



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

CONCEPTUAL DESIGN REVIEW

MODIFICATIONS TO ECCS

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1 (SONGS-1)

Background

The feedwater pumps at San Onofre Unit 1 currently have dual functions. They are used to supply feedwater to steam generators during normal operation and inject borated water to the reactor for emergency core cooling when needed. Figure 1 presents the schematic flow diagram of the as-built system. The switchover from the feedwater function to safety injection function relies on the realignment of the safety injection system valves (HV 851 A & B, HV 852 A & B, HV 853 A & B and HV 854 A & B) located upstream and downstream of the feedwater pumps.

As discussed in the staff's Safety Evaluation Report dated November 2, 1981, the SONGS-1 event of September 3, 1981 resulted in both trains of the safety injection system failing to operate when challenged under actual operating conditions. Following a manual reactor trip from 88% power, the licensee reported 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.

Following the event investigation, the licensee concluded that the combined feedwater/safety injection system design was a contributing factor to the common mode failure. Failure of the HV-851 A&B valves was attributed to one or more of the following:

- (1) Double-disk dragging - made possible by the double-disk gate valve design.
- (2) Undersized Actuators - the valve actuators were changed from motor-operated to hydraulically - operated in 1977 in order to reduce the stroke time.
- (3) Galling (metal to metal transfer between the disc and the valve seat) although galling was not evident after the September 3, 1981 event, subsequent testing of the valves showed clear signs of galling.

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In the November 2, 1981 evaluation, the staff concluded that, although the licensee had explored the likely failure mechanisms associated with the September 3, 1981 event, insufficient data and analysis were available to conclusively demonstrate that their explanation was correct. However, due to a number of design modifications and commitments made by the licensee, approval was given for the interim operation of SOMGS-1. Briefly stated, the design modifications made before restart included:

- (1) Tripping the feedwater pumps and restarting them after an eleven second time delay;
- (2) Venting of the HV-851 and HV-853 valve body cavities; and
- (3) Changes to the control logic for both valves and pumps in order to minimize the differential pressure across the valves.

Commitments made by the licensee included:

- (1) Replacement of both the valves and valve actuators for the HV-851, 852, 853 and 854 valves. The new valves would be designed such that the undesirable tripping/restarting of the feedwater pumps could be eliminated. The licensee would provide a schedule for their replacement by December 1, 1981.
- (2) The licensee would perform an indepth reevaluation of the entire SIS. A schedule for this reevaluation would be provided by December 1, 1981.
- (3) An indepth inservice testing program was developed for the valves in the safety injection system. Technical Specification changes were made to require monitoring valve opening forces and reporting the findings to the NRC. This testing program would be in effect throughout the current fuel cycle (which began in June, 1981).
- (4) The licensee would submit a long term surveillance program (beyond the current fuel cycle) for the safety injection system.

Present Status of Long term Commitments

Subsequent to the staff's Safety Evaluation Report which approved plant restart and interim operation, the following correspondence has been received:

- On December 8, 1981 the licensee stated that bids for the valves replacement had been received and were being evaluated. In addition several different conceptual studies of SIS modifications were being made.
- On March 30, 1982 the licensee stated that valves and valve actuators were being ordered from Borg-Warner Corporation. Construction and startup testing was projected for the first half of 1985. In addition, the licensee stated that of the various conceptual SIS redesigns being studied, the alternative involving dedicated SI pumps, had been selected for further

study. It was stated that if this redesign of the SIS were implemented, the Borg-Warner valve and valve actuator order would be cancelled.

- On September 28, 1982 the licensee stated that a major redesign of the SIS was warranted and that the Borg-Warner valve order was being cancelled. The redesign will be based on a dedicated SI system (new feedwater pumps) design.

Evaluation

Due to the failure of HV's 851 A & B in 1981, a conceptual study has been conducted with the objective of separating the feedwater and safety injection systems so that the safety injection function would not rely on the alignment of these valves. The addition of new dedicated feedwater pumps has been selected as the best method of separating these systems.

The new feedwater pump modification includes the addition of a pair of feedwater pumps with the associated piping, valves, power source, instrumentation and controls. These modifications will leave the existing feedwater pumps, currently shared by the feedwater and safety injection systems to be exclusively available for the safety injection function. Thus, the feedwater system and safety injection system will be separated. The only modifications to the SIS will be capping off piping connections previously associated with the feedwater system, and modifying electrical and control circuits to reflect the system design.

Figure 2 shows the proposed modifications to the existing piping and the new feedwater pump arrangement. Additional piping, isolation valves and check valves for the new feedwater pumps will be required.

Current instrumentation and controls common to both the safety injection and feedwater systems will be dedicated to the safety injection system operation. All instrumentation and controls used exclusively for the current feedwater system will be utilized in the new feedwater trains.

Implementation of this modification will eliminate the need for valve sequencing between the feedwater and safety injection systems. Replacement valves will no longer be required and are being cancelled. Once the systems are separated, there will not be continuous pressure from the feedwater system on the hydraulic valves (HV853 A&B and HV851 A&B). This will eliminate the high pressure on the valve seats which contributed to the earlier problems. In addition, by isolating the two systems the valves will no longer require sequencing and interlocks to prevent condensate from being supplied to the SIS. The requirement for keeping the remaining SIS valves closed during normal operation will be further evaluated as engineering progresses.

A non-safety related power supply dedicated to the new feedwater pumps motors will be required for this design. A new 30 MVA, 230 kV-4.36 kV, 3 phase transformer, similar to the existing spare "C" transformer, will be installed.

According to the licensee, the control logic for the following components will require revision to implement the proposed design.

- a. SI discharge valves HV-851 A & B,
- b. SI suction valves HV-853 A & B,
- c. FW discharge valves HV-852 A & B,
- d. FW suction valves HV-854 A & B,
- e. Feedwater pump recirculation valves CV875 A & B,
- f. Feedwater pump recirculation valves CV36 and CV37,
- g. Condensate and feedwater pumps' start/stop controls.

Conclusion

The licensee has provided a conceptual design description of a revised SIS at San Onofre Unit 1. The objective of the SIS redesign is to minimize the reliance on extensive sequencing of the SIS hydraulic valves.

The staff agrees that a redesign of the SIS is warranted. The conceptual design information provided by the licensee is acceptable to the staff. However, the information provided to date is preliminary and design details have yet to be submitted. Before final staff approval is given to the SIS redesign, the licensee must submit a detailed description of the proposed modifications. In addition the licensee must submit a long term surveillance program for the SIS valves.

Dated: May 27, 1983

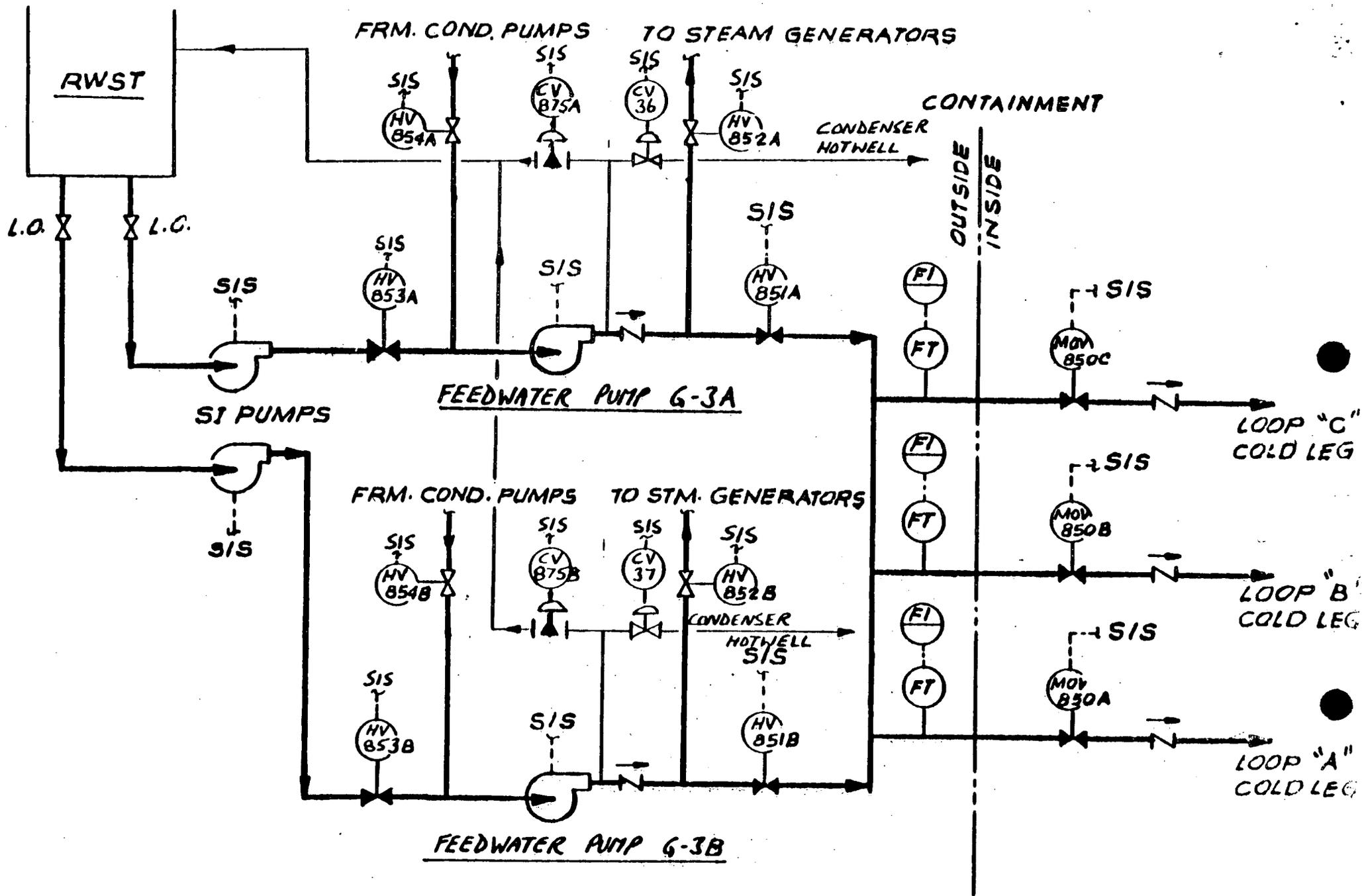


FIGURE 1
AS BUILT SYSTEM

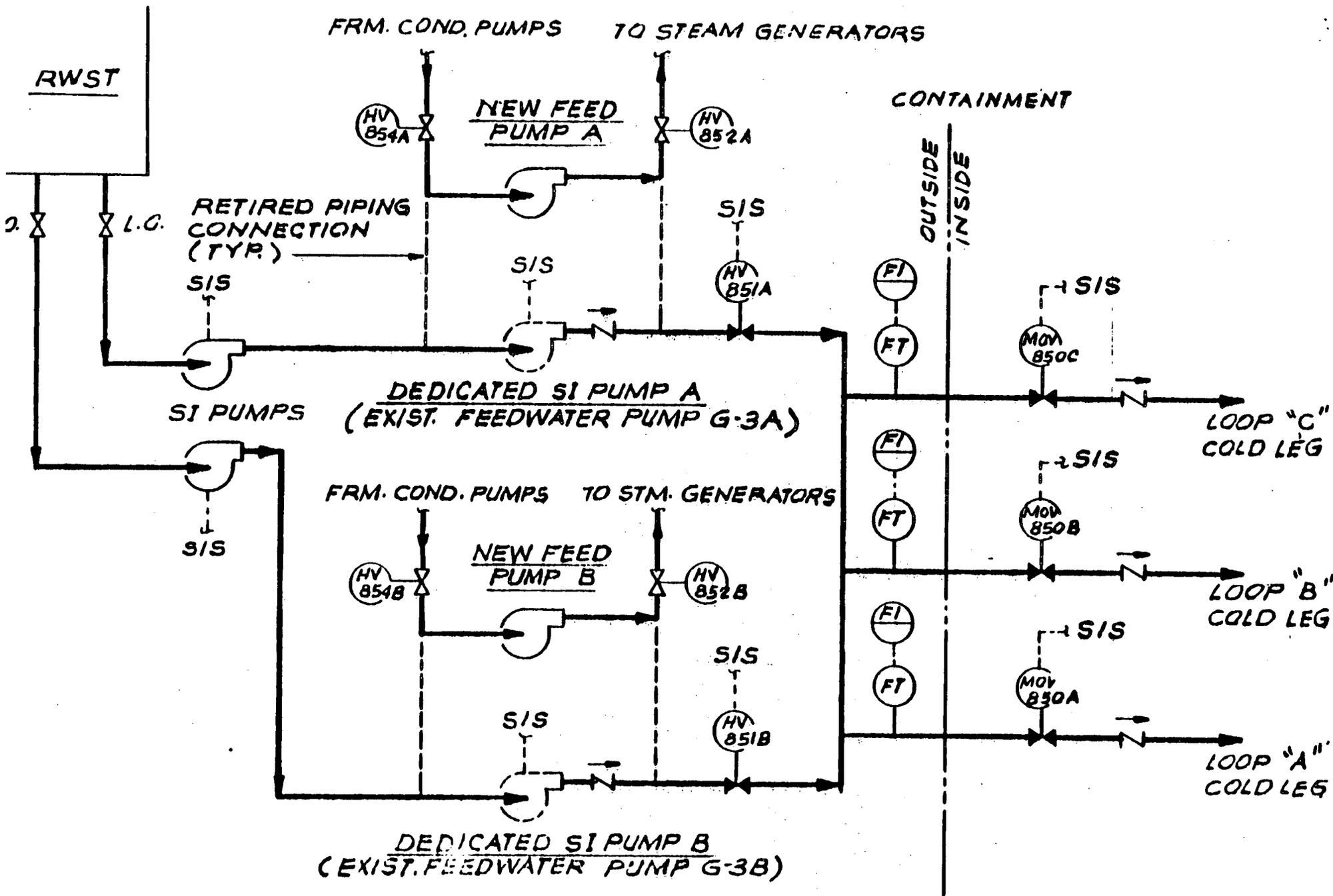


FIGURE 2
 (NEW DEDICATED FEED PUMPS)