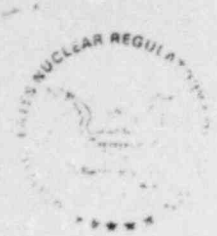

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

DEMONSTRATION OF CONTAINMENT PURGE AND VENT VALVE OPERABILITY

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

Valve Number	Size (Inches)	Location	Use
SB-16-19-23	6	Outside containment	Inert supply
SB-16-19-6	8	Outside containment	Torus vent
SB-16-19-7	18	Outside containment	Purge exhaust
SB-16-19-7A	18	Outside containment	Purge exhaust
SB-16-19-7B	18	Outside containment	Purge exhaust
SB-16-19-8	18	Outside containment	Purge supply
SB-16-19-9	18	Outside containment	Purge supply
SB-16-19-10	18	Outside containment	Purge supply

The Vermont Yankee purge and vent system butterfly valves with Bettis air operated, spring return actuators are supplied by the Allis Chalmers Corporation. Valve number SB-16-19-6 (8-inch) vents the torus continuously so that a small differential pressure is maintained between the drywell and suppression chambers; the remainder of the valves are kept closed except during purging when they are operated from the control room. Actuator model numbers were not furnished by the licensee.

3.0 Demonstration of Operability

3.1 The Vermont Yankee Nuclear Power Corporation (VYNPC) has provided operability demonstration information for the purge and vent system isolation valves at their Vermont Yankee Nuclear Plant in the following submittals.

A. VYNPC letter dated March 26, 1982 from L. D. Marsolias (VYNPC) to D. B. Vasallo (NRC).

B. VYNPC letter dated May 21, 1981 from L. D. Marsolias (VYNPC) to T. A. Ippolito (NRC).

C. VYNPC letter dated April 30, 1981 from R. L. Smith (VYNPC) to T. A. Ippolito (NRC).

D. VYNPC letter dated June 22, 1982 from J. B. Sinclair to D. B. Vassallo (NRC).

E. Telecon November 28, 1983 (NRC, BNL, VYNPC) discussing assumptions used for torque calculations.

3.2 Vermont Yankee Nuclear Power Corporation's approach to operability demonstration is based on the following information presented in their submittals.

a. The Allis Chalmer's (A.C.) test report VER-0209 was used as the basis for predicting dynamic valve loads under the postulated DBA/LOCA. Test numbers from VER-0209 that correspond to specific valves are provided in Reference B as follows:

Valve Number	Test Number
SB-16-19-23	22
SB-16-19-6	21
SB-16-19-7	32
SB-16-19-7A	29
SB-16-19-7B	30
SB-16-19-8	30
SB-16-19-9	31
SB-16-19-10	30

VYNPC used peak LOCA containment pressure (Reference D) in the analysis that predicts dynamic torques. This is a more conservative assumption than the ramp rise approach.

b. Reference A states that Allis Chalmers valve tests demonstrate that all the installed butterfly valves can close from full open conditions at design basis containment pressure. This is true with flow through the valves in the post-LOCA direction. However, as an additional conservatism, limit stops have been added to those valves, where the flow force that tends to open the valve is potentially significant as dictated by the flow tests applicable to those particular valves. Valve numbers V16-19-7 and -7A are blocked at 50° open.

c. The minimum torque margin for each valve, and the disc closure angle at which it occurs are furnished in References A and B are shown below.

*Torque margin defined as available torque minus opposing torque.

Valve	Disc Angle at Minimum Margin (° Open)	Torque Margin* (ft-lb)
SB-6	20	302.2
SB-7	50	443
SB-16-19-7A	40	461.8
SB-16-19-8,10	10	455
SB-16-19-9	20	459
SB-16-19-23	25	41
SB-16-19-7B	70	283

d. Reference B includes a tabulation of stresses in critical valve parts based on simultaneous seismic and static loads at 150 psi rated pressure shown below:

Valve	Critical Part	Calculated Stress Pressure (psi) and Seismic	Design Allowable (psi)
8-inch, SB-6:			
	Shaft	461 (seismic .15%)	30,000
	Disc-bending	5,500 (seismic .01%)	22,500
	Bearings	362 (seismic .15%)	20,000
	Operator mounting bolts	793 (seismic 27%)	54,000
	Flange-clamping force	203 lb. seismic	1,870 lb by bolts
18-inch, SB-7, SB-16-19-7A, B, 8, 9, 10:			
	Disc-bending	6,690 (seismic .1%)	17,500
	Shaft	4,250 (seismic .1)	30,000
	Bearings	4,200 (seismic .1%)	20,000
	Operator mounting bolts	271 (seismic 22%)	54,00
	Flange-clamping force	363 lb seismic	8,810 lb by bolts
6-inch, SB-16-19-23:			
	Disc-bending	5,140	17,500
	Shaft	3,915	30,000
	Bearings	1,050	20,000
	Operator mounting	Shear 1,817	54,000
	Bolts	Tensile 2,282	--

As an example of torque induced stress, Test No. 21 shows the maximum torque for SB-6 to be 174 ft-lb, resulting in a stress of 3,700 psi. Total shaft allowable stress is 30,000 psi. It can similarly be shown for the other valves that the torque induced stresses are well within the design margin.

e. The purge and vent valves are designed to the following codes and standards:

*Torque values (opposing torque) for this valve are incorrect due to installation orientation discrepancy. See Section 4.2 and 4.4 of this evaluation.

AWWA Standard C504-66
USASI Std. for ASA B16.1 150 cast iron flange, for end flange dimensions
USASI B16.5 for hydrostatic test
Manufacturers Standardization Society Standard Practice SP-61, 1961 Edition for Seat Leakage Test.

4.0 Evaluation

4.1 Vermont Yankee Nuclear Power Corporation uses the Allis Chalmer's test report VER-0209 as a basis for predicting dynamic valve loads under the postulated DBA/LOCA conditions. VER-0209 is based on a test program using 6-inch valves with varying disc thickness to diameter ratios, inlet pressures, and geometries resulting in tables of dynamic torque coefficients that may be applied to larger valves in the calculation of dynamic torques during closure against DBA/LOCA accident conditions.

The test report data sheets for the specific purge and vent valves used at Vermont Yankee showing the tabulation of P_1, ΔP, C_T, and T_D versus increments of closure angle were not included in the submittals reviewed; however, torque margin information furnished in Reference B is considered adequate for the purposes of this evaluation in the absence of the test report data sheets.

4.2 Vermont Yankee Nuclear Power Corporation was asked by the staff to check the installation and closure direction of their purge and vent valves to ensure that a particular orientation causing high torques at small angles from the closed position did not exist. VYNPC confirmed that the problem orientation existed for valve SB-16-19-9. Since the torque coefficients with this orientation are more than three times greater than any other orientation tested by Allis Chambers; they recommended in Reference C that any valve mounted this way be removed and re-oriented or that an analysis be made using torque coefficients from model testing with this configuration. VYNPC in Reference D states that valve SB-16-19-9 was re-oriented, as well as valve SB-16-19-8, which upon inspection also had been originally installed with the same orientation.

4.3 The tabulation of stress analysis results presented in References A and B based on a conservative static pressure of 150 psi indicates large factors of safety when the allowable stresses are compared to the calculated stresses. The basis for the 30,000 psi allowable stress in the shaft was not discussed. However, even with a Boiler and Pressure Vessel Code allowable stress of 12,000 psi the stresses are still acceptable, as all the calculated stresses in the shaft are less than 12,000 psi. The calculated shaft stress in the 8-inch SB-16-19-9 valve of 461 psi appears to be low compared to the values calculated for the 6-inch (3,215) and 18-inch (4,250 psi) valves. This is acceptable to the staff, even if an upward revision in shaft stress for the 8-inch valve is found to be necessary, as the allowable stress is 12,000 psi and the shaft stress will be similar to the 6-inch and 8-inch valves (approximately 4,000 psi).

4.4 Minimum torque margins (available torque minus opposing torque) [illegible] from References A and B and reproduced in Section 3.2C of this evaluation demonstrates adequate operator capacity to close all valves under the postulated accident conditions.

4.5 The seismic capability of containment purge and vent valves will be reviewed and resolved as a part of the implementation of the Unresolved Safety Issue A-46.

5.0 Summary

We have completed our review of information submitted to date concerning operability of containment purge and vent valves for Vermont Yankee Nuclear Power Plant. We find that the information submitted has satisfactorily demonstrated the ability of the containment purge and vent valves at the Vermont Yankee Nuclear Power Plant to close against the buildup of containment pressure in the event of a DBA/LOCA.

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Dated: May 22, 1984