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EVALUATION OF WELDED CONTACTS OF CLASS 1E CIRCUIT BREAKER AUXILIARY SWITCHES AND LIMIT SWITCHES USED FOR UNIT 2 AND COMMON ANNUNCIATOR INPUTS

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EVALUATION OF WELDED CONTACTS OF CLASS 1E CIRCUIT BREAKER AUXILIARY SWITCHES AND LIMIT SWITCHES USED FOR UNIT 2 AND COMMON ANNUNCIATOR INPUTS

1.0 SCOPE

The purpose of this SEA is to evaluate the impact if the contacts of Class 1E Westinghouse 4.16kV Circuit Breaker Auxiliary Switches or Limitorque or Namco Limit Switches which are used for annunciator inputs, should perhaps weld shut. SEA-EE-183 determined that closed contacts of these switches could potentially weld shut for impressed voltage faults. The concern is that one welded contact will prevent other contacts in the same switch from changing positions.

2.0 CONCLUSIONS AND RECOMMENDATIONS

2.1 CONCLUSIONS

The Westinghouse auxiliary switches used for annunciator inputs are from The Engineered Safeguard System 4 kV Buses normal and alternate source incoming circuit breakers. These auxiliary switches are in series with undervoltage time delay relay contacts.

When the circuit breaker is closed and its incoming line voltage is less than 92% of rated for more than 10 seconds the annunciator input circuit closes exposing the Westinghouse auxiliary switch contact to potential welding until the low voltage problem is corrected. This low voltage will be promptly corrected (within 1 hour) by transfer of loads to an alternate source. Thus exposure of the auxiliary switch contact to potential welding is eliminated, therefore, affects of welded contacts do not require further consideration.

Analysis of the Class 1E valves which use Namco limit switches for annunciator inputs shows that these valves will meet their minimum performance even if their annunciator input limit switches should weld shut. This conclusion is based upon the evaluation that shows:

- The limit switches are used for alarm and indication only and are not used in Class 1E circuits.

  or

- The limit switches are in affiliated circuits and are not used in Class 1E circuits.

Analysis of the Unit 2 Class 1E motor-operated valves shows that these valves, except for the RHR Minimum Flow Valves HV-E11-2F007A and HV-E11-2F007B, will meet their minimum performance requirements even if the annunciator input limits switches should weld shut. This is based upon an evaluation that shows:

- The valves change position and meet their minimum performance requirements before the annunciator input switches are exposed to potential welding., i.e. The valve limit switches are normally open and they close when the valves change to their isolation position.

- The HV-21210A and HV21210B valves meet their minimum performance requirements even with annunciator input limit switches welded shut, i.e. The valves can open to throttle RHR service water flow with the annunciator input switches welded shut.

In the event annunciator input limit switches for HV-E11-2F007A and HV-E11-2F007B weld shut, the limit switch main drive shafts could perhaps break loose internal to the valves causing the valves to jam, thus potentially preventing full closure of the valves. More than likely the welded shut limit switches would cause damage to the limit switch gearing, but would not prevent the subject valves from closing.

2.2 RECOMMENDATION

To assure that the HV-E11-2F007A and HV-E11-2F007B, valve annunciator input limit switches do not weld shut, qualified Class 1E - non-Class 1E isolation devices should be installed in the annunciator input limit switch circuits from these valves. The circuit design should be such that the limit switches actuate the Class 1E - non-Class 1E isolation devices with contacts from these devices used as annunciator inputs. This prevents the annunciator input limit switches from welding shut for impressed voltages on the annunciator input cables. This action will be tracked by NCR 87-0021.

In order to preclude the need for future engineering analysis and maintain compliance with Regulatory Guide 1.75, qualified Electrical Isolators, capable of withstanding 120V AC and 250V DC, should be installed for newly-engineered annunciator inputs developed from Class 1E devices. Also Qualified Electrical Isolators should be installed for existing annunciator inputs when modifications to existing Class 1E - non-Class 1E annunciator interface devices are performed. This recommendation is in-line with NPE-Electrical Group strategy of eliminating potential pitfalls for maintaining compliance to the plant licensing commitments.

This recommendation will be included in the Design Description Manual, Chapter 29 for the ACR and E1012, "Specification of Electrical Separation."

3.0 INPUTS AND ASSUMPTIONS

3.1 INPUTS

At Susquehanna SES, all annunciator input circuits are non-Class 1E. A large number of these inputs are developed from Class 1E devices.

An exception to Regulatory Guide 1.75, which endorses IEEE 384-1974, and as discussed in FSAR Section 8.1.6.1q(7), allows the connection of low-energy non-Class 1E circuits to Class 1E devices provided an analysis has been performed to demonstrate that the Class 1E circuits are not degraded below an acceptable level for faults on the non-Class 1E circuits.

Annunciator cables are routed in non-Class 1E raceways which also contain 120V AC, 125V DC and 250V DC cables. Potential damage to cables in non-Class 1E raceways may cause accidental imposition of 120 volts AC or 250 volts DC on annunciator input wire(s), and through these wires to the Class 1E device(s).

Both open contacts and closed contacts of the Class 1E - non-Class 1E annunciator interface devices are to be evaluated.

The study is limited to digital annunciator inputs for the Unit 2 and common annunciators.

3.2 ASSUMPTIONS

The study was based on as-built drawings and the documents issued as of the date of task initiation.

Affiliated circuits in this study were treated the same as Class 1E circuits.

A change in state of a annunciator input contacts while there is an impressed voltage was not considered. Only the contacts in the open or closed position were analyzed.

4.0 METHOD

The Unit 2 and Common Annunciator schematic drawings E-321 through E-332 inclusive were examined to determine which annunciator inputs are developed from circuit breakers auxiliary switches, Limitorque and Namco limit switches.

The initiating circuits for the identified annunciator inputs were reviewed to determine which inputs are derived from Class 1E devices.

The impacts of welding shut of the identified Class 1E annunciator input switches were evaluated to assure that the parent Class 1E devices can perform their safety-related functions with welded annunciator input switches.

5.0 RESULTS

5.1 WESTINGHOUSE AUXILIARY SWITCHES

The Westinghouse auxiliary switches used for annunciator inputs are from The Engineered Safeguard System 4 kV Buses normal and alternate source

incoming circuit breakers (see Table 1). These auxiliary switches are in series with undervoltage time delay relay contacts.

When the circuit breaker is closed and its incoming line voltage is less than 92% of rated for more than 10 seconds the annunciator input circuit closes exposing the Westinghouse auxiliary switch contact to potential welding until the low voltage problem is corrected. This low voltage condition will be analyzed promptly and corrected (within 1 hour) by transfer of loads to an alternate source. This action is required by Alarm Response Procedure AR-015-001 and ON-004-001. The exposure of the auxiliary switch contact to potential welding is eliminated by this corrective action, therefore the affects of welded contacts do not require further consideration.

5.2 NAMCO LIMIT SWITCHES

Namco limit switches from the Class 1E valves listed in Table 2 are used for annunciation and indication only. Contacts from these switches are not used in Class 1E circuits. Therefore welding of the annunciator input limit switches do not effect Class 1E circuits. Welding of the limit switches do not prevent the valves from changing position.

The Suppression Pool Vacuum Relief Valves and the Drywell Cooling Water Control Valves also use Namco limit switches for annunciator inputs. These affiliated valves are powered from Class 1E sources. However, these valves and their limit switches are not used in Class 1E circuits. Therefore welding of the annunciator input limit switches do not effect Class 1E circuits.

5.3 LIMITORQUE LIMIT SWITCHES

The Limitorque limit switches from the Class 1E Primary Containment Isolation Valves listed in Table 3 are used for annunciator inputs. These limit switches are open during normal plant line-up and are not exposed to potential welding. In the event the normal plant line-up is changed, the valves change to their new position and isolate containment before the limit switches are exposed to potential welding. Therefore, welding shut of the annunciator input limit switches does not prevent these motor-operated valves from meeting their minimum performance requirements.

In addition to the valves in Table 2, the RHR Pump Minimum Flow Valves HV-E11-2F007A and HV-E11-2F007B limit switches provide annunciator inputs. These switches could be closed during normal plant line-up and exposed to potential welding.

In the event the annunciator input limit switches weld shut, the limit switch main drive shafts could perhaps break loose internal to the valves causing the valves to jam, thus potentially preventing full closure of the valves. Per Dan Warshing of Limitorque Corp., this is very unlikely. More than likely, the welded shut limit switch will cause damage to the limit switch gearing, but will not prevent the valves from closing.

To assure that the HV-E11-2F007A and HV-E11-2F007B, valve annunciator input limit switches do not weld shut, qualified Class 1E - non-Class 1E isolation devices are to be installed in the annunciator input limit switch circuits from these valves. The circuit design should be such that the limit switches actuate the Class 1E - non-Class 1E isolation devices with contacts from these devices used as annunciator inputs. This prevents the annunciator input limit switches from welding shut for the specified impressed voltages on the annunciator input cables.

The RHR Service Water Heat Exchanger Inlet Valves HV-21210A and HV-21210B are the only other annunciator inputs developed from Class 1E Limitorque limit switches. These limit switches could be closed during normal plant operations and exposed to potential welding. In the event these limit switches weld shut, the valves still can be opened to throttle the RHR Service Water Flow. However, the welded limit switch could perhaps prevent the valves from positioning to 100% closed. Indication of the valves "Not 100% Closed" is provide via lights on panel 2C601 or 2C201.

Therefore welding shut of the annunciator input limit switches does not prevent the HV-21210A and HV-21210B opening which is their minimum performance requirements.

6.0 REFERENCES

6.1 SEA-EE-183, Rev. 0

6.2 IEEE 279-1971.

6.3 IEEE 384-1974.

6.4 Regulatory Guide 1.75, Rev. 0.

6.5 Annunciator Schematic Drawing; E-321 through E-332 Inclusive

6.6 Design Description Manual Chapters 8, 10, 14 and 16.

6.7 Unit 2 Technical Specification 3/4.6.3

6.8 RHR Service Water Procedure OP-216-001 Rev. 12.

6.9 AR-015-001 Rev. 2

6.10 ON-004-001 Rev. 10

TABLE 1

WESTINGHOUSE AUXILIARY SWITCHES

CIRCUIT BREAKER	DESCRIPTION
52-20101	4.16kV Bus 1A Incoming Feeder Breaker from ESS Trans 101
52-20109	4.16kV Bus 1A Incoming Feeder Breaker from ESS Trans 201
52-20201	4.16kV Bus 1B Incoming Feeder Breaker from ESS Trans 111
52-20209	4.16kV Bus 1B Incoming Feeder Breaker from ESS Trans 211
52-20301	4.16kV Bus 1C Incoming Feeder Breaker from ESS Trans 111
52-20309	4.16kV Bus 1C Incoming Feeder Breaker from ESS Trans 211
52-20401	4.16kV Bus 1D Incoming Feeder Breaker from ESS Trans 101
52-20409	4.16kV Bus 1D Incoming Feeder Breaker from ESS Trans 201
52-20101	4.16kV Bus 2A Incoming Feeder Breaker from ESS Trans 101
52-20109	4.16kV Bus 2A Incoming Feeder Breaker from ESS Trans 201
52-20201	4.16kV Bus 2B Incoming Feeder Breaker from ESS Trans 111
52-20209	4.16kV Bus 2B Incoming Feeder Breaker from ESS Trans 211
52-20301	4.16kV Bus 2C Incoming Feeder Breaker from ESS Trans 111
52-20308	4.16kV Bus 2C Incoming Feeder Breaker from ESS Trans 211
52-20401	4.16kV Bus 2D Incoming Feeder Breaker from ESS Trans 101
52-20408	4.16kV Bus 2D Incoming Feeder Breaker from ESS Trans 201

TABLE 2

NAMCO LIMIT SWITCHES

VALVE	DESCRIPTION
HV-E41-2F100	HPCI Warm-up Line
HV-E51-2F088	RCIC Warm-up Line
HV-25703	Suppression Chamber Exhaust Isolation
HV-25713	Containment Purge Exhaust Isolation
HV-25705	SGTS Exhaust Bypass - Supp. Pool
HV-25711	SGTS Exhaust Bypass - Drywell

TABLE 3

LIMITORQUE LIMIT SWITCHES

VALVE	DESCRIPTION
HV-C41-2F006	Standby Liquid Control Injection Valve
HV-E41-2F003	HPCI Outboard Steam Supply Line Isolation Valve
HV-E41-2F002	HPCI Inboard Steam Supply Line Isolation Valve
HV-E41-2F006	HPCI Turbine Exhaust to Suppression Pool
HV-E41-2F075	HPCI Turbine Exhaust Vacuum BKR Outboard Valve
HV-E41-2F079	HPCI Turbine Exhaust Vacuum BKR Inboard Valve
HV-E11-2F004A	RHR Pump A Suction Valve
HV-E11-2F004B	RHR Pump B Suction Valve
HV-E11-2F004C	RHR Pump C Suction Valve
HV-E11-2F004D	RHR Pump D Suction Valve
HV-E11-2F006A	RHR Shutdown CLG Suction Valve
HV-E11-2F006B	RHR Shutdown CLG Suction Valve
HV-E11-2F006C	RHR Shutdown CLG Suction Valve
HV-E11-2F006D	RHR Shutdown CLG Suction Valve
HV-E51-2F059	RCIC Turbine Exhaust to Suppression Pool
HV-E51-2F060	RCIC Vacuum Pump Discharge
HV-E51-2F062	RCIC Turbine Exhaust Vacuum Breaker Outboard
HV-E51-2F084	RCIC Turbine Exhaust Vacuum Breaker Inboard
HV-E21-2F001A	Core Spray Suppression Pool Suction
HV-E21-2F001B	Core Spray Suppression Pool Suction