UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SAN ONOFRE NUCLEAR GENERATING STATION, UNIT NO. 1

SOUTHERN CALIFORNIA EDISON COMPANY

DOCKET NO. 50-206

DEMONSTRATION OF CONTAINMENT PURGE AND VENT VALVE OPERABILITY (B-24)

1.0 REQUIREMENT

Demonstration of operability of the containment purge and vent valves, particularly the ability of these valves to close during a design basis accident is necessary to assure containment isolation. This demonstration of operability is required by BTP CSB 6-4 and SRP 3.10 for containment purge and vent valves which are not sealed closed during operational conditions 1, 2, 3, and 4.

2.0 DESCRIPTION OF PURGE AND VENT VALVES

The valves identified as the containment isolation valves in the purge and vent system are as follows:

Valve Number	Manufacturer	Size (Inches)	Use	Location
POV-9	Pratt	24	Supply	Outside containment
POV-9A	Pratt	24	Supply	Outside containment
POV-10	Pratt	24	Exhaust	Outside containment
POV-10A	Pratt	24	Exhaust	Outside containment
CV-10	Fisher	6	Vent	Outside containment
CV-116	Fisher	6	Vent	Inside containment

The valves are all butterfly valves. No catalogue information on these valves was submitted by the licensee. The valves were described as air operated, but no description of the operators was presented.

The Southern California Edison Company has committed to maintaining the 24 inch valves closed whenever the reactor is not in a cold shutdown or refueling mode (See Reference A below), and to limit the opening of the 6-inch vent valves to 50° (See Reference B below). The 6-inch valves are presently open during all phases of operation in order to maintain the containment design pressure of 14.7 psia during operation. This review is therefore limited to the 6-inch valves.

3.0 DEMONSTRATION OF OPERABILITY

The following documents (Reference) were examined for this review:

A. Letter of December 14, 1979 from K.P. Baskin of Southern California Edison Company to D.L. Ziemann, ORB #2, U.S. Nuclear Regulatory Commission.

B. Letter of February 29, 1980 from J.G. Hynes of Southern California Edison Company to D.L. Ziemann, ORB #2, U.S. Nuclear Regulatory Commission.

C. Enclosure entitled "Containment Purge and Vent Valve Operation - San Onofre Unit 1" to letter of January 15, 1980 from Southern California Edison Company to U.S. Nuclear Regulatory Commission.

D. "Effect of Fluid Compressibility on Torque in Butterfly Valves" ISA Annual Conference, ISA Transaction, Vol. 8, No. 4, pg. 18, 1969.

Reference A indicated that the licensee was discussing a qualification program for the 24 inch purge valves with the vendor, and committed to keeping them closed as an interim measure. These valves must remain closed until the licensee demonstrates valve operability.

Reference B documented the licensees commitment to limit the opening of the 6-inch vent valves to 50° opening based on the data presented in Reference C. Reference C presented the following table which summarized the calculated differential pressure at which the valves would operate for different angles of opening between 0° and 90°.

TABLE 1 for 6-inch valves)

Angle Opening (degrees)	10	20	30	40	50	60	70	80-90
Differential Pressure (PSI)	188.1	185.8	192.1	164.7	138.2	83.3	59.7	35.5
Actuator Torque Required (in-lb)	733.2	738.2	724.5	734.4	733.3	707.3	676.4	644.1

The differential pressure listed in this table was the maximum allowable based on a stress analysis of valve components. The licensee states that since the maximum expected containment pressure is 49.4 psig (Reference C), the valve should be capable of closing from 70° open. At this angle, with a differential pressure of 50 psi, the torque required would be 592 inch pounds. The licensee goes on to postulate that since it takes 62 seconds after initiation of the accident to reach the maximum of 49.4 psig, and if a valve closing time of 5 seconds is assumed, the actual differential pressure experienced by the valve at this time is less than 35 psig. It is pointed out that Table 1 indicates that at an opening of 80°-90°, the vent valves will close against a differential pressure of 35.5 psig. The valve manufacturer, however, only recommends an opening of 70°.

Based on the conclusions postulated above, and the valve vendor's recommendation, the licensee feels it is acting conservatively by limiting the valve opening to 50°.

Although the licensee has inferred that the valve operator is capable of providing the required torque at 50° opening, the actual torque capabilities of the operator throughout its range of operation was not presented. Also, no analysis of seismic effects on the valve/operator configurations was presented.

4.0 EVALUATION

4.1 From the submittals of other licensees which use valves manufactured by Fisher Controls, the staff is familiar with the process by which this valve manufacturer analyzes his valves. The dynamic torque (T_D) predictions used by Fisher stem from coefficients developed by bench tests on model valves representing the design of the in-service valves. Analytical techniques involving scaling are used to determine T_D for the actual valve sizes. The Fisher Control authored I.S.I. paper entitled, "Effect of Fluid Compressibility on Torque in Butterfly Valves," (Reference D) gives the basis for Fisher's T_D predictions.

Fisher's approach to evaluating critical valve parts is to determine maximum allowable ΔP across the valve at a given disc angle. This maximum allowable ΔP is based on the valves weakest operating part, but does not include the operator and associated mounting hardware. The maximum allowable ΔP for each disc angle (10° increments) is compared to the operating pressure condition, in this case, 49.2 psig. From this, the maximum disc-opening angle is selected.

The Fisher developed computer program used to establish the maximum opening angle is described as follows:

- o For a given valve at some angle of opening, the program begins by calculating the loading. This includes a hydrostatic load on the disc, seating torque, bushing and packing torque, and dynamic torque.

- o After the loading is determined, the program calculates stresses in the shaft, key, pin, and bushing for a specific ΔP and compares these stresses to a material strength. This strength is based on 1.5 x "S". "S" is the allowable stress figure found in Section III of the ASME Boiler and Pressure Vessel Code. "S" is equal to 1/4 of the maximum tensile strength or 2/3 of the minimum yield strength, whichever is less. For shear stresses 0.75 "S" is used.

Case 1 - Stress in the shaft at the disc hub due to bending and torsion.
Case 2 - Stress in the shaft at the disc hub due to torsion and traverse shear.
Case 3 - Stress at the pinned disc-shaft connection.
Case 4 - Stress at the keyed actuator-shaft connection.
Case 5 - Stress at the shaft bushing.

o The program output shows the lowest ΔP which is calculated for each angle of opening. The actuator torque required for the lowest ΔP is also listed. This is the information listed in Table 1 above.

Inherent in the calculations are the following assumptions:

1. Peak containment pressure is the ΔP experienced by the valve at all disc angles.

2. Pressure losses due to inlets, piping configuration etc., or other valves in the line are neglected.

3. For valves with asymmetric discs, flow is assumed toward the hub side for predicting dynamic torques.

The analysis is based on model valve tests with straight inlets which do not account for asymmetric flow and forces due to elbows or other fittings upstream of the valve. Information available from other valve manufacturers has indicated that for any given valve, using equivalent flow conditions, the dynamic torques developed for a configuration with an elbow upstream of the valve is up to three times that developed for a configuration with a straight pipe inlet. Other manufacturers have found that if the valve shaft is in plane with the upstream elbow, the increase in dynamic torque is of the order of 1-1/2 times, while if the valve shaft is 90° out of plane with the elbow, the increase in dynamic torque is of the order of 2 to 3 times.

The staff, in reviewing Table 1 above, would agree that the 6-inch valves (without the operator) would not be harmed by the DBA/LOCA conditions expected for opening angles up to 50°. At this opening angle, the valve manufacturer has calculated enough margin to overcome any inaccuracy due to inlet configuration. This conclusion by the staff does not apply to angles greater than 50°.

4.2 A determination of the valve operators ability to generate and withstand the torques required, and consequently the operability of the combined valve/operator configuration, was not presented by the licensee. There is no basis for the staff to conclude that the combined valve/operator package will operate as intended during a DBA/LOCA.

4.3 The effect of a seismic event on the operability of these valves has not been addressed. The staff notes that operability of equipment following a seismic event for all operating plants is being addressed under the Unresolved Safety Issue A-46 ("Seismic Qualification of Equipment in Operating Plants").

5.0 SUMMARY

We have completed our review of the information submitted to date concerning operability of the 6-inch valves used in the containment vent system for San Onofre Unit 1. We find that the information submitted did not demonstrate that these valves have the ability to close against the buildup of pressure in the event of a DBA/LOCA from 50° open position. Paragraph 4.2 is the basis for these findings. Maintaining the 24-inch valves closed whenever the reactor is not in a cold shutdown or refueling outage mode is acceptable to the staff.

6.0 ACKNOWLEDGEMENT

This evaluation was prepared by R. Wright and E. McKenna.

Dated: February 16, 1984