



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO MECHANICAL OPERABILITY OF PURGE/VENT BUTTERFLY VALVES

ALABAMA POWER COMPANY

JOSEPH M. FARLEY NUCLEAR PLANT, UNIT NO. 1

DOCKET NO. 50-348

Introduction and Purge Valve Description

The containment purge systems have the capability to purge the containment through 48.0-inch butterfly valves or 18-inch (mini-purge) butterfly valves. The 48-inch valves have been used for limited purge operations while the 18-inch valves have been used for essentially continuous purging during plant operation.

Each of the valve assemblies consists of valve body, operator, and pilot solenoid valve manufactured by H. Pratt, Bettis, and ASCo respectively. The operators are air to open-spring to close type. When the solenoid valve is energized, the operator (piston) is air loaded to open the valve. When deenergized, the operator is vented and the spring force acts to close the valves.

Evaluation

Alabama Power Company's (APCo) evaluation of the purge/vent system butterfly valves were reviewed against the applicable criteria of Standard Review Plan 3.9.3, Rev. 1, "ASME Code Class 1, 2, and 3 Components, Component Supports, and Core Support Structures," and staff "Guidelines for Demonstration of Operability of Purge and Vent Valves," which were sent to all licensees by letter dated September 27, 1979. This review was accomplished by the Equipment Qualification Branch, Division of Engineering, NRR in conjunction with Brookhaven National Laboratory.

A. 18-Inch Mini-Purge Valves

The following information was submitted by APCo and reviewed by the staff and its consultants, Brookhaven National Laboratory, in order to assess the.

operability of the 18-inch mini-purge valves:

- Reference A: Alabama Power Company letter, August 14, 1980 (Farley 1 and 2), F.L. Clayton Jr. to A. Schwencer.
- Reference B: Alabama Power Company letter, December 10, 1979 (Farley 1), F.L. Clayton, Jr. to A. Schwencer.
- Reference C: Teleconf 9/19/80: Restivo (BNL), Zudans/Kintner (NRC), George (APCo), Gallagher/Bell (Bechtel).
- Reference D: Alabama Power Company letter, September 30, 1980 (Farley 2), F.L. Clayton, Jr. to A. Schwencer.
- Reference E: Alabama Power Company letter, November 4, 1980 (Farley 2), F.L. Clayton, Jr. to A. Schwencer.

The following sections summarize the highlights of our review. The details of the review are contained in Brookhaven National Laboratory letter dated November 12, 1980 from T.J. Restivo to J.J. Zudans.

Mechanical Evaluation (Valves)

APCo has indicated (Reference A) that the subject valves are designed to the requirements of the ASME Boiler and Pressure Vessel Code - Section III. A tabulation (Table 1) is provided to show stress levels calculated by H. Pratt vs. stress allowables for the valves' critical components based on the loadings resulting from the DBA postulated. Components such as the shaft, disc to shaft pins, etc., were listed. As examples, the combined maximum stress in the shaft is determined to be 25,077 psi (33,700 psi allowable) and the maximum shear stress in the upper disc to shaft pin (upper) given as 5812 psi (8160 psi allowable).

The stress analysis is based on APCo/Pratt having defined the major force and torque loads acting on the components during the postulated DBA-LOCA. These loadings are predicated on the containment pressure condition assumed and are basically a function of dynamic torque coefficient and valve ΔP or valve ΔP alone.

The ΔP s used to determine dynamic torques for the 18-inch valves are conservative. Typically, the maximum T_d is developed at disc angles above 70° open (90° = full open). The ΔP used to determine the maximum T_d was 24 psig which was based on the containment pressure (P_c) reaching 24 psig at the point of full valve closure at 6.0 seconds into the LOCA (Reference A, Attachment 1). In actuality the ΔP across a single valve at these higher disc angles would be significantly less due to piping entrance and exit losses, pipe/duct losses, and losses across the valve in series with the one being analyzed.

Also to be considered is that the actual containment pressure is less than 24 psig when the valve position is above 70° open. If the stroke time vs. disc angle is assumed to be linear, the containment pressure would only be approximately 10 psig when the disc angle reaches 70° (Reference A, Attachment 1). This would also tend to reduce the ΔP across the valve.

Based on the information presented, the staff finds that APCo has satisfactorily demonstrated that the subject 18-inch valve assemblies are adequately designed to withstand the LOCA-related loads resulting from the ascending differential pressures of APCo's DBA-LOCA condition as the valves close from the full open (90°) position.

System Evaluation (Ducts-Valve Disc Interference-Debris)

The mini-purge supply and exhaust system inlets inside the containment building are fabricated ductwork. The duct openings are located outside the primary shield wall and away from any lines whose rupture would initiate a LOCA. The duct openings are screened with 0.5-inch mesh, 0.047-inch wire to prevent debris from entering or blocking the ducts. The design of the ductwork inside containment emphasized minimizing the length of the ductwork so that flow-developed pressure drop through the ductwork remains negligible. Due to the minimization of ducting, the elimination of potential debris and the low approach velocities, the staff agrees with APCo that ductwork damage inside containment and therefore interferences with the closure of the valves is unlikely.

The piping between the inside and outside mini-purge valves is fabricated with a design pressure rating in excess of the peak LOCA pressure.

In the mini-purge system ductwork outside of containment, the postulated flow and pressure conditions will tend to cause overpressurization failures of the ductwork. These failures have low probability of interference with the closure capability of the valves.

All the ducting and piping which is part of the mini-purge system has been designed to maintain structural integrity under the seismic event postulated for these facilities.

Seismic Evaluation (Valve Assemblies)

In Reference A, APCo has indicated that the valve and operator assembly are seismically qualified by static analysis using a seismic inertial load of 3.0 g acting simultaneously in the horizontal and vertical directions. The analysis was performed in accordance with IEEE-344 (1971).

In its recent review of the licensee application for Farley 2, the staff has evaluated the seismic qualification program conducted by APCo for the Farley plant. The staff concluded that this program, which included the qualification of the purge valves, provided reasonable assurance that the seismic Category I mechanical and electrical equipment are adequately qualified seismically.

Environmental Evaluation (Actuator, Solenoid and Main Valve Sealing Device)

The 18-inch mini-purge valves use ASCO pilot solenoid valves to actuate the Bettis operators. The review of environmental qualification concerning these solenoid valves will be included in the staff's overall review of the environmental qualification of equipment being performed in accordance with the Commission Memorandum and Order (CLI-80-21) dated May 23, 1980.

In Reference D, APCo describes Bettis operators used inside containments as being qualified for the expected environment following a design basis accident. Qualification levels for the various environmental conditions are presented. Qualification is based on material programs rather than testing an assembled prototype operator.

In Reference E, APCo indicated that Bettis recommends replacement of the operator seal kits on a regular basis with intervals not to exceed five years. This replacement cycle is said to be based on industry standards for minimizing maintenance work and associated equipment downtime and not for maintaining a qualified design life of the material.

Based on this, APCo will replace the operator seals every five years as recommended. The upgraded Technical Specifications for Unit No. 1 will include this as a surveillance item.

With respect to the valve body seals, APCo has indicated that no preventive maintenance is necessary for these components. This has been confirmed by a vendor representative. However, information now exists to indicate that seal deterioration may go undetected unless tests are run more frequently. Refer to Enclosure 1 to the forwarding letter for the basis for new Technical Specification surveillance tests being recommended to assure valve leak tightness.

R. 18-Inch Purge Valves

APCo is presently committed to maintaining these valves closed whenever Farley 1 and 2 are in operational modes 1, 2, 3, and 4. The upgraded Technical Specifications for Unit No. 1 will include this as a Limiting Condition of Operation.

APCo is evaluating these valves for operability under LOCA conditions. Operability assessment information is to be submitted by APCo at a later time. However, the 8-inch, fully qualified valve system described in Enclosure 3 to the forwarding letter would appear to negate a need for attempting to qualify such a large valve. (See BTP CSB 6-4 Position B.1.C).

Some information for these valves has been provided in Reference A under 18-inch mini-purge valves concerning preventive maintenance and inspection. The valve manufacturer's recommendation to flush the top and valve trunnions with silicone grease and inspecting valve seats will be performed at refueling outages. APCo has indicated that degradation of the valve seat material will be noted based on unsatisfactory results of the yearly local leak rate test.

The staff considers more frequent local leak rate tests are needed to denote degradation of sealing capability as with the 18-inch valves. Also, these seals should be replaced on an interval not to exceed five years.

Based on the above, the staff finds that the 48-inch valves will successfully maintain containment isolation during postulated loss-of-coolant accidents if they are maintained sealed closed during modes 1, 2, 3, and 4, with resident seals replaced at five-year intervals, and the seat leakage surveillance performed at the recommended frequency.

Evaluation Summary

Based on the licensee provided information, the staff finds that APCo has satisfactorily demonstrated that the 18-inch mini-purge valves are capable of closure from a full 90° open position when subjected to the loading associated with postulated loss-of-coolant accidents.

The staff finds that the seismic qualification of the valves and operators is acceptable. The staff finds that the environmental qualification of the valve components are acceptable (except as noted for the main valve seals). An evaluation of the associated electrical equipment for these valves will be included in the staff's overall review of the environmental qualification of equipment being performed in accordance with the Commission Memorandum and Order (CLI-80-11) dated May 23, 1980.

The staff finds that the piping-ducting-debris evaluation performed by the licensee acceptably demonstrates that these mini-purge system components will not affect valve closure and sealing.

The staff considers that changes are necessary to the existing Technical Specifications to assure that an adequate margin of safety exists for both the 48-inch and the 18-inch purge system valves.