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U.S. Atomic Energy Commission
Washington, D.C. 20545

Subject: Reactor Containment Leakage Testing for the Dresden and Quad-Cities Reactors, AEC Dkts 50-237, 50-249, 50-254 and 50-265

Dear Mr. Ziemann:

In response to your letter dated August 9, 1973, the following information is provided concerning the applicability of 10 CFR 50, Appendix J to containment leakage testing at Dresden and Quad-Cities. The numbering of the following responses corresponds to the numbering of requests in your August 9, 1973 letter.

Question 1: Integrated Primary Containment Leak Test

The Dresden Units 2 and 3 and Quad-Cities Units 1 and 2 Integrated Primary Containment Leak Test (IPCLT) Programs are discussed in the Technical Specifications. More detailed information is provided in the IPCLT reports which are submitted to you in accordance with the Technical Specifications.

a. These test procedures deviate from ANSI-N45.4-1972 in the following areas.

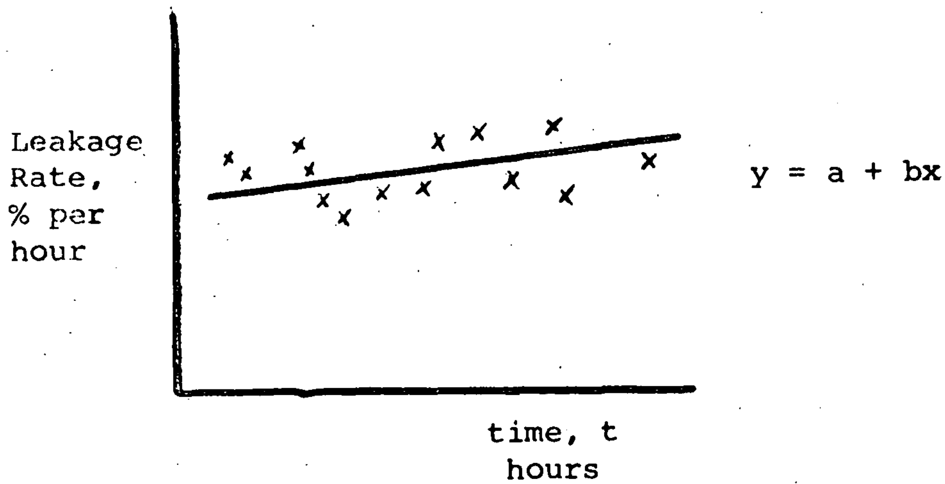
The first area is the general testing plan that we have used. Our plan has been to conduct local leak rate tests during the first part of an outage. We then conducted an integrated leak rate test close to the end of the outage. The results of the integrated leak rate test are then corrected back to determine the conditions that existed at the beginning of the outage using local leak rate test results. ANSI-N45.4 does not permit this plan.

The ANSI guide requires that an integrated leak rate test be conducted before any local leak rate testing is done. Further, this guide requires that a second integrated leak rate test be performed after all necessary penetration repairs are made. If we were to follow this guide, we estimate that three days would be added to our refueling outages.

An apparent deviation of our test methods from ANSI-N45.4-1972 is that we do not statistically average our hourly leakage rates by a linear least-squares fit for the Integrated Leak Test. ANSI N45.4-1972 section 7.9 states that "The leakage determined from these hourly calculations shall be plotted against time, and a statistically averaged hourly leakage rate shall be obtained by a linear least-squares fit to the resulting graph." The Quad-Cities Station procedures call for the hourly leak rate data to be added up to obtain a leakage in % per day. This number is then divided by 24 to obtain an average leakage per hour. Then the uncertainty is calculated using variance and the standard deviation.

We feel that the use of a least-squares fit to the data to obtain an averaged hourly leakage rate is somewhat misleading. The method of least-squares says that, given a set of data, the line $y = a + bx$ will be the best "fit" to the data providing that the sum of the squares of the distance of each data point from the line is a minimum.

IPCLT data is a set of hourly leakage rates corresponding to specific times. For a leak rate line, $y = a + bx$, b should be close to zero because the leak rate should theoretically be constant. This would result in $y = a$ where "a" is a constant corresponding to the "statistically averaged hourly leakage rate." In reality, however, "b" will not be zero and the data fit will result in a line, $y = a + bx$, with a definite slope of "b". For example, using the least-squares fit could result in a graph which looks like this:



Thus the only thing accomplished is a transfer of data points to a line. We still are faced with the problem of determining an average hourly leak rate. The uncertainty calculation, on the other hand, seems quite adequate, and we feel meaningful.

Another area where the Dresden Station procedure deviates from the ANSI guide is in the area of data reduction. The methods used for data reduction are shown in the attached procedure. We have not been able to use the methods in the ANSI guide primarily because we do not have an external readout for humidity in the drywell. In future tests, we will attempt to follow the ANSI guidelines in this area. We are currently trying to obtain the test equipment we will need.

b. Our methods to detect penetration and isolation valve leakages are derived from the Absolute Method of internal pressurization as described in ANSI N45.4-1972. The volume inside a penetration or the volume between isolation valves is pressurized to 48 psig or 25 psig in the case of the main steam isolation valves.

With the volume pressurized, the leakage rate can be determined by two methods: (1) Pressure Decay, or (2) Pressure Maintenance through

Rotameters. We use both methods, with the specific application depending upon convenience, size of the volume under test and accuracy required.

The Pressure Decay Method calls for calculation of leakage by the formula:

$$(SCFH) = \frac{V}{t} \left(\frac{P1\_P2}{T1\ T2}\right) \times \frac{T_{STD}}{P_{STD}}$$

where, after pressurization to P1, an initial temperature reading (T1) is taken. Final temperature (T2) and pressure (P2) readings are taken at the end of the test time. These values then yield the leakage in standard cubic feet per hour. Test volumes were determined from construction drawings and actual pipe measurements.

The Rotameter Method, on the other hand, looks only at leakage in SCFH and does not involve the size of the volume in the calculation. The test volume is initially pressurized, and then a pressure regulator is valved in to maintain the test pressure by injecting make-up air. The make-up air flow is therefore the same as the test volume leakage flow. This flow is determined in SCFH by sending the make-up air through rotameters which are calibrated for either 48 or 25 psig air at $70^{o}F$ and a viscosity of 0.0181 centipoises. The inaccuracies involved with this method are essentially only inaccuracies in instruments. And these inaccuracies can be analyzed to determine test result reliability.

If the test volume is not known precisely the Rotameter method is considered more reliable than the Pressure Decay Method and is used if possible.

c. Essentially, the Quad-Cities Station test reduction methods consist of taking temperature and pressure readings, correcting them for humidity, and calculating an hourly leakage rate. A variance for the calculated leakage rate is then determined incorporating the inaccuracies of the various instruments. From the variance, a standard deviation is calculated. And, using two standard deviations for a 95% confidence level, a final uncertainty is determined for the hourly leakage rate.

Then at Quad-Cities Station a sample variance is calculated for the hourly leakage rate measurements. Again, using two standard deviations for a 95% confidence limit, an uncertainty is determined for the average hourly leakage rate. We feel this method of data reduction is quite satisfactory. As was mentioned previously, in the answer to Question 1.a., we do not calculate a statistically averaged leakage rate by the curve fitting method of least-squares.

For future tests ANSI-N45.4-1972 data reduction methods will be applied at both stations.

Question 2: Personnel Air Lock Leak Testing

The Technical Specifications are somewhat misleading with respect to personnel airlock local leak rate tests. The Technical Specifications state that "air lock door seals shall be tested at a pressure of 10 psig." Since the air lock door seals are not double gasket seals, there is no way to test just the seals. The actual test procedure consists of testing the entire air lock at a test pressure of 10 psig (with a strong back installed on the inner door since the seals are not designed to withstand pressure in the reverse direction) and extrapolating the test results to the containment design pressure of 48 psig using the Laminar Flow Equation:

$$L(48)/L(10) = P(48) - 1/P(48) + P(10) - 1/P(10) = 3.715.$$

The extrapolated leak rate L(48) is then compared with the maximum allowable leakage for any one penetration of 5% $L_{to}(48)$ to determine acceptance of the leak rate for the personnel air lock. Therefore, the current test procedure does leak test the complete airlock.

Also, it should be pointed out that, whereas the Technical Specifications only require one air lock door be closed when primary containment integrity is required, both air lock doors are interlocked and are therefore closed whenever primary containment is required. The only exception to this is for drywell inspection purposes when primary containment integrity is required. Drywell entry under this condition is the only time that one air lock door is open when primary containment is required. Therefore, the probability of the personnel air lock ever reaching the calculated primary containment pressure of 48 psig in the event of a LOCA is practically nil since the inner door is always closed except for drywell inspections and would be forced in the closed direction due to the high drywell pressure.

Question 3 - <u>MSIV Leak Testing</u>

The reason why the MSIV leak rate test pressure is 25 psig is due to the fact that a higher test pressure would result in leakage past the inboard MSIV since it is being tested in the reverse direction. The MSIV is held closed by a combination of the spring force, pilot air pressure and upstream line pressure due to the valve design. Since there is no upstream line pressure on the inboard MSIV during the leak rate test, any downstream test pressure greater than 25 psig would have a tendency to lift the valve disc off its seat. The acceptance leak rate for the MSIV's of 11.5 scf/hr @ 25 psig was used because of these design considerations and test procedure (i.e., the only practical way to test the leak rate is to pressurize between the inboard and outboard MSIV since there are no isolation valves upstream of the inboard MSIV). This acceptance criteria was derived by the Staff during their consideration of the proposed Technical Specification.

By applying the Laminar Flow Equation discussed in Question 2 to the Technical Specifications acceptance leak rate criteria for the MSIV's, it can be shown that there is considerable conservatism in the specified leak rate of 11.5 scf/hr @ 25 psig if it is assumed that the Technical Specifications acceptance criteria of 5% L_{to} (48) for any one penetration or isolation valve is applicable to the MSIV's. The extrapolation multiplication factor of the Laminar Flow Equation is 1.730:

$$L(48)/L(25) = P(48) - 1/P(48) \div P(25) - 1/P(25)$$

$$4.265 - 0.234 \div 2.7 - 0.370 = 1.730.$$

The maximum allowable leakage for any one penetration or isolation valve is 29.34 scf/hr. Therefore, since 1.730 x 11.5 = 19.895 scf/hr is considerably less than 29.34 scf/hr, there is a considerable amount of conservatism in the accpetance leak rate criteria for the MSIV's of 11.5 scf/hr @ a 25 psig test pressure when extrapolated to the design pressure of 48 psig.

Question 4: Manually Operated Instrument Line Isolation Valves

The manually operated valves on the instrument lines do not serve an isolation function. Further, there are no automatic isolation valves on instrument lines carrying primary system fluid. Therefore, the need to leak test the existing valves on the instrument lines does not appear to be a requirement for assuring primary containment integrity.

A description of these instrument lines for Dresden Station can be found in the "Application for Conversion from Provisional Operating License to Full-Term Operating License, Dresden Nuclear Power Station Unit 2," on Page 4-23. Quad-Cities instrument lines are similar in design.

One signed original and 39 copies of this information are submitted for your review.

Very truly yours,

J. S. Abel
Nuclear Licensing Administrator - Boiling Water Reactors