
GENESIS 3368AA	ASCO NPB316E36V	MAIN STEAM ISOLATION BYPASS VALVE HV 3368A	PT7846	SLI	CLOSED	DEENERGIZED	
GENESIS 3368BA	ASCO NPB316E36V	MAIN STEAM ISOLATION BYPASS VALVE HV 3368B	PT7846	SLI	CLOSED	DEENERGIZED	
GENESIS 3368CA	ASCO NPB316E36V	MAIN STEAM ISOLATION BYPASS VALVE HV 3368C	PT7846	SLI	CLOSED	DEENERGIZED	
GENESIS 3378A	ASCO NPB316E36V	MAIN STEAM ISOLATION BYPASS VALVE HV 3378A	PT7846	SLI	CLOSED	DEENERGIZED	
GENESIS 3378B	ASCO NPB316E36V	MAIN STEAM ISOLATION BYPASS VALVE HV 3378B	PT7846	SLI	CLOSED	DEENERGIZED	

PLANT ID NO	MANUFACTURER & MODEL	SERVICE	SOURCE, HP	AUTO WCR/ATM/RELAY SIGNAL	INITIAL POSITION FOLLOWING THE STATUS FOUND 9070 ACT.SHA AUTO ACT.SHA	REMARKS
QIN125V3276C	ASCO NP8320A196E	<u>MAIN STREAM ... COOL</u>  <u>AUXILIARY FEED WATER</u>	STEAM	CLOSED	DEENERGIZED	
QIN125V3278AA	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228A	177590	SG LOW-LINE LEVEL & ON RCP BUSES	OPEN	ENERGIZED
QIN125V3228AB	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228A	177590	(MANUAL)		EMERGENCY TO CLOSE DEENERGIZED TO MOD
QIN125V3228BA	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228B	177590	SG LOW-LINE LEVEL & ON RCP BUSES	OPEN	ENERGIZED
QIN125V3228BB	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228B	177590	(MANUAL)		EMERGENCY TO CLOSE DEENERGIZED TO MOD
QIN125V3228CA	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228C	177590	SG LOW-LINE LEVEL & ON RCP BUSES	OPEN	ENERGIZED
QIN125V3228CB	ASCO NP8320A196E	TD AFW PUMP DISCHARGE HV 3228C	177590	(MANUAL)		EMERGENCY TO CLOSE DEENERGIZED TO MOD
QIN125V3235A	ASCO NP8320A186V	STEAM TO TD AFW PUMP HV 3235A	177189	SG LOW-LINE LEVEL & ON RCP BUSES	OPEN	ENERGIZED
QIN125V3235B	ASCO NP8320A186V	STEAM TO TD AFW PUMP HV 3235B	177189	SG LOW-LINE LEVEL & ON RCP BUSES	OPEN	ENERGIZED
QIN125V3234A	ASCO NP8320A186V	STEAM TO TD AFW PUMP HV 3234A	177857	CIA	CLOSED	DEENERGIZED
QIN125V3234B	ASCO NP8320A186V	STEAM TO TD AFW PUMP HV 3234B	177857	CIA	CLOSED	DEENERGIZED

Point No	Description	Service	Brake No	Auto Actuation Signal	Volt Position	Set Hold	Remarks
142304 3227A	AUTO OPEN	auxiliary feed water	097591	VARIOUS	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS [MANUAL]	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS [MANUAL]	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD
3227A	AUTO OPEN	auxiliary pump bypass	097591	VARIOUS	OPEN	ENERGIZED	ENERGIZED TO CLOSE DEENERGIZED TO HOLD

PLANT ID NO	MANUFACTURER & MODEL	SERVICE	SCRMN NO	AUTO ACTUATION SIGNAL	VALVE POSITION FOLLOWING THE AUTO ACT. SIG.	SOLENOID STATUS FOLLOW AUTO ACT. SIG.	REMARKS
<u>Aux Feed Water....Cont.</u>							
QIN2354 327CA	ASCO NP225WNR	MB RFW PUMP DISCHARGE HV 3227C	177391	VARIOUS	OPEN	ENERGIZED	
QIN2354 327CB	ASCO NP225WNR	MB AFW PUMP DISCHARGE HV 3227C	177391	(MANUAL)			ENERGIZED TO CLOSE DEENERGIZED TO OPEN
QIN2354 327CC	ASCO NP225WNR	MB AFW PUMP DISCHARGE HV 3227C	177391	VARIOUS	OPEN	ENERGIZED	
<u>Chemical Injection System</u>							
QIN2354 377CA	ASCO NP225WNR	Injection To Sln Gen HV 3772A	177373	CIA	CLOSED	DEENERGIZED	
QIN2354 377CB	ASCO NP225WNR	Injection To Sln Gen HV 3772B	177373	CIA	CLOSED	DEENERGIZED	
QIN2354 377CC	ASCO NP225WNR	Injection To Sln Gen HV 3772C	177373	CIA	CLOSED	DEENERGIZED	

PLANT ID NO.	DESCRIPTION of module	SERVICE	SCHEMATIC NO.	AUTO ACTUATION FOLLOWING THE STATUS, AND SIGNAL	VALVE POSITION ISOLATED AUTO ACT. SIG.	REMARKS
SAMPLING SYSTEM						
CHP1000 8100	ASCO PRESSURIZER	Pressurizer liquid H/P 3103	177371	CIA E PEN. ROOM HI PRESSURE	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Locular Hot Leg H/P 3765	177371	CIA E PEN. ROOM HI PRESSURE	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Reactor Water Sample H/P 3765	177371	CIA	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Steam Gen Blowdown H/P 3174A	177383	VARIOUS	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Steam Gen Blowdown H/P 3174B	177383	VARIOUS	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Steam Gen Blowdown H/P 3174C	177383	VARIOUS	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Steam Gen Blowdown H/P 3180A	177383	VARIOUS	CLOSED	DEENERGIZED
CHP1000 3700	ASCO PRESSURIZER	Steam Gen Blowdown H/P 3180B	177383	VARIOUS	CLOSED	DEENERGIZED

PLANT NO	NAME/DESCRIPTION	SERVICE	AUTO ACTUATOR SIGNAL	AUTO ACTUATOR SIGNAL	VALVE POSITION SENSORS	STATUS ELEMENTS	REMARKS
411954 8802	Water Treatment Inlet	Steam Gen Burner	411954-47 HV SIGNS	411954-47 HV SIGNS	VARIOUS	CLOSED	DEENERGIZED
411954 8803	Water Treatment	Steam Gen Burner	411954-48 HV SIGNS	411954-48 HV SIGNS	VARIOUS	CLOSED	DEENERGIZED
411954 8804	Water Treatment	Steam Gen Burner	411954-49 HV SIGNS	411954-49 HV SIGNS	VARIOUS	CLOSED	DEENERGIZED
411954 8805	Water Treatment	Steam Gen Burner	411954-50 HV SIGNS	411954-50 HV SIGNS	VARIOUS	CLOSED	DEENERGIZED
411954 8806	Water Treatment	Steam Gen Burner	411954-51 HV SIGNS	411954-51 HV SIGNS	VARIOUS	CLOSED	DEENERGIZED
411954 8807	Water Treatment	Steam Gen Burner	411954-52 HV SIGNS	411954-52 HV SIGNS	CIA C	CLOSED	DEENERGIZED
411954 8808	Water Treatment	Steam Gen Burner	411954-53 HV SIGNS	411954-53 HV SIGNS	PEN. ROOM HI PRESSURE	CLOSED	DEENERGIZED
411954 8809	Water Treatment	Steam Gen Burner	411954-54 HV SIGNS	411954-54 HV SIGNS	PEN. ROOM HI PRESSURE	CLOSED	DEENERGIZED
411954 8810	Water Treatment	Steam Gen Burner	411954-55 HV SIGNS	411954-55 HV SIGNS	PEN. ROOM HI PRESSURE	CLOSED	DEENERGIZED
411954 8811	Water Treatment	Steam Gen Burner	411954-56 HV SIGNS	411954-56 HV SIGNS	CIA	CLOSED	DEENERGIZED

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Plant ID No.	Manufacturer & Model	Service	Schematic No	#AUTO ACTUATOR		VANE POSITION RELAY/PIEZO STATUS FOLLOW Auto ACT.SIG	REMARKS
				SIGNAL	SOLENOID		
SP1150 3443	ASCO PROGRESSIVE	Component Cooling Water		CIB E NO PRESSURE	CLOSED	ENERGIZED	
SP1150 3443	ASCO PROGRESSIVE	NEUT. COOL. THERM. COOL. HV 3164	PP1155	CIA	CLOSED	DEENERGIZED	
SP1150 3443	ASCO PROGRESSIVE	NEUT. COOL. THERM. COOL. HV 3443	PP11574				