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REGION V

(CORRECTED COPY)
December 8, 1984
ANPP-31429-TDS/TRB

U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane - Suite 210
Walnut Creek, California 94596-5368

Attention: Mr. D. F. Kirsch, Acting Director
Division of Reactor Safety and Projects

Subject: Final Report - DER 84-62
A 50.55(e) Reportable Condition Relating To Load Sequencer Did Not Function Properly During Safeguards Testing.
File: 84-019-026; D.4.33.2

Reference: A) Telephone Conversation between P. Narbut and T. Bradish on August 17, 1984
B) ANPP-30531, dated September 17, 1984 (Interim Report)
C) ANPP-30794, dated October 11, 1984 (Time Extension)
D) ANPP-31001, dated October 30, 1984 (Time Extension)
E) ANPP-31131, dated November 14, 1984 (Time Extension)
F) ANPP-31262, dated November 30, 1984 (Time Extension)

Dear Sir:

Attached is our final written report of the deficiency referenced above which has been determined to be Not Reportable under the requirements of 10CFR50.55(e).

Very truly yours,

E. E. Van Brunt, Jr.
APS Vice President
Nuclear Production
ANPP Project Director

EEVB/TRB/plk

Attachment

cc: See Page Two

IE-27

cc: Richard DeYoung, Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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1100 Circle 75 Parkway, Suite 1500
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FINAL REPORT - DER 84-62
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

The Balance of Plant (BOP) Engineered Safety Features Actuation System (ESFAS) has four modes of operation. Two of these modes are:

Mode 1 - Safety Injection Actuation Signal (SIAS) without Loss of Power (LOP). See Figure 1 for timing sequence.

Mode 2 - SIAS with LOP. See Figure 2A for timing sequence.

In Mode 1, the Diesel Generator (D/G) is running with its breaker open and ready to close if off-site power is lost. Upon receipt of a LOP signal, the Diesel Generator breaker closes. This closure shifts the BOP ESFAS sequencer to Mode 2. The shift to Mode 2 causes the 480V Load Center (LC) main breakers and the High Pressure Safety Injection (HPSI) pump breaker to close 0.5 seconds later. However, the LOP event independently triggers a load shed signal of 1 second duration which keeps the LC and HPSI breakers open even though they receive a close signal 0.5 seconds after LOP occurs. These simultaneous "open" and "close" commands to the LC and HPSI breakers cause their anti-pump circuits to "lockout," thereby deenergizing the LC and preventing the HPSI pump from starting as required.

This problem, which is reported in startup Field Report 1SA-062, was discovered during the pre-operational integrated safeguards acceptance test program.

The integrated safeguards pre-operational acceptance test program is conducted to assure that the BOP ESFAS is correctly sequenced and that the time intervals are correctly set to match the characteristics of the devices to be actuated.

Evaluation

The BOP ESFAS is a digital logic system that monitors key process variable signals and in response generates ESF actuation signals in predetermined sequence and time intervals. This sequence and the time intervals were specified at the time of purchase of the BOP ESFAS, when the time constants, inertia, etc. of the various components that are actuated by the BOP ESFAS were not fully known and/or identified. Therefore, the BOP ESFAS purchase Specification No. 13-JM-103 requires in paragraph No. 4.5.14.3 (page 4-15) that the sequencer shall provide up to ten independent, time-separated loading signals, adjustable in one second step increments over a total time span of 60 seconds. This adjustable time sequencing was specified and provided by the vendor in the form of an erasable memory because it was anticipated that the time intervals between loading signals would have to be changed based upon later obtained design and test data.

The BOP ESFAS was tested by its supplier and found to meet its specified requirements. However, the BOP ESFAS is only one part of the overall safety system. Namely, it must be compatible with the physical and electrical characteristics of the components that it activates. Also, it must interface with the NSSS ESFAS and various other protection systems and devices.

Analysis of the recorder graphics taken during the pre-operational tests confirmed that the HPSI pump breaker did not close because it had locked into an anti-pump mode due to the presence of the simultaneous load shed (open) and start (close) signals.

In regards to the 480 volt center, the recorded data showed that its breaker did not close for the same reasons listed above; i.e., simultaneous open and close signals to its breaker which caused it to lock out. However, it was further noted that the breaker's closing spring charging motor requires a period of 2 to 5 seconds to re-charge after a trip (open circuit breaker) before it is capable of closing the breaker again.

A root-cause analysis is not applicable, because this condition is not a deficiency. As documented by specification 13-JM-104, the BOP ESFAS was designed and provided with the capability to be changed to provide different time-separated loading signals.

II. Analysis of Safety Implications

Based upon the above, this condition is evaluated as not reportable under the requirements of 10CFR50.55(e) and 10CFR Part 21. This condition is considered as "in-process" work wherein only a sequence mis-match was discovered during a pre-operational test program whose purpose it is to discover these types of conditions.

III. Corrective Action

It was decided to implement an "interim" solution for Unit 1 and a "permanent" solution for Units 2 and 3. The "permanent" solution will be implemented prior to the warranty run for Unit 1. Both of these solutions involve the interface beween the BOP ESFAS sequencer and the starting circuits of the HPSI and 480 Volt Load Center, and both are described below.

A. Interim Solution

1. HPSI Pump

The simultaneous "open" and "close" signals to the HPSI pump breaker were eliminated by delaying for 2 seconds the closing of the D.G. Breaker after a loss of offsite power following a SIAS. Since closing of the D.G. Breaker shifts the BOP ESFAS sequencer from Mode 1 to Mode 2, the entire sequence of contact closures for Mode 2 is also delayed by 2 seconds. Thus, since the LOP event independently triggers an immediate load shed signal of 1 second duration, the open and close signals are now totally separated by 2 - 1 = 1 second. This separation is schematically shown on Figure 2B. To accomplish this 2-second delay, two redundant Class 1E Agastat relays were connected in a "one-out-of-two" logic circuit which actuates the "close" circuit of the diesel generator circuit breaker. These relays are simultaneously energized on loss of offsite power and their respective contacts close in 2 seconds.

This work has been completed on Unit 1 and is documented by NCR SM-5236.

2. 480 Volt Load Center

The problem regarding the simultaneous "start" and "stop" signal to the 480 volt load center breaker has been solved in the same manner as described above for the HPSI pump. Furthermore, the 2-5 second delay required by the 480 volt load center's breaker closing spring charging motor has been totally eliminated. This was accomplished by bypassing an interlock so that the breaker's closing spring will be recharged after the breaker is closed, instead of after it is opened, as it had been originally connected. Thus, the breaker will be ready to close immediately (without the 2-5 second delay) upon lifting of the load shed signal.

This change has been completed on Unit 1 and is documented by DCP 10E-PG-800.

B. Pernament Solution

1. HPSI Pump

The simultaneous "open" and "close" signals to the HPSI pump breaker will be eliminated by adding an interlock to the HPSI pump circuit that does not allow the start signal from the BOP ESFAS sequencer to be applied to the HPSI pump breaker until after the load shed trip signal has disappeared/cleared.

This work will be performed under DCPs 2SE, and 3CE-PG-023 for Units 2 and 3 and will be completed prior to licensing of the respective units. DCP 10E-PG-023 will be completed for Unit 1 prior to the warranty run.

2, 480 Volt Load Center

The simultaneous "open" and "close" signals to the 480 volt load center breaker will be eliminated by deleting the load shed signal ("open" signal) after a loss of off-site power to this breaker. Thus the load center breaker will be continuously tied to the Engineered Safety Features (ESF) bus. It has been verified that this load will not degrade the operability of the diesel generator.

This work will be performed under DCPs 2SE, and 3CE-PG-023 for Units 2 and 3 and will be completed prior to licensing of the respective units. DCP 10-PG-023 will be completed for Unit 1 prior to the warranty run.

IV. Reference

13-10407-J-104-8 Insruction Manual for PVNGS BOP ESFAS

Attachments

1. Figure 1: Mode 1 Timing Diagram
2. Figure 2A: Mode 2 Timing Diagram (Original Design)
3. Figure 2B: Mode 2 Timing Diagram (Modified Design)

MODE (1) TIMING DIAGRAM: SIAS·$\overline{\text{LOP}}$

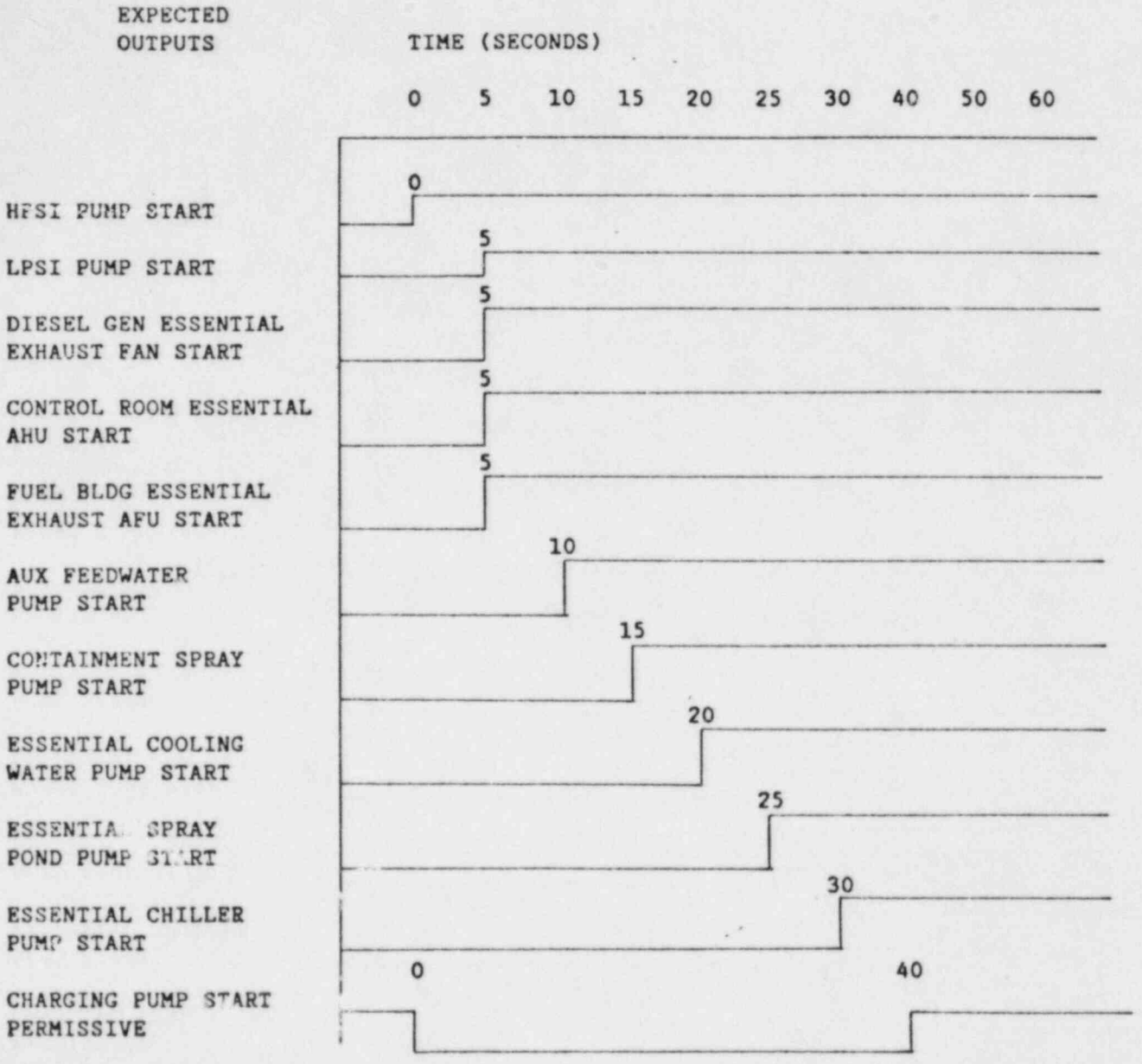

Figure 1

MODE (2) TIMING DIAGRAM: SIAS LOP DG BKR

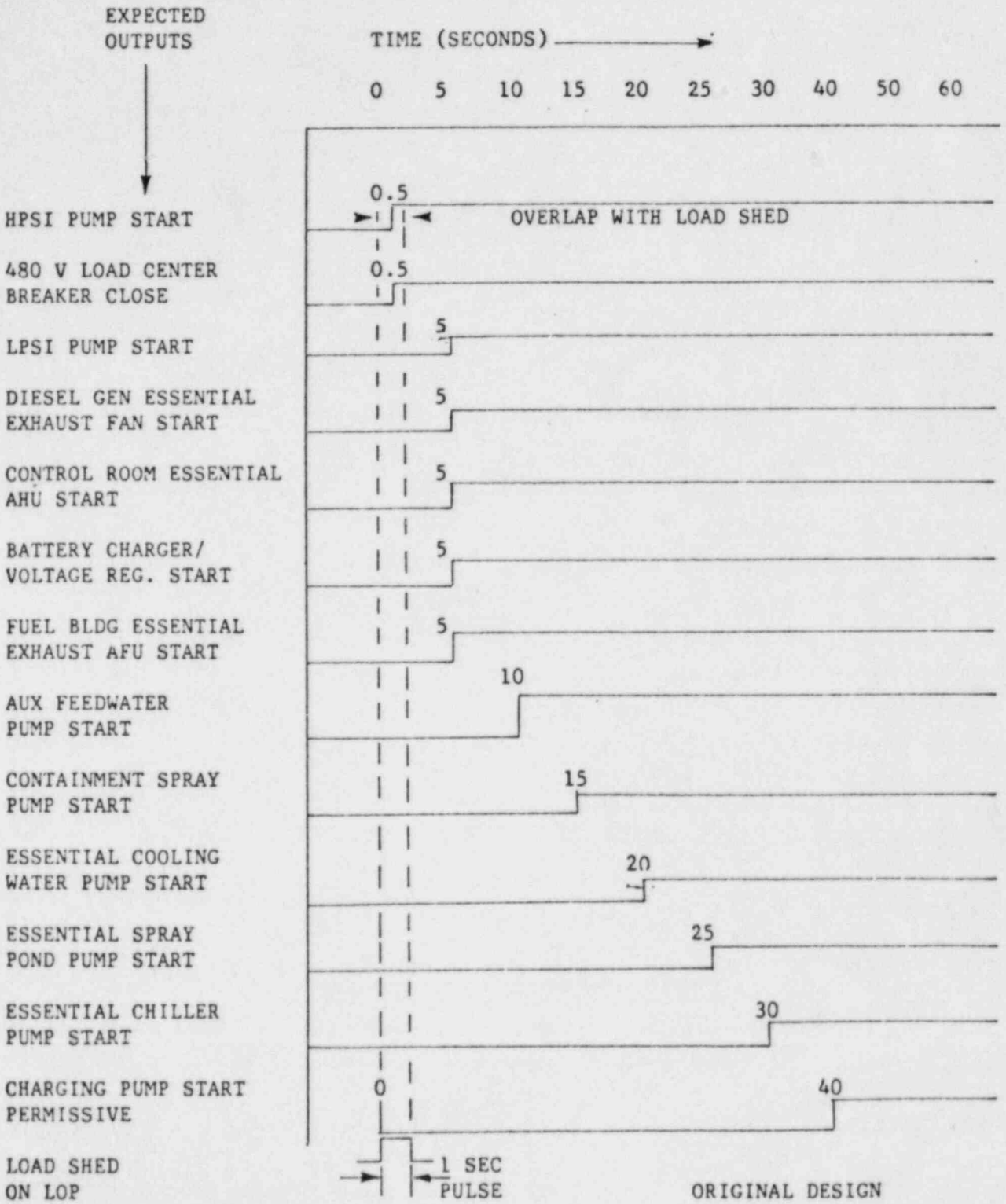

Figure 2A

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MODE (2) TIMING DIAGRAM: SIAS LOP DG BKR

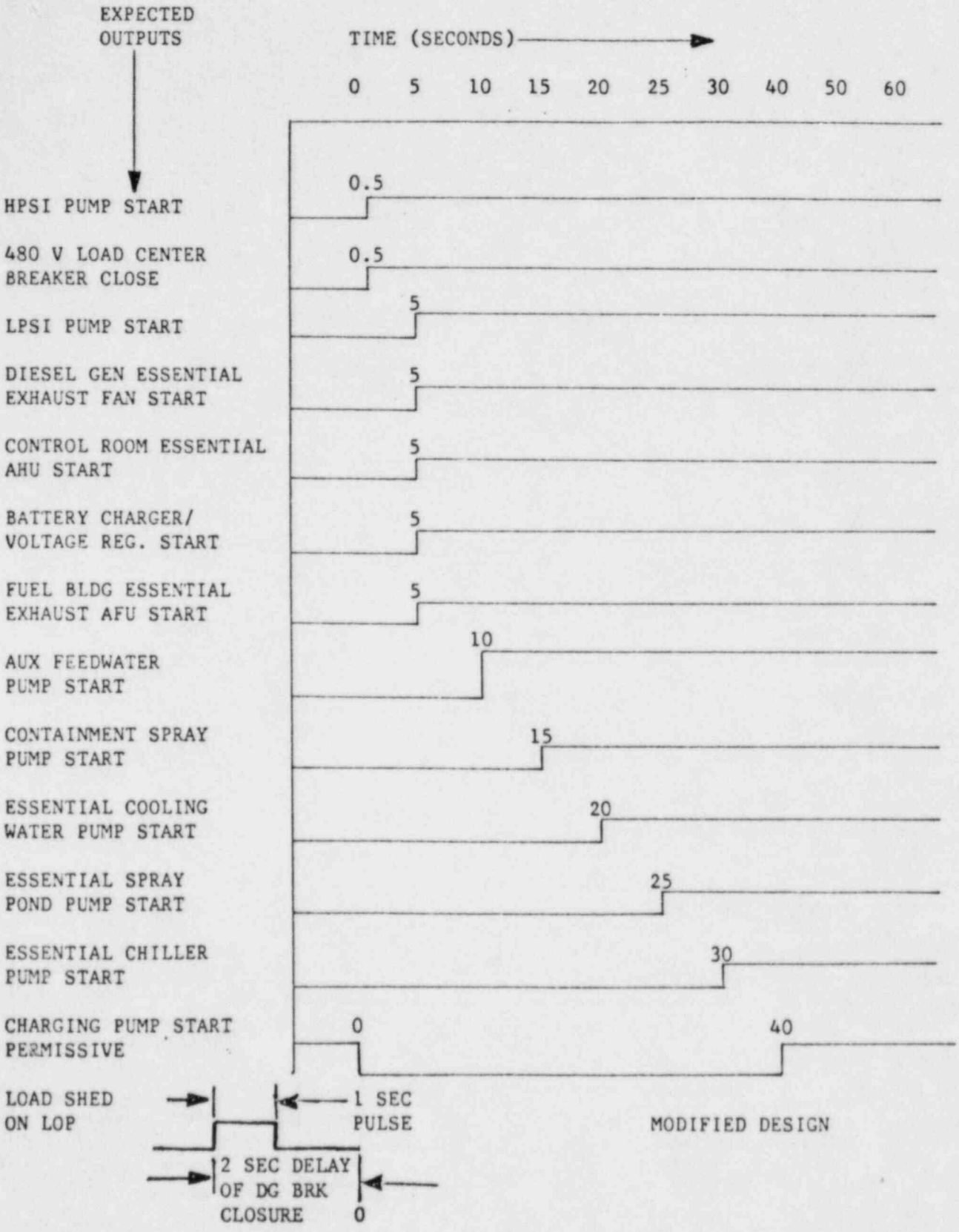

Figure 2B