UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 57 TO LICENSE NO. DPR-13

SOUTHERN CALIFORNIA EDISON COMPANY

SAN ONOFRE UNIT NO. 1

DOCKET NO. 50-206

INTRODUCTION

Existing Design

The San Onofre Nuclear Generating Station, Unit 1 (SONGS-1) safety injection system is shown on the attached Figure 1. The design uses the feedwater pumps as safety injection pumps during the injection mode while the pumps designated as "safety injection pumps" in Figure 1 are used as booster pumps.

Figure 1 shows the valve lineup used for normal operation. Condensate from the condenser hotwell is pumped by the condensate booster pump through Heater #2 and HV-854 A&B. Feedwater is then pumped through HV-852 A&B, Heater #1 and on to the steam generators. During normal operation valves MOV-850 A,B&C, HV-851 A&B and HV-853 A&B are closed.

Following a safety injection signal (SIS) the feedwater pump takes its suction from the refueling water storage tank (RWST) and discharges borated water into the reactor coolant system cold legs. Automatic valve sequencing terminates flow of the unborated condensate and initiates flow of borated water from the RWST. The HV-854 A&B and HV-852 A&B close while MOV-850 A,B&C and HV-853 A&B open. The safety injection pumps are also given a simultaneous start signal. An interlock exists between the HV-854 valves and the HV-851 valves. In order to prevent unborated water from inadvertently being injected following an SI signal, the HV-851 valves do not receive their open signal until the HV-854 valves are closed. During this entire process, the feedwater pumps run without interruption.

For a safety injection signal accompanied by loss of offsite power (SISLOP), the sequence times for valves and pumps are different from those of SIS. In this case the running feedwater pump is tripped by the loss of off-site power and restarted by the sequencer at 11 seconds. The same 11 second sequencer step is used to start the SI pump and actuate the safety injection system valves as described in the SIS case. This time delay is included to allow the diesel generator to come to rated speed, voltage and frequency and to allow its breaker to close on the class 1E buses at the 10 second sequencer step.

September 3, 1981 ECCS Failure

On September 3, 1981, both trains of the San Onofre Unit 1 safety injection system were found to be inoperable when challenged under actual operating conditions. Following manual reactor trip from 88% power due to steam generator flow and level oscillations, caused by a regulated power supply failure, low primary system pressure caused a safety injection signal (SIS). The licensee reported that operators dispatched to the auxiliary building following the safety injection initiation signal found that neither of the HV-851 safety injection valves, located in the discharge of both trains of the safety injection pumps, had opened as required. There were no adverse consequences in this particular event since there was no loss of coolant accident. The reactor pressure remained above the safety injection/feedwater pump's shutoff-head and therefore no actual injection of water would have occurred if the valves had opened. However, had reactor pressure decreased and actual injection been required, injection flow would not have been automatically available as required in the design.

The HV-851 A&B valves which failed to open are 14-inch Anchor Darling, Series 600, stainless steel, Part No. SI-50-WDD double-disk gate valves using Greer Hydraulics No. 832210 actuators. Tests were conducted on these valves in the as-found condition following this event and both valves failed to open against the 1250 psi differential pressure which would normally exist across the valves following a safety injection signal with the feedwater and SI pumps operating. Pressure was lowered until one valve opened with a differential pressure of about 520 psid and the other at about 80 psid. Tests to determine the cause of the failure were performed after readjusting the valve packing. These tests also failed to provide consistent opening against a 1,200 psid.

The present safety injection system was modified in 1977 by replacing the motor operators with hydraulic operators. The licensee states that the system was tested following the modifications with full differential pressure across the HV-851 A&B valves. However, subsequent testing of these valves, as required by ASME Section XI, only verified valve operability and stroke time. ASME Section XI does not require valve tests to be performed with the expected operating differential pressure across the valves. Therefore, the September 3, 1981 event was apparently the first time that the system was challenged since the pre-operational testing of 1977.

The HV-851 A&B valves which failed to open had not received any major maintenance, such as disassembly or removal, between the 1977 modifications and September 3, 1981. Only minor maintenance had been performed.

Following the failure of the valves, the licensee and its consultants tested and disassembled the valves twice. The licensee identified two problem areas that they felt caused the problems. They are:

(1) The coefficient of friction between disk and seat assumed in the valve design was too small; and

(2) The average contact stress at the valve seat surface would exceed the threshold for galling (i.e., surface wear and damage in which material is transferred between the disk and seat) if the full operating 1250 psi differential is exerted on the valve disks.

The double-disk gate valves with narrow seating areas are susceptible to galling when a large differential pressure exists across the valve. Testing has indicated that without galling and without a large ΔP, the valves did not experience failures. The licensee concluded that the failure of the HV-851 A&B valves was probably due to one or more of the following:

(1) Double-disk dragging - This can occur when the pressure between the disks exceeds the upstream and downstream pipe pressure. Differential pressures across both valve disks can double the load on the valve's actuator. Inspection of the valve disk internals indicated that both valve disks were experiencing friction during opening. The valve actuators are sized to overcome the friction force of only one disk.

(2) Undersized Actuators - In 1977 the valve actuators of HV-851, 852, 853, and 854 were changed from motor-operated to hydraulically-operated actuators in order to reduce the stroke time. The hydraulically-operated actuators are not as strong as motor-operated actuators.

The coefficient of friction used to size the actuator should have included margin for long term effects. Coefficients of friction for stellite to stellite surfaces range from 0.119 to 0.4 depending upon operating conditions with the maximum value measured after long term set effects not exceeding 0.4. During gate valve tests performed in the laboratory in clean water, the coefficient of friction values ranged from 0.15 to 0.25 for undamaged seat faces (i.e., undamaged by heavy wear or galling) and seat contact stresses were below 10,000 psi. The design value of 0.2 coefficient of friction was exceeded under ideal conditions and therefore, a 0.4 coefficient of friction should have been used rather than the 0.2 value originally used.

(3) Galling - Although galling was not found after the September 3, 1981 failures, subsequent testing of the valves showed galling.

Galling of the valve seats occurred during valve cycling because of an excessive contact stress (i.e., approximately 32,000 psi) on the valve seat face due to the operating differential pressure (i.e., 1250 psi) across the valve disk during opening. An average contact stress of 10,000 psi provides margin for gate valves using stellite overlaid seats and disk faces to eliminate galling. Galling increases the coefficient of friction significantly, and therefore, a much higher than design actuator force would be required. Galling is technically defined as that material transfer due to adhesive wear, and once galling is initiated and surface movement is repeated under high loads, the process continues (i.e., smearing and scuffing both the surfaces). The surfaces degrade progressively until seizing occurs.

EVALUATION

The licensee has proposed a three phase solution to the problem. The interim solution includes tripping the feedwater pump upon receipt of SIS then restarting the pump after an eleven second delay. The trip/restart of the feedwater pump allows for rapid pressure decay across the valves thus reducing the potential for excessive drag and galling. The second phase of the licensee's proposed solution is to replace both the valves and valve actuators of the 851, 852, 853, and 854 valves. The redesigned valve will eliminate the undesirable tripping/restarting of the feedwater pumps which forms the basis of the interim solution. By December 1, 1981, the licensee will provide a schedule for replacement of the present valves. Finally, the licensee has committed to perform an indepth reevaluation of the entire ECCS. The licensee has committed to provide a schedule for this long-term study by December 1, 1981.

Interim System Modifications

The system modifications for the licensee's interim solution include the following:

1. Tripping the Feedwater Pumps Upon SI Signal

   In order to reduce the differential pressure across the valves in the safety injection system, the feedwater pumps will be automatically tripped following an SI signal. For both cases, with and without offsite power, the feedwater pumps will be automatically restarted 11 seconds after the SI signal by means of an AC timer. The timer is actuated by the pump breaker control power and SIS, and automatically closes the breaker after an 11 second time delay.

   To maintain the average contact stress at the valve seat face to less than 10,000 psi, the differential pressure across the valve disks during opening should not exceed 450 psi. In order to assure an additional margin, the maximum differential pressure under operating conditions will be limited to 350 psi. Tripping the feedwater pump is designed to reduce the pressure acting on the downstream disk of HV-851 A&B to 350 psi or less, thus reducing sufficiently the force required to ensure opening and eliminate the potential for galling of the valves.

There is a normally isolated volume of liquid between HV-851 A&B and MOV-850 A,B&C. This volume could be pressurized to 700 psig (spring loaded check valve setpoint) from leakage of HV-851 A&B or from MOV-850 A,B&C. In order to ensure a maximum differential pressure of 350 psi across HV-851 A&B, the pressure in this volume will be administratively controlled to a maximum of 350 psig. An existing alarm in the control room will be reset to this value and venting required if the alarm is activated.

In terms of the system's ability to come up to rated speed, the licensee's analysis indicates a minimum terminal voltage of 86.3% when the feedwater pump starts simultaneously with SI pump together with the minimum experienced grid voltage. Only 85% terminal voltage is needed to start and bring the feedwater pump to full speed in designed time. Factory tests were also conducted on the licensee's diesel generators in 1976 to demonstrate its capability to restore rated voltage and frequency in designed time by simultaneously starting and operating a 4300 HP motor load and a 3750 kw resistive load. The analysis and test results ensure start and operation of the feedwater pump in various sequencing and loading conditions.

2. Vent Body Cavities of HV-851 and HV-853 Valves

In order to further ensure that pressure is relieved across the double-disk gate valves, pressure relief systems have been installed on both the HV-851 and HV-853 valves.

The HV-851 A&B valves have had a one-inch line inserted into the valve body, between the disks, which relieves upstream of the valve (discharge side of the feedwater pump as seen in Figure 1). A normally closed solenoid valve in the pressure relief line will automatically open upon receipt of a safety injection signal. This relief line reduces differential pressure across the upstream disks of HV-851 A&B.

The HV-853 A&B valves have also had a one inch line inserted into the valve body between the disks. This relief line, which is normally open, discharges downstream of the valve (suction side of the feedwater pump as seen on Figure 1). This relief line reduces differential pressure across the downstream disks of HV-853 A&B.

3. Check Valve Notching

If the check valves located immediately downstream of the feedwater pumps were leaktight to reverse flow, adequate pressure decay may not occur. Therefore, the check valve has been notched and drilled so that following pump trip, pressure can be relieved through the feedwater recirculation line. The check valve notching has been sized to assure pressure decay assuming reverse flow through the HV-852 valve prior to its closure.

4. Time Delay for MOV-850 Valves

When offsite power is available, the original valve sequencing (Attached Figure 2A) had the MOV-850 A,B&C valves opening immediately following receipt of an SIS. With the feedwater pump now being tripped and restarted, pump runout could be a concern if the feedwater pump was started with the HV-851 and MOV-850 valves in the open position. Therefore, an eleven second time delay has been inserted before the MOV-850 A,B&C valves open. For both cases, with and without offsite power, the MOV-850 valves will not begin to open until the feedwater pumps have been given a restart signal.

There is a separate D.C. operated time delay relay for each of the three MOV's (850 A,B&C). The sequencer energizes the time delay relays immediately following SIS and the relays initiate valve movement with a time delay of 11 seconds.

The delayed opening of MOV-850 A,B&C by 11 seconds will also mitigate the effects of back pressure on HV-851 A&B which could potentially exist due to a leak in the reactor coolant boundary check valves located downstream of MOV-850 A,B&C.

5. Valve Sequencing for SIS-Only and SIS-With-Loss of Off-site Power (SISLOP)

The attached Figures 2A and 2B show the valve sequencing for both the existing design and the design change respectively.

In the existing design, valve movement is initiated immediately following SIS if off-site power is available and is delayed for 11 seconds for SISLOP. The sequencer connects the diesel generator to the bus at a 10 second step and initiates valve movement at an 11 second step.

The modification makes SIS-only valve sequencing design identical to that of SISLOP.

6. Removal of Condensate Pump Interlock

The "existing design" had an interlock which prevented tripping of the condensate pump until the HV-853 valve was completely opened. This interlock has now been removed so that the condensate pumps are tripped upon an SIS. This modification trips the condensate pump approximately five seconds earlier and helps relieve the differential pressure across the downstream valves.

Accident Analysis

Loss of Coolant Accident

The limiting case LOCA, which is accompanied by a loss of offsite power, was analyzed in the FSAR assuming that full flow to the reactor vessel occurred 26.7 seconds following the SI signal. As a result of the SIS modifications, a reevaluation of the total time delay was made. Effective full flow to the reactor vessel is now conservatively estimated to occur 24.2 seconds following initiation of a SIS. Therefore the LOCA analysis as found in the FSAR remains bounding.

Main Steam Line Break

The worst case MSLB assumes that offsite power is available. This is because the reactor coolant pumps will not be tripped. With a secondary side break the primary side cools down much faster with the reactor coolant pumps running thus increasing the rate of reactivity insertion. Therefore, tripping and restarting the feedwater pumps, which delays the safety injection flow, is non-conservative for this transient.

The previous FSAR analysis assumed that safety injection flow was fully effective 28.5 seconds after the pipe break. With the new modifications, the MOV-850 valves will not be fully open until 37.5 seconds following the pipe break. By taking credit for partial opening of the gate valves (i.e., 50% valve opening corresponds to approximately 90% full flow), the licensee has stated that the safety criteria of DNBR >1.30 is not exceeded. In addition, the licensee's calculations show that the safety criteria remains valid even if flow is not assumed through the system until the MOV-850 valves are fully open.

Reliability-Analysis

The licensee has performed a reliability analysis of the SIS modifications for SONGS-1. The NRC staff has made a brief review of the evaluation and notes that the results compare favorably with WASH-1400. We have not found any obvious factors which would significantly alter these results. However, these conclusions are very dependent on the analysis assumptions, data, methodology, and subjective treatment of common mode failures. Additional information, including sensitivity studies, would be necessary to fully evaluate these aspects of the report. For this reason the importance of a satisfactory pre-operational and in-service testing program is increased.

Pre-Operational Testing Program

The modifications made to the safety injection system result in lower differential pressure across the valves and lower loads on the valve actuators. The attached Figure 3 provides a comparison of the differential pressures and actuator loads between the former and modified design. The licensee's proposed pre-operational testing program is included in the attached Figure 4.

The purpose of the pre-operational testing is to verify proper installation of the modifications and to demonstrate component/system performance capability. These tests have been conducted to verify the modified electrical circuitry, component ratings and settings, operability of various components in the circuits and contact configurations. Relays setpoint will be monitored and verified each three months during the surveillance testing.

The individual valves have been monitored to determine their opening force. Monitoring the opening force throughout the testing program has verified margin and repeatability. In addition, monitoring of the opening force can indicate trends or signs of unusual wear. Briefly, the completed testing program and the objective of each test was as follows:

ΔP Stroke Test For MOV-850 and HV-853 Valves

With the upstream side of the MOV-850 A,B&C valves pressurized to 1250 psig, the operability and stroke time have been verified.

With the upstream side of the HV-853 A&B valves pressurized to 171 psig, the operability and stroke time have been verified.

HV-851 Opening Force Test

The system modifications are predicted to lower the system pressure to 350 psi before the HV-851 valves receive an open signal. This test verifies the operability of the valves with both a 350 psi ΔP and a 0 psi ΔP. Since there are no system provisions to maintain a static 350 psi differential pressure on the upstream side of the valve (feedwater pump seal failure may occur if this portion of piping is pressurized without the feedwater pump running), this test was performed by pressurizing the downstream piping with the differential pressure on the upstream disk. The licensee stated that since the valve is nearly symmetrical, a verification of the upstream disks operability is sufficient. Because these tests did not demonstrate operability or margin in a condition typical of the accident condition, the staff required additional testing in the "Cold Flow ΔP Sequencing (Pump Decay)" portion of the test program.

Hot Opening Force Test for HV-851

The HV-851 valve was heated to full power operating temperature (290-320°F) and the operability and stroke time were verified with a ΔP of 350 psi. As discussed above, the differential pressure was placed on the downstream side of the valve thus testing the upstream disk only.

ΔP Stroke Test For HV-851

This test verified operability and repeatability of the HV-851 valve at a ΔP of 350 psi. Similar to the above, this pressure test was only applied to the upstream disk.

Cold No-Flow Sequencing

This test verified the valve sequencing as modified. There was no flow and zero ΔP existed across the valves for this test.

Cold Flow ΔP Sequencing (Pump Decay)

These tests began with the feedwater pump running and verified the switchover from feedwater to borated water. They also verified that the feedwater pump discharge pressure decays to acceptable levels before HV-851 A&B receive an OPEN signal.

The pump decay tests were run with the MOV-850 valves closed. Water was pumped back to the RWST via the recirculation line. The results of these tests are shown in the attached Figure 5.

HV-851 A&B Internals Inspection

After the valves were repeatedly cycled under static and pressure decay conditions, they were disassembled and inspected for signs of galling or unusual wear.

Valve Inspection Results

Following the successful completion of the cold flow ΔP sequencing (Pump Decay) tests, the licensee disassembled the HV-851A&B valves and inspected the valve internals for signs of galling or unusual wear. Both of the downstream disks and seats were found to be in excellent condition only showing signs of normal wear (i.e., small surface scratches). The upstream disk of HV-851A was also found to be in excellent condition. However, inspection of the upstream disk of HV-851B showed that scratching and galling had started.

Galling of the HV-851B disk was not as severe as was observed following earlier tests. The licensee's consultant has concluded that the workmanship, machining and lapping of the upstream disk were of excellent quality.

Double-disk gate valves characteristically apply a greater force on the downstream disk when opening. Since the upstream disk that was galled was acting as a downstream disk during the Opening Force Tests, when the ΔP was applied in the reverse direction, the licensee believes that the galling may have been caused during these reverse pressure tests. Supporting bases for the licensee's position include:

- When the HV-851 were exposed to 350 psi ΔP in the reverse direction (Opening Force Tests), the actuator force necessary to open the HV-851B valve was nearly twice the force necessary to open the HV 851A valve. This observation occurred on each of the three 350 psi ΔP tests and could imply that galling occurred during these tests.

  Figure 5, which includes the results of the Cold Flow ΔP Sequencing (pump decay) tests, shows that the galled HV-851B valve required a greater actuator force during the pre-inspection testing.

- Examination of the valve assembly shows that the stem to upper wedge connection on the galled disk is rigid and does not allow the upper wedge to "float" and self-align to the seat face. The licensee believes that the observed galling can be attributed to lack of self-aligning action of the wedge, resulting in non-uniform contact pressure distribution. In addition, when the ΔP is applied in the reverse direction, the force exerted by the wedging action is added to the ΔP exerted by the fluid.

- The valve manufacturer recommends a preferred direction of flow through the valves. The reverse direction pressure testing, which was performed in this manner for convenience, induces conditions of operation not intended for the valves.

Post Inspection Testing

Following the HV-851 inspection, there were three Cold Flow ΔP Sequence (Pump Decay) Tests. The results are shown in Figure 5. In addition a Hot Functional SIS test will be performed before plant restart with the primary system in the hot shutdown condition and at approximately 1700 psig and 535^{o}; a SIS will be generated on low pressurizer pressure. The test will verify operation of all SI system components by event recorders and personal observation. Although the MOV-850 valves will open, injection will be prevented by the downstream check valves because the primary system's pressure will be above the feedwater pump cutoff head.

Surveillance Testing

The licensee has committed to perform periodic surveillance testing of the modified safety injection system. Throughout the remainder of the current fuel cycle, the following testing will be performed to verify continued operability.

- Not less than two weeks nor more than three weeks following return to power at the conclusion of the current outage, the unit will be brought to either a hot standby or a hot shutdown condition and a hot test performed. This test will be similar to the Hot Functional SIS Test performed during the current outage and will be performed to demonstrate the operable status of the safety injection system. The MOV-850 A,B&C

valves will be locked closed for the surveillance testing. This test will include a determination of the force required to open HV-851 A&B and the margin to available actuator force after the valve has been allowed to "set" in place. The "set" phenomena results from the valve remaining closed against a high differential pressure and temperature. Opening the 851 valves at this time is expected to require more actuator force than that necessary during the pre-operational testing.

Acceptance criteria have been established for the measured HV-851 A&B actuator forces. The acceptance criteria will determine if the frequency of the quarterly pump decay tests (discussed below) should be increased. In addition, the acceptance criteria will determine when it is necessary to declare the HV-851 valves inoperable.

- Every three months the plant will be placed in mode 3 or 4 and a Hot Functional SIS Test will be performed. The opening force of each valve will be monitored to verify that adequate margin remains.

If the safety injection system surveillance testing does not verify system operability, the licensee will report the results along with proposed corrective actions to the NRC. The plant will be shut down until the NRC staff gives approval for restart.

The surveillance testing will be included in the San Onofre Unit 1 Technical Specifications.* The specifications include the testing criteria contained in this evaluation and are, therefore, acceptable.

The licensee has committed to submit a long term surveillance program (beyond the current fuel cycle) for the safety injection system. This program will also require NRC staff approval.

Summary

The proposed modifications have been made to the safety injection system with the objective of ensuring that hydraulically actuated valves have sufficient actuator force to open under their respective operating conditions. The design approach to accomplishing this objective relies upon limiting the maximum differential pressures, and therefore, the forces developed on valve seating surfaces when the valves are required to open such that (1) the force required to open each valve is less than the available actuator force, and (2) the potential for galling of valve seating surfaces is eliminated.

The staff finds the licensee has explored the likely failure mechanisms associated with the September 3, 1981 event and the galling observed during the preoperational tests on HV-851B. However, insufficient data and analysis are available to conclusively demonstrate that the licensee's explanation is correct. We therefore required additional testing of the 851 valves with pressure applied in the same direction as experienced during an accident. This testing (four strokes of the 851 valves after re-assembly plus surveillance testing in

*The Technical Specifications assume an actuator force of 10,000 lb_f as a threshold indicator of loss of actuator margin. The licensee has indicated that a revised value may be proposed based on test results and further investigations.

accordance with the revised Technical Specifications) along with monitoring of the actuator force necessary to open the valves provides sufficient assurance: (1) that the system as installed is operable; (2) that margin exists between the force necessary to open the valves and the available actuator force; and (3) that the force necessary to open the HV-851 A&B valves at the time of startup is similar to the force needed to open the 851A before the inspections in which it was found to be in excellent condition, therefore implying that both the 851 A&B valves are in excellent condition.

Based on our review of the licensee's submittals, we conclude that the proposed program, schedule, system modifications and technical specifications are acceptable.

ENVIRONMENTAL CONSIDERATIONS

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment inovlves and action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4) that an environmental impact statement, or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

SIGNIFICANT HAZARDS CONSIDERATION

In making the determination that the proposed amendment does not involve a significant hazards consideration, the staff has considered whether operation of the facility in accordance with the modification would (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possiblity of an accident of a type different from any evaluated previously, or (3) involve a significant reduction in a margin of safety.

The proposed modification does not change the probability or consequences of an accident previously evaluated, since the modification of the safety injection system would not influence the probability of any of the facility's design basis accidents. In addition the licensee's analyses of the Loss of Coolant Accident and Main Steamline Break Accident demonstrate that the consequences of these events would not exceed the consequences as addressed in the facility's Final Safety Analysis Report.

The system modifications do not introduce the possibility of any new types of accidents since a malfunction of the modified system would not introduce any new failure modes or mechanisms.

In terms of the potential for a reduction in a margin of safety, the staff has reviewed the proposed modification to determine if the reliability of the safety injection system has been significantly reduced. The licensee and their consultant performed a reliability analysis of the modified system and concluded that no significant change in reliability was involved. The staff reviewed this analysis and did not find any obvious factors which would significantly alter the results. However, the staff has required the following steps to assure that no significant margin reduction has occurred:

1. An extensive pre-operational test program on the safety injection system and particularly the previously failed valves. This program has been significantly more extensive, in terms of the number of tests and the quantity of information, then that required for a new system. If either valve should fail the test criteria given in the Technical Specifications, NRC approval is required prior to returning the plant to service.

2. A greatly increased surveillance program, in terms of frequency and quantity of information, has been required.

3. The period of time under which the facility can be operated has been limited to the present fuel cycle (a system modification and/or modified surveillance program is required before the next fuel cycle).

On the basis of the information reviewed and the pre-operational and surveillance testing, we conclude that no significant reduction in the margins of safety has occurred.

CONCLUSION

We have found that for the reasons given in the preceding sections of this evaluation that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: November 5, 1981

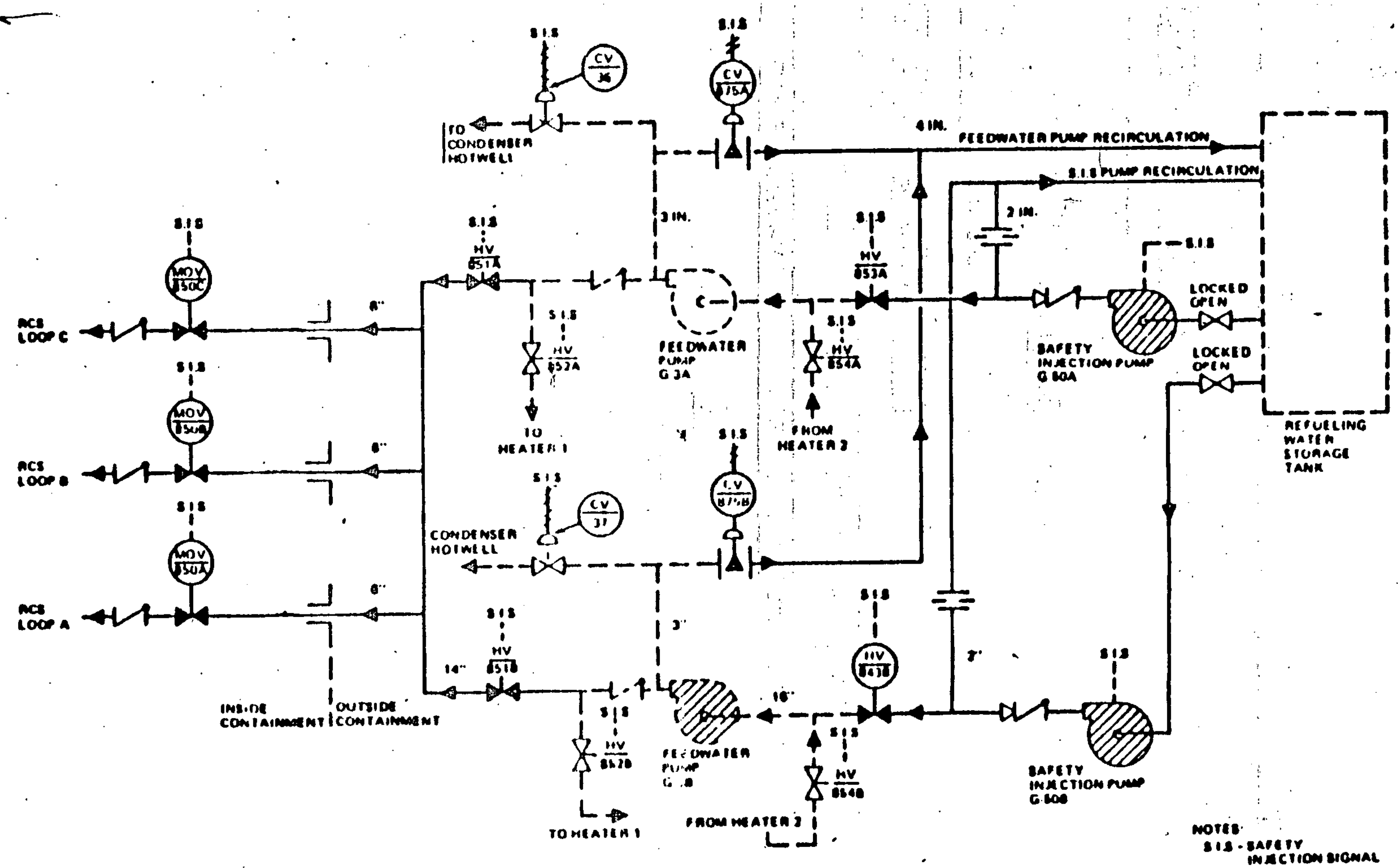

FIGURE 1

SIMPLIFIED SCHEMATIC OF SONGS-1 SAFETY INJECTION SYSTEM

FIGURE 2A

SAFETY INJECTION DELAY TIME (SECONDS)

EXISTING SYSTEM

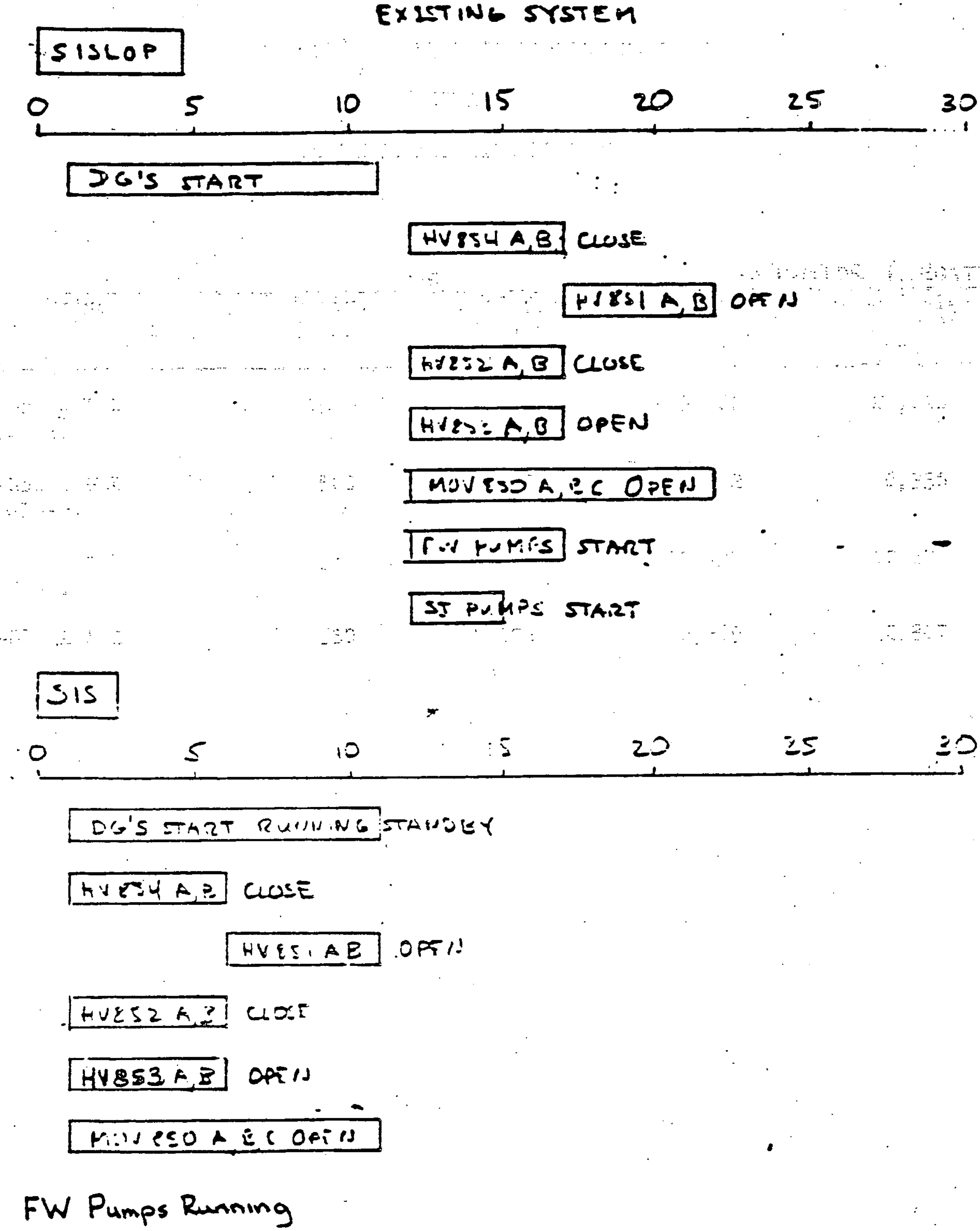

FIGURE 2B

SAFETY INJECTION DELAY TIME (SECONDS) FOR MODIFIED SIS

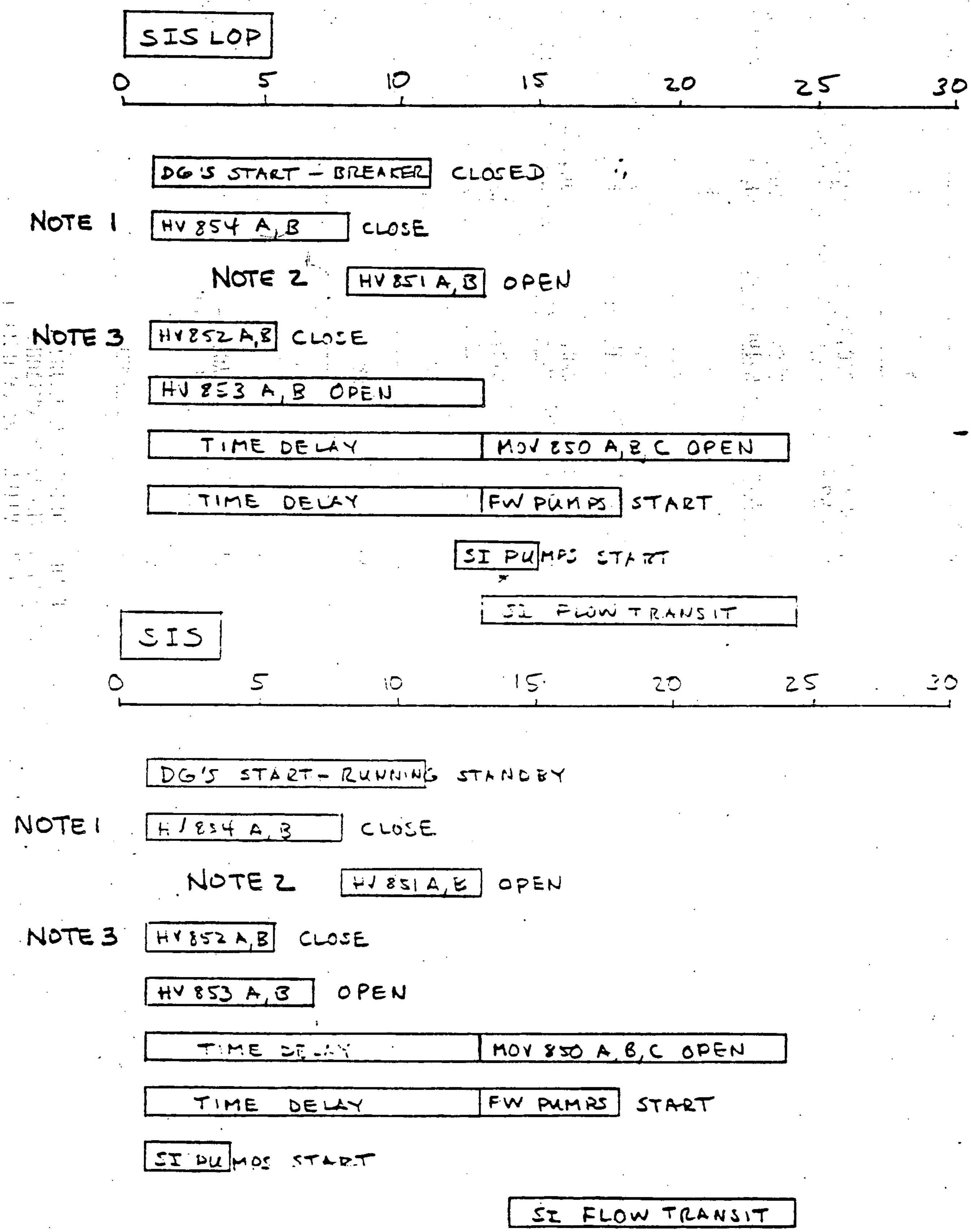

FIGURE 3

SAN ONOFRE NUCLEAR GENERATING STATION

UNIT 1

SIS VALVE ACTUATOR EVALUATION

Valve (Position for SIS)	Δp Design (PSI)	Δp Post 9/81 Design (PSI)	Actuator Thrust Design (LB)	Actuator Thrust Load Design Post 9/81 (LB)
HV-851 A & B (Open)	1500	350	33,160	21,646
HV-852 A & B (Close)	1500	22	44,942	6,336
HV-853 A & B (Open)	350	171	13,130	10,825
HV-854 A & B (Close)	350	174	10,269	2,807

FIGURE 4

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1
SAFETY INJECTION VALVES MODIFICATIONS
PREOPERATIONAL FUNCTIONAL TEST MATRIX

TEST (IN SEQUENCE)		MOV 850 A, B, C	HV-851 A, B	HV-852 A, B	HV-853 A, B	HV-854 A, B	SV 2900 SV 3900
ΔP STROKE		ΔP = 1250 CYC's = 1	NA	NA	ΔP = 175 CYC's = 3	NA	NA
OPENING FORCE		NA	ΔP = 0/350/0 CYC's = 3/3/3	NA	NA	NA	Maintained Open
*HOT OPENING FORCE (851A only)		NA	ΔP = 350 *CYC's = 3	NA	NA	NA	Maintained Open
ΔP STROKE		NA	ΔP = 350 CYC's = 10	NA	NA	NA	Maintained Open
COLD NO-FLOW SEQUENCING	1-SIS 1-SISLOP	ΔP = 0 CYC's = 2	ΔP = 0 CYC's = 2	ΔP = 0 CYC's = 2	ΔP = 0 CYC's = 2	ΔP = 0 CYC's = 2	ΔP = 0 CYC's = 2
COLD FLOW/ΔP SEQUENCING	3-SIS	Maintained Closed	Maintained Closed	ΔP = Pump Decay CYC's = 3	ΔP = Pump Decay CYC's = 3	ΔP = Pump Decay CYC's = 3	Maintained Closed
COLD FLOW/ΔP SEQUENCING	9-SIS 1-SISLOP	Maintained Closed	ΔP = Pump Decay CYC's = 10	ΔP = Pump Decay CYC's = 10	Maintained Open	ΔP = Pump Decay CYC's = 10	ΔP = Pump Decay CYC's = 10
VALVE INTERNALS INSPECTION		NA	HV-851A, B Only	NA	NA	NA	NA
COLD FLOW/ΔP SEQUENCING	1-SIS	Maintained Closed	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1	Maintained Open	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1
HOT SIS	1-SIS	ΔP = Pump Start CYC = 1	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1	ΔP = Pump Decay CYC's = 1
TOTAL CYCLES, EACH VALVE, AT 0 ΔP		2	8	2	2	2	2
TOTAL CYCLES, EACH VALVE AT $\Delta P > 0$		2	*HV-851A - 28 HV-851B - 25	15	7	15	15

SIS VALVE PROJECT
SAN ONOFRE UNIT 1
OPENING FORCE DATA

RUN NO.	HV-851A ACCUM'R PSIG	HV-851A MAN'D PSIG	HV-851A LINE PSIG	HV-851A FORCE lbf	HV-851B ACCUM'R PSIG	HV-851B MAN'D PSIG	HV-851B LINE PSIG	HV-851B FORCE lbf
COLD SIS RWST LINE-UP PRE-INSPECTION								
1	3200	2200	350	3636	3200	2100	320	5033
2	3200	2200	335	3588	3200	2000	320	6525
3	3200	2200	350	3636	3200	2100	315	5018
4	3200	2200	350	3636	3200	2200	320	3541
5	3100	2200	350	2531	3200	2100	320	5033
6	3200	2200	350	3636	3200	2200	320	3541
7	3200	2200	320	3541	3200	2000	315	6510
8	3200	2200	335	3588	3200	2100	315	5018
9	3200	2200	335	3588	3200	2100	315	5018
AVERAGE	3189	2200	342	3489	3200	2100	318	5027
COLD SIS RWST LINE-UP POST-INSPECTION								
1	3200	2200	350	3636	3200	2200	320	3541
2	3200	2300	345	2128	3200	2300	335	2096
3	3200	2300	350	2144	3200	2300	335	2096
AVERAGE	3200	2267	348	2630	3200	2267	330	2573

FIGURE 5