SUMMARY REPORT

DESIGN ACTION LIST (DAL)-17 ANALYSES OF NON-CLASS 1E DEVICES CONNECTED TO CLASS 1E POWER SUPPLIES

NINE MILE POINT NUCLEAR STATION - UNIT 2
(NIAGARA MOHAWK)

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Prepared by: J. Leahey 11/20/84
J. Leahey

Reviewed by: M. Patel 11-20-84
M. Patel

Approved: V. F. Blanchette
M. A. Smith, Manager
Regulatory Compliance Engineering
Electrical Design Engineering

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1. INTRODUCTION

This report summarizes Failure Modes and Effects Analyses (FMEA) performed to demonstrate that the failure of non-Class 1E devices connected to Class 1E power supplies, and not properly isolated per Regulatory Guide 1.75, would not adversely affect either the Class 1E power supplies or connected Class 1E equipment. These analyses were required by IEEE Standard 384-1974 and Regulatory Guide 1.75 and were performed in accordance with IEEE Standard 352-1975.

2. METHODOLOGY

The non-Class 1E devices to be analyzed were identified by a study of Elementary Diagrams and Elementary Diagram Device Lists for all safety systems in the GE scope of supply for NMP2. Those non-Class 1E devices connected to Class 1E power supplies, without acceptable isolating devices, were listed together with their Purchased Part Drawings (PPD). Each PPD was then checked to see if the device is Nuclear Safety Related (meets all requirements for Class 1E applications). Devices qualified for Class 1E applications were then removed from the list of non-1E devices to be analyzed. Devices connected to a Class 1E power supply during testing or maintenance only (not during normal plant operations) were also removed from the list. (See the Appendix for a list of non-1E devices analyzed.)

Each non-Class 1E device was then analyzed to determine whether a component or mechanical interaction could credibly fail and provide a ground path for the Class 1E power supply. A consequence analysis was performed if it could not be credibly demonstrated that the non-Class 1E device would not degrade the 1E power supply. The consequence analysis assessed the effects of a non-Class 1E device failure upon its Class 1E power supply, other Class 1E devices connected to the same power supply, and Class 1E or safety related functions. A worst case single failure was also assumed.

The analyses were based on IEEE Standard 352 "Guide for Reliability Analysis of Nuclear Power Equipment". In accordance with the standard, Failure Mode and Effects Analyses (FMEA) were performed to define and provide a detailed evaluation of failures of each non-Class 1E device which has the potential to adversely affect the Class 1E power source or the function of Class 1E devices that are also powered by the same source.

The acceptance criteria (Section 3) define the failure necessary to adversely affect the Class 1E power supply. The FMEA evaluated all device failure modes and addressed only those that have the potential for adversely affecting the Class 1E bus. The FMEA excluded detailed evaluation of open-circuit or instrument-drift failure modes because these modes would not adversely affect a Class 1E bus. The FMEA also exclude failure mechanisms that are not intrinsic to the device (e.g., operator error, environmental stress loads that exceed those specified for the location, fire, flooding, and sabotage). The function of the non-Class 1E device was not a concern of the analyses.

A failure rate was then assigned to the identified failures. Mil Handbook 217D, IEEE Standard 500 and manufacturer and industry data provided the basis to establish these electrical component failure rates.

3. ACCEPTANCE CRITERIA

The FMEA must demonstrate that:

1. The failure of the non-Class 1E device will not degrade the Class 1E power supply such that Class 1E devices connected to that bus are degraded.

2. A safety related function is not degraded.

3. The consequences of the non-Class 1E device failure combined with the worst postulated single failure are acceptable.

The following acceptance criteria were established:

1. Internal circuit protection, e.g., fuse or fusable resistor, does perform the design function and limits current if a ground fault internal to the circuit of the non-Class 1E device occurs. However, the independent random failure of the fuse or fusable resistor is investigated.

2. There can be no credible (see criterion 3 and 4) fault of a non-Class 1E device or component to short and create a direct path to ground.

3. Where there exists a single electrical component between the Class 1E power supply and ground (or instrument common) the probability of failure to short shall be less than 10^{-6} failures per year ($<10^{-6}$/year).

4. Where there exists a minimum of two electrical components between the Class 1E power supply and ground (excluding branch circuit protective devices), i.e., two component in series, simultaneous independent random failures that cause both components to short shall have a probability of occurrence of $<10^{-6}$ failures/year.

The following considerations augmented the preceding acceptance criteria in many cases:

- Data on infant mortality of the devices during manufacturer's burn-in tests of 168 hours or more

- Supplier test results

- Failure information on identical or similar devices installed at nuclear plants during preoperation and startup tests and during commercial operation

- Results of seismic testing on Class 1E panels containing the non-Class 1E devices in the normal operational mode

- Mounting location of the device. (Many non-Class 1E devices are located in a benign environment such as the control room.)

5. RESULTS SUMMARY

All devices analyzed as described herein were confirmed to have no credible failure mode that would adversely affect the Class 1E power supplies, connected Class 1E devices, or any safety function.

APPENDIX

LIST OF DEVICES ANALYZED

MPL	DEVICE	PPD
B22-R610	Meter	159C4540P145049
B22-R615	Recorder	163C1871P1710000
B22C-F1 thru F10, F13 thru F24, F41 thru F52, F79 thru F88, F113, F114, F120 thru F123	Fuse	145C3039P005
B22C-F119,F128	Fuse	145C3039P004
B22C-J01,J02	Receptacle	159C4374P181S
B22C-R01 thru R28	Resistor	145C3232P60F2001
B22H-F13,F19,F62,F63, F79,F86,F90,F91 F92,F95	Fuse	145C3039P004
B22H-JB1 thru JB6	Junction Box	235A1543AAG001
B22H-R1,R2,R3,R4	Resistor	145C3232P65F2500
B35A-C3A,C3B,C4A,C4B, C5A,C5B,C6A,C6B	Capacitor	234A9933P105
B35A-R3A,R3B,R4A,R4B, R5A,R5B,R6A,R6B	Resistor	145C3232P60F47R0
C41-R600	Meter	159C4540P1329178
C41-R601	Meter	159C4540P148005
C41A-F1A,F1B	Fuse	145C3039P004
C41A-SRU1	Signal Resistor Unit	195B9437P004
C41A-Z01A,Z01B	Meter Panel	195B9851G001
C72A-F21A,F21B,F22A,F22B, F53A,F53B,F54A,F54B	Fuse	145C3039P004

MPL	DEVICE	PPD
C72A-CR3A,CR3B,CR4A,CR4B	Diode	176A1572P004
C72A-JB103	Junction Box	235A1543AA
C11-F110A,F110B	Solenoid Valve	12D1466
E12-N001A,N001B, N025	Conductivity Cell*	163C1544P017, 163C1545P012
E12-N030A,N030B, R006	Conductivity Transmitter*	163C1545P010, 163C1545P007
E12-R606A,R606B	Meter	159C4540P113010
E12-CR01 thru CR12	Diode	176A1572P004
E12A-F1,F2,F14,F20, F26 thru F29, F31,F37,F38, F39,F41,F42	Fuse	145C3039P005
E12A-F8,F9,F32,F33 F34,F40,F43, F44 thru F52, F54	Fuse	145C3039P004
E12A-F35	Fuse	145C3039P007
E12A-F53	Fuse	145C3039P001
E12A-J01	Receptacle	159C4374P181S
E12A-JB1 thru JB9	Junction Box	235A1543AA
E12A-T1	Transformer	209A4866P002
E12A-R111,R112,R113	Resistor	145C3232P65F2500
E12A-R114A,B & R115A,B	Variable Resistor	234A9775P003
E12A-Z2A,Z2B	Manual Unit	272A7232P001
E12-R604A,R604B, R605,R606A,R606B	Controller	248A9393G005,G006, G007

*These devices are being removed from Class 1E power supply and will be connected to non-1E power. (Ref. PWA 450321, Rev. 0)

MPL	DEVICE	PPD
E12-K001A,K001B, K003A,K003B	Transducer	158B7013P007
E12-K605A,K605B	High/Low Auto Selector Switch	272A7240P001
E12-R608A,R608B, B609A,R609B	Meter	112C3768
E21A-CR01 thru CR17	Diodes	176A1572P004
E21A-F01,F02,F04, F06 thru F10, F12 thru F15	Fuse	145C3039P005
E21A-F17,F18,F19,F24	Fuse	145C3039P001
E21A-J01	Receptable	159C4374P181S
E21A-JB1,JB2,JB3,JB4	Junction Box	235A1543AA
E22A-F1 thru F6, F8, F12,F13,F14	Fuse	145C3039P005
E22A-F7,F9,F10,F11	Fuse	145C3039P001
E22A-F15,F16,F17	Fuse	145C3039P004
E22A-J01	Receptacle	159C4374P181S
E22A-JB1 thru JB4	Junction Box	235A1543AA
E22A-R21,R22	Resistor	234A9775P003
E22A-SRU1	Signal Resistor Unit	195B9537P004
E22-K001	Current Transducer	198B6972P002
E22-K002	VAR Transducer	198B6970P002
E22-K003	Watt Transducer	198B6970P001
E22-R004	Watt-Hr Meter	163C1159P002
E22-R604, R606	Meter	112C3768P029
E22-R607	Ammeter	163C1157P038
E22-R608	VAR Meter	163C1157P003
E22-R609	Watt Meter	163C1157P002
E22-R610,R611	Voltmeter	163C1157P002

MPL	DEVICE	PPD
E22-R612	Frequency Meter	163C1157P062
E22-R613	Synchroscope	163C1157P063
E22-R614,R615	Voltmeter	163C1157P005
E22-R616	Ammeter	163C1157P001
E22-R618	Voltmeter	163C1157P007
E22-R619,R620	Ammeter	163C1157P067
E11-R621	Ammeter	163C1157P068
E22B-F1,F2,F3,F4	Fuse	145C3039P006
E22B-K34,K37	Relay	163C1170P002
E22B-R01A	Resistor	145C3232P70H50R0
E22B-S1,S12	Switch	249A1471P002
E22B-TS1,TS3,TS7,TS8	Test Block	163C1192P002
E22B-TS2,TS4	Test Block	163C1192P001
E22B-TS5,TS6	Switch	209A4690P8
E51-R601	Meter	159C4540P238028
E51-R603	Meter	159C4540P237030
E51-R604	Meter	159C4540P242044
E51A-J01	Receptacle	159C4374P181S
E51A-F1 thru F26	Fuse	145C3039P005
E51A-SRU1	Signal Resistor Unit	159B9437P001