HELPING BUILD ARKANSAS

ARKANSAS POWER & LIGHT COMPANY

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February 9, 1979

DONALD A. RUETER
DIRECTOR
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1-029-11

Director of Nuclear Reactor Regulation
ATTN: Mr. R. W. Reid, Chief
Operating Reactor Branch #4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Arkansas Nuclear One-Unit 1
Docket No. 50-313
License No. DPR-51
Reduced Pressure Testing Of
Containment Isolation Valves
(File: 1510)

Gentlemen:

On January 19, 1979, a telephone conversation between your Messrs. Guy Vissing and John Huang and members of our General Office staff discussed proposed modifications to several of our containment isolation valves (double disc (i.e. split wedge) gate valves) to more adequately meet the requirements of 10CFR50, Appendix J. Particularly, our Reactor Building sump drain valve (CV-4446) was discussed with regard to the difficulties we would encounter, including, but not limited to, man-rem exposure, if a modification were attempted on this valve. During this conversation, we proposed testing this valve at a reduced pressure in the direction of the accident flow (i.e. a differential pressure across the valve less than the accident P_a of 60 psig) by pulling a vacuum downstream of this valve. This would test the proper side of the disc per 10CFR50, Appendix J. However, since it is physically impossible to have a vacuum of greater than 14.7 psig, a reduced pressure exception to Appendix J would be required. Mr. Vissing and Mr. Huang stated they would like to see data as to how this would affect leak rates associated with the valve. We stated at that time that we would attempt to obtain data relative to this request.

Attached is our justification for testing not only the aforementioned CF-4446 at a reduced differential pressure, but the other valves which were scheduled for modification with CV-4446 (i.e. SF-43, SF-44, CV-1053, CV-1214, and CV-1216).

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Based on the attached, we find that our proposed reduced differential testing method meets the requirements of 10CFR50, Appendix J and ASME Section XI, Article IWV-3423(e), and no modifications to the aforementioned valves are necessitated.

Very truly yours,

Donald A. Rueter

Donald A. Rueter

DAR:DGM:lg

Attachment

JUSTIFICATION FOR REDUCED PRESSURE TESTING

OF CONTAINMENT ISOLATION VALVES

Per 10CFR50, Appendix J, valves which provide isolation of the Reactor Building must be tested with a differential pressure (equal to the maximum pressure the valve would experience during an accident situation) across the valve in the direction of the postulated accident pressure. Exceptions to the direction criteria are given in Appendix J and ASME Section XI, Article IWV-3423, and an exception is granted by Appendix J if the alternative test is shown to be equal to or more conservative than that test specified by Appendix J.

Arkansas Nuclear One - Unit 1 contains several double disc (split wedge) gate valves, of which at this point in time, there are no means by which they can be Type C leak tested (as defined in 10CFR50, Appendix J) in the "accident" direction. Extensive, sensitive and/or costly modifications would be required to modify these valves, thus necessitating a study of possible other means of satisfying Appendix J. The valves in question are:

SF-44 - 8" double disc gate valve - Fuel Transfer Canal Fill and Drain

SF-43 - 3" double disc gate valve - Incore Instrument Tank Fill and Drain

CV-1053 - 3" double disc gate valve - Quench Tank (T-42) drain to Aux. Bldg. Equipment Drain Tank (T-11)

CV-4446 - 3" double disc gate valve - Reactor Bldg. sump drain to Aux. Bldg. Sump.

CV-1214 and CV-1216 - 3" double disc gate valves - discharge isolation valves from Letdown Coolers.

A bench test was conducted at the Anchor/Darling Valve Company facility in Williamsport, Pennsylvania on January 27, 1979, to determine leakage characteristics of a double disc gate valve at low differential pressures across the valve. The valve tested was an ASME Section III, Class 2,4"-150#, flex disc gate valve. The valve was leak tested at a series of differential pressures (ranging from 3.5 psig to 59.9 psig) using pressurized nitrogen. The collected data was reduced and analyzed, and is shown on Figure 1. The upper figure shows the data plotted as Differential Pressure (PSIG) vs. Leak Rate (cc/min.). The lower figure exhibits the data as the Square Root of Differential Pressure (PSIG) vs. Leak Rate (cc/min.). Note that the Leak Rate increases steadily as pressure is increased to near 60 psig, thus showing no seat deflection at these low pressures. In fact, at these low pressure differentials, the characteristics exhibited are those of a flow orifice. From theory and engineering practice, flow through an orifice may be expressed as:

$$L = K\sqrt{\Delta\rho} \text{ (for incompressible fluids)}$$

where L = flow
K = some constant which may be determined analytically for a particular orifice
$\sqrt{\Delta\rho}$ = square root of the pressure differential across the orifice

It should be noted that this equation holds true for air and nitrogen at the low pressures which we are investigating. The aforementioned lower figure shows the above concept in a graphical manner. Note that the square root of the differential pressures plotted versus leak rate, generates a straight line. Therefore, in measuring a leak rate across a valve of this type (or for that matter, any type of gate valve in the 150# range or greater) tested at a differential pressure less than that of interest, the leak rate at the "accident" differential pressure (that being the Δp of our concern) may be determined graphically by plotting the value obtained as the square root of the test pressure differential versus the leak rate, and then drawing a straight line from the origin, through the plotted point to the leak rate associated with the square root of the "accident" differential.

In this manner, a vacuum may be drawn upstream of the valve to be tested, creating a differential pressure in the desired direction, and thereby providing information which the leak rate associated with the "accident" differential pressure may be determined.

The above described method of determining the leak rate is fully consistent with ASME Section XI, Article IWV-3423(e), which states "Leakage tests involving pressure differentials lower than function pressure differentials are permitted in those types of valves in which service pressure would tend to diminish the overall leakage channel opening, as by pressing the disk into or onto the seat with greater force... When leakage tests are made in such cases using pressures lower than function maximum pressure differential, the observed leakage shall be adjusted to function maximum pressure differential value. This adjustment shall be made by calculation appropriate to the test media and the ratio between test and function pressure differential, assuming leakage to be directly proportional to the pressure differential to the one-half power." This method is also consistent with 10CFR50, Appendix J, Section III.C.1 that "... the pressure applied in the same direction as that when the valve would be required to perform its safety function, unless it can be determined that the results from tests in a different direction will provide equivalent results to those obtained by pressuring the upstream side of the valve to P_a."

Based on the above, it is our conclusion that all gate valves (especially the aforementioned six) may be tested at a reduced pressure by vacuum downstream of the valve and will yield results which meet the requirements of 10CFR50, Appendix J. No further modification to the aforementioned valves is, therefore, deemed necessary.