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Docket No. 50-461

Mr. George Wuller
Supervisor - Licensing
Illinois Power Company
500 South 27th Street
Decatur, Illinois 62525

Dear Mr. Wuller:

Subject: Containment Purge and Vent Valve Operability

We have reviewed your submittal of October 22, 1982 regarding operability of the subject valves under combined LOCA/seismic loadings. This review has indicated that the information submitted failed to demonstrate the ability of the 24" and 36" valves to close against the containment pressure buildup resulting from a LOCA. The technical evaluation leading to this conclusion is provided in Enclosure 1. It is our position that, to permit use of these valves during operating modes 1, 2, 3, and 4 from the full open position, you must justify further the applicability of the lift and drag coefficients obtained from water tests as applied to these valves for air. An alternative is to block these valves such that the opening is limited to 50°. In either case the manufacturer's preferred orientations of valve installations must be confirmed. Your response to this position is requested.

Any questions regarding this matter should be directed to Dr. Harvey Abelson, the Licensing Project Manager, at (301) 492-8344.

Sincerely,

Original signed by

A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

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CLINTON
DOCKET NO. 50-461

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

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

Valve Number	Size (Inches)	Use	Location
1VQ001A	24	Not given	Not given
1VQ001B	24	Not given	Not given
1VQ002	24	Not given	Not given
1VQ003	36	Not given	Not given
1VQ004A	36	Not given	Not given
IVQ004B	36	Not given	Not given
IVQ005	10	Not given	Not given
IVR001A	36	Not given	Not given
1VR001B	36	Not given	Not given

The valves are all butterfly valves manufactured by Posi Seal International, Inc. of North Stonington, Connecticut. The 36-inch valves are ASME class 150/150 with operator model number 45102 SR 80 supplied by MATRYX, as shown on Posi Seal drawing No. 16204-23. The 24-inch valves are ASME class 150/150 with operator model 33082 SR-80 supplied by MATRYX, as shown on Posi Seal drawing No. 16204-28. The 10-inch valves are ASME class 150 with operator model 26062 SR80 supplied by MATRYX as shown on Posi Seal drawing No. 16204-31.

3.0 Demonstration of Operability

The following documents were examined for this review:

A. Letter of October 22, 1982 from G. E. Wuller, Illinois Power Company to C. O. Thomas, Division of Licensing, U.S. Nuclear Regulatory Commission.

B. Report entitled, "Nuclear Seismic and LOCA Analysis," issued by Posi Seal International, Inc., on October 21, 1982.

C. ASME code Section III, 1974 through spring 1979.

D. "Effect of Fluid Compressibility on Torque in Butterfly Valves," F. P. Hartman, ISA 1968 Annual Conference, ISA Transactions, Vol. 8, No. 4, pg. 28.

The licensee's submittals did not contain a description of the complete containment purge and vent system, and a review of the FSAR for this plant did not reveal either a description or schematics for this system.

Reference A indicates that the Illinois Power Co. intends to "utilize the presently designed containment HVAC system on a continuous basis during normal plant operations," based on the results of the report cited as Reference B above. In the preceding statement, taken directly from Reference A, the term HVAC system refers to the system including the containment purge and vent valves which are the subject of this report. It is assumed from this statement that there is no intention to limit valve opening in any way. Reference A also provides a commitment to change the body/bracket bolts for the 36-inch valves to a new material (A354 GR BD), and to check the orientation of all valves to insure that they are installed as recommended by Reference B.

Reference B is a detailed analysis of all the valves supplied by Posi Seal for the Clinton purge and vent system (referred to as the HVAC system by the Illinois Power Co.). It includes descriptions of the various valve configurations and their relationship to one another, but does not contain a complete description or schematic of the entire system.

The analysis provided by Reference B is divided into the following major sections:

1. LOCA analysis which includes a discussion of modeling of the pumping system and derivation of torque equations
2. Seismic analysis
3. Valve stresses
4. Detailed analysis
5. Influence of bends and tees.

Five appendices to the report contain the actual data and calculations used to arrive at the conclusions. They are entitled as follows:

a. Schematics of the piping systems (partial schematics showing only the relationship between 2 or 3 valves).

b. Determination of flow conditions (computer printouts of pressure, temperature, and velocities for air flow at selected points).

c. Determination of closing times (computer printouts of calculated torques, #P, and time for various angles of closure for each valve).

d. Comparison of actual vs calculated closing times (computer printouts of calculated closing times under no flow conditions and actual test data on valves under no flow conditions).

e. Seismic and LOCA stress analysis (computer printout of calculated stresses under combined seismic and LOCA loads for all critical parts of each valve).

The conclusions reached in this report (Reference B) are summarized as follows:

1. All valves are capable of closing from the full open position under combined LOCA and seismic loads.

2. The valves should be inspected to determine that they are in the "preferred" orientation.

3. The body/bracket bolts for the 36-inch valves should be changed to a new material (A354 GR BD).

The applicant has committed to inspect the valves and correct their orientation if required, and to replace the body/bracket bolts for the 36-inch valves with bolts of the recommended material (Reference A).

The calculation of aerodynamic torques is based on hydrodynamic tests (water) on smaller valves (up to 12-inches). The Posi Seal report assumes that for the same size and class of valve the coefficients of lift and drag for any given valve angle is the same regardless of fluid, flow, or temperature. Based on this assumption, the coefficients of lift and drag which are derived from the hydrodynamic tests are used to calculate aerodynamic torques under the conditions predicted for the DBA/LOCA scenario chosen. The DBA/LOCA chosen results in a containment pressure of 9 psig and a dry well pressure of 30 psig, with a steam/air mixture at 100% R.H. and a temperature of 330°F flowing through the valves. These conditions were held constant for this analysis and are more severe than the design accident conditions listed in the Clinton FSAR.

Stress on all the critical valve components were calculated based on the conditions described above and 1-g seismic loads. These stresses were compared to a listing of "allowable" stresses. These "allowable" stresses were based on 1.65 times the allowables given in Section III of the ASME Boiler and Pressure Vessel Code (quoted from page 7 of Reference B).

4.0 Evaluation

4.1 The assumption that coefficients of lift and drag are independent of flow media (fluid), flow, or temperature is only valid for compressible flow at low Mach number (less than 0.3). For Mach numbers approaching 1 (over 0.8), the coefficient of drag increases exponentially. For Mach numbers between 0.3 and 0.8, the coefficient of lift generally increases as a function of Mach number. The rate of increase is dependent on the shape of the airfoil. The velocities calculated in reference B for most valve configurations at high angles of opening (over 50°) indicate that the Mach number is over 0.3 and approaches

0.5 for these configurations. For this reason, the assumption that coefficients of lift and drag are the same as those calculated from the water tests for a 12-inch valve, is not acceptable to the staff. Even at low Mach numbers, the coefficient of drag is a function of Reynolds number and should only be transposed between fluids if the Reynolds numbers are equal. For these reasons, the calculation of aerodynamic torques based on hydrodynamic data is not acceptable to the staff until a more rigorous analogy is made.

4.2 Reference D describes another method for predicting aerodynamic torque using torque relationships developed for incompressible flow. It is of interest here not because of the method presented, but because it describes a test program which compared the results of torque calculations with test results for similar valves using air and water. The data presented in Reference D indicates that for low pressure drops across a valve (less than 5% total pressure) the resultant torque is essentially equal for both air and water. For higher pressure drops, the resultant torques decrease for air at a rate of approximately 4% decrease in torque per 1% increase in pressure drop. This rate of decrease continues until a pressure drop of 15% is reached. Above 15% pressure drop, the decrease in aerodynamic torque compared to hydrodynamic torque is exponential.

If these relationships are used, we would expect that the torques calculated by Posi Seal in Reference B for large angles of valve opening to be closer to the hydrodynamic values shown in Technical Bulletin 1A (enclosure 4 of Reference B). For example, for the 36-inch valve of Case 3 (page B-41 of Reference B), at an angle of 80° with a pressure drop of 1.74 inches across the valve, we would expect an aerodynamic torque of approx. 80% of the hydrodynamic torque or approx. 150,000 in/lbs, rather than the 88,675 given on page B-41 of Reference B.

For angles less than 60°, where the pressure drops are much higher, the values predicted by Posi Seal are closer to what we would expect, and are generally low even in hydrodynamic values such that they do not generate high stresses in any of the critical valve components. Therefore, the staff would find it acceptable if the licensee proposed to operate the 24-inch and 36-inch valves with an opening limitation of 50°.

4.3 For the 10-inch valves, the stress generated by the aerodynamic torques are low and even if the torques calculated in Reference B are doubled, the stresses generated are still below allowable for all angles of opening. For this reason, we find that the applicant has demonstrated the operability of the 10-inch valves.

4.4 The 1.65 factor used to increase the allowable stresses given in Reference C is applicable only to principle stresses in the valve body for Class 2 valves. Table NC-35-21-1 which lists this factor for combined stresses for Level B service limits, states in note (3) "Design requirements listed in this table are not applicable to valve discs, stems, seat, rings, or other parts of the valves, which are contained within the confines of the body and

bonnet." The note on page 7 of Reference B is misleading, since this factor was not applied to the allowable stress for the disc pin on the table of seismic and LOCA stresses given on that page. The allowable stress given for the disc pin material (SA 564 GR 630 and H1075) is taken directly from Table 1.71 of Reference C with a correction for temperatures only. These values are acceptable.

5.0 Summary

We have completed our review of the information submitted to date concerning operability of the 10-inch, 24-inch, and 36-inch valves used in the containment purge and vent system for the Clinton Power Station, Unit 1. We find that the information submitted for the 24-inch and 36-inch valves did not demonstrate that these valves have the ability to close against the buildup of pressure in the event a DBA/LOCA from the full open position. Paragraphs 4.1 and 4.2 are the basis for these findings. For this reason, the 24-inch and 36-inch valves should be sealed closed in accordance with SRP Section 6.2.4, III.6.f. Furthermore, these valves should be verified to be closed at least once every 31 days.

We find that the information submitted demonstrated the ability of the 10-inch valve to close from a full open position against the buildup of pressure in the event of a DBA/LOCA.

The applicant should confirm that the valves are in the "preferred" orientation as described by the valve manufacturer.