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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Request for Relief from Certain ASME Code
Requirements for Class 2 System Pressure Tests

Gentlemen:

The Arkansas Power & Light Company hereby submits a request for relief from Article IWC-5000 of Section XI of the 1974 Edition, Summer 1975 Addenda, of the ASME Code with respect to the required test pressure value for the Class 2 system hydrostatic test on the ANO-2 main steam system. The bases for this request are discussed below.

The Inservice Inspection Program for ANO-2 for the first ten-year period is to the 1974 Edition, Summer 1975 Addenda, of Section XI of the ASME Code. Article IWC-5000, System Pressure Tests, for Class 2 systems specifies that the test pressure of the hydrostatic test be 1.05 times the design pressure at a test temperature of 500 degrees F. Article IWC-5000 of the 1980 Edition of Section XI specifies that the contained fluid in systems shall serve as the pressurizing medium. In AP&L's letter of November 30, 1987 (2CAN118702), approval for performing the secondary system hydrostatic test with steam (versus water) at a pressure 1.05 times the design pressure of the main steam system (1085 psig) at a temperature greater than 500 degrees F (Mode 3) was requested with NRC approval granted by Amendment 83 to the ANO-2 Technical Specifications.

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On September 25 and 26, 1989, during shutdown for the last refueling outage in the ANO-2 first ten-year period, the hydrostatic test was performed in Mode 3 conditions (RCS average temperature of approximately 555 degrees F to obtain a secondary pressure of approximately 1140 psig). The required hydrostatic test pressure of 1.05 times the system design pressure of 1085 psig was 1140 psig. During attempts to achieve a minimum hydro test pressure of 1160 psig as required by the test procedure (i.e., 1140 psig plus 20 psig for 1% instrument tolerance), control room indications confirm that pressures as high as 1180 psia (i.e., 1165 psig) were achieved for as long as 15 minutes. However, due to safety valve leakage and potential resultant damage (e.g., steam cutting of the valve seats) during performance of the test, the maximum pressure which could be maintained for the four hour required holding time was 1140 psig. Utilizing 2000 psig pressure test gauges with an actual instrument accuracy of 0.5% (10 psi tolerance), the actual test pressure maintained during the test was conservatively measured to be 1130 psig. This is 10 psi less than the required test pressure at 500°F. The two test gauges were installed on the atmospheric dump line vent at the high point of the system. Pre-test and post-test calibrations of the instruments yielded the following results:

Valve Tested (psig)	Pre-Test (psig)	Post-Test (psig)
A) Test Gauge BTG-058:		
0	0	0
400	400	400
800	800	800
1200	1200	1201
1600	1600	1600
2000	2000	1998
B) Test Gauge BTG-059:		
0	0	0
400	400	400
800	800	800
1200	1200	1202
1600	1600	1598
2000	2000	1996

Each of these values was within the 0.5% accuracy specified by the manufacturer. The greatest calibration variance measured during the post-test check was 0.2% (4 psi). The test gauges were calibrated with a dead weight tester having an accuracy of 0.03% of the reading. In the range of the pressure of interest (i.e., 1200 psig) the post-test calibration readings were 2 psig above the dead weight tester value. Considering the 0.03% accuracy of the dead weight tester, this would correlate to a worst case reading of 2.36 psig above the actual pressure. These calculations do not account for errors specific to the actual test; however, they do provide a high degree of confidence that the actual errors were well within the manufacturer's specified tolerance.

The following pressure readings were obtained during the performance of the test.

Time (Hrs) 9/25 - 9/26/89	Primary Gauge (psig) (BTG-058)	Backup Gauge (psig) (BTG-059)
2000	1141	1142
2015	1141	1143
2030	1141	1143
2045	1141	1142
2100	1141	1143
2115	1141	1143
2130	1141	1142
2145	1141	1143
2200	1142	1143
2215	1142	1143
2230	1142	1148
2245	1143	1148
2300	1141	1144
2315	1140	1141
2330	1140	1141
2345	1140	1142
2400	1141	1142
0015	1141	1142
0030	1140	1141
0045	1140	1143
0100	1140	1143
0115	1140	1142
0130	1140	1141

Although the minimum instrument readings were 1140 psig, for the purpose of determining code compliance we can conservatively assume the test was performed at 1130 psig which is 1.04 times the system design pressure versus 1.05 times the design pressure required by the code.

In reviewing the ASME Code, Section XI, IWC-5220(b), test pressure/ temperature correlations are given as follows:

Test Temperature	Test Pressure
100°F	1.25 Pd
200°F	1.20 Pd
300°F	1.15 Pd
400°F	1.10 Pd
500°F	1.05 Pd

Although the ASME Code does not address temperatures above 500°F, it is evident that as temperature increases, the required pressure decreases. During the ANO-2 secondary hydrostatic test, the pressurizing medium (steam) was at saturation temperature and pressure. For 1140 psig, this temperature is 564°F. While we recognize that the Code does not allow extrapolation of the values in this table, we believe that the pressure-temperature correlation exists beyond 500°F. Extending the IWC-5220(b) table to 564°F, a test pressure of 1.02 Pd (or 1107 psig where Pd = 1085 psig) would result. Since the actual test pressure achieved was considerably greater than this value, we conclude that any structural deficiencies would have been more evident under the actual test conditions than at a lower temperature at the same pressure. We feel this provides technical justification, in part, for the granting of relief.

The stresses induced on the Main Steam system are calculated using the pressure stress equations provided in the 1971 Edition, with W72 Addenda of Section ID, subsection NC-3651, of the ASME code (ANO-2 Code of Record), as follows:

$$Slp = [(P) \times (d^{**}2)] / [(Do^{**}2) - (d^{**}2)]$$

Slp = Longitudinal Pressure Stress (psi)
P = Internal Pipe Pressure (psi)
Do = Outside Pipe Diameter (in)
d = Inside Pipe Diameter (in)
tn = Pipe Wall Thickness (in)

As can be seen, the change in pressure has a direct linear effect on the longitudinal pressure stress. Any percent change in internal pipe pressure will change the longitudinal pressure stress by the same amount. For example, the 38" diameter main steam pipe, with a 1.167" minimum wall thickness, has a longitudinal stress of 8434.2 psi at an internal pressure of 1140 psig (i.e., 1085 psig times 1.05). Using an internal pressure equal to the minimum achieved hydrostatic pressure of 1130 psig, based on the instrument accuracy of 0.5%, the longitudinal stress would be 8360.2 psi. The difference in pipe stress between these two pressures, is only 74.0 psi (or less than 1%).

The allowable stress for this pipe at a temperature of < 650 degrees is 17500 psi (SA-106, Grade C or SA-155, Grade WCF-70, Class I). At 1140 psig, pressure stress of the pipe would be 48.2% (i.e., 8434 x 100/17500) of the allowable. At 1130 psig, pressure stress of the pipe would be stressed to 47.8% (i.e., 8360 x 100/17500) of the allowable. AP&L feels that this difference is insignificant with respect to the purpose and results of the hydrostatic test for the discovery of any structural integrity leakage. The intent of the performance of hydrostatic tests is to challenge system integrity at pressure stresses greater than design and operating pressure. The system walkdowns performed did not identify any structural integrity leakage. Various packing and gasket leakage was identified, but there was no evidence of leakage of any structural components. Therefore, AP&L considers the difference between the pressure attained and the required pressure for meeting ASME Code requirements to be of very little significance in the testing of system structural integrity. We have such available margin in the system relative to the allowables that we would not expect a test at 10 psi greater to challenge the system any differently.

Based on the above, AP&L requests relief from Article IWC-5000 of Section XI of the ASME Code for the 1.05 times system design pressure requirement. We request that the test performed September 25-26, 1989, be accepted as the first 10-year hydrostatic test of the secondary system at approximately 1.04 times system design pressure. The 10-year period ends March 26, 1990. This request is based technically on the fact that the pressure attained for that test was conservatively within 1% of the required test pressure with a secondary system temperature slightly greater than the specified temperature (i.e., 564°F versus 500°F).

In addition, subjecting the system to another hydrostatic test, especially for the current 2R7 outage, would unnecessarily reduce the margin of hydrostatic cycles for which the system was designed (10 cycles total), would subject test personnel to additional radiation exposures, and would subject AP&L to a large cost burden.

Although low, AP&L feels that the additional 35 man-mrem which would be received by test personnel is unnecessary when considering the minimum benefit to public health and safety and for maintaining occupational exposures as low as reasonably achievable. Furthermore, the conduct of such testing results in extended outage time in both total time and critical path time (10 to 20 days) such that actual monetary costs would be in the range of $2 to $4 million dollars additional in fuel displacement costs for the outage extension alone while any benefits realized to enhanced public health and safety are negligible.

Our current refueling outage is scheduled to be completed by November 22, 1989, with the turbine on line. Therefore, we respectfully request the staff's determination on this relief request as soon as possible.

Should you have any questions, please do not hesitate to call me.

Very truly yours,

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General Manager,
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ECE/RP/lw

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