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PEACH BOTTOM ATOMIC POWER STATION - "PROCEDURE FOR CONTAINMENT FINAL LEAKAGE RATE TEST" PREPARED BY CHICAGO BRIDGE AND IRON COMPANY

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The suggested procedure, as prepared by Chicago Bridge and Iron Company (Contract 8-5470) and submitted by Philadelphia Electric Company, has been reviewed to evaluate its adequacy as the final pre-operational leakage rate test for the Peach Bottom containment.

The procedure has been compared with the retest requirements as developed in my earlier memorandum of July 10, "Suggested Containment Testing Specification Peach Bottom Atomic Power Station". It is recognized that the final pre-operational test will differ from the future tests of the "as is" condition of the containment in that numerous repairs will be made during the pre-operational test to reduce containment leakage below the permissible limit of 0.2%/day at 8 psig pressure.

However, the test procedure for the pre-operational test should provide the same assurance that the measured leakage rate is as reasonably accurate as will be required for the retests. The following comments, therefore, reflect the differences between the recommended test procedure and that proposed by Chicago Bridge and Iron Company:

(a) The proposed test procedure elects to use the reference chamber method of testing as outlined in Figure 1. In reviewing this test layout, several items warrant consideration:

    (1) The accuracy of measurement instrumentation is not defined from which an estimate of the uncertainty in measured values could be determined. This measurement uncertainty should be determined to permit an evaluation of uncertainty propagated into the measured leakage rate.

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(2) The use of water in the manometer is generally undesirable because of the possible variations attributed to loss or gain of volume of water from either vaporization or condensation. Recent practices suggest the use of a nonaqueous fluid having low saturated vapor pressure at test temperature. Such fluids are available from manometer manufacturers.

(3) The use of a single combined temperature-humidity meter is not considered sufficient to establish a measure of temperature or humidity gradients, which may exist in the containment vessel during the testing interval. Several units are generally preferred and judiciously disposed in the vessel particularly if it becomes necessary to make corrections in measured leakage rate for changes in humidity from the conditions initially recorded.

(4) No indication is given in the specification that test apparatus and piping external of the containment vessel should be adequately protected from significant ambient temperature variations. Undesirable errors are readily introduced, for example, if the apparatus is directly exposed to the sunlight during the day when temperatures may become markedly different than during the night hours.

(b) Although the specification requires leak-tight testing of reference chambers and piping as a preliminary test prior to the start of the containment test, no test is required of this system after completion of the containment test. Such a test is generally desirable since any leak which may have developed in the system (externally of the containment vessel) leads to serious errors in the measured leakage rate. This test can readily be performed by merely maintaining the pressure in the reference chamber and connected tubing for a period of 24 hours or longer and comparing initial and final pressure, compensated for temperature change, as initially performed on the reference system prior to the start of the test.

(c) The equation specified in the procedure for calculating the leakage rate assumes that only two readings of the instrumentation are necessary; i.e., the initial readings and the final readings at the selected time to terminate the test. Unless temperatures within the containment are alike when these two readings are taken, the calculated leakage rate is not valid. Such temperature measurements are not available under the test procedure presented.

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Examination of containment test results indicate that temperature conditions do not necessarily agree from day-to-day. Current practice in containment tests is to calculate the cumulative leakage (with proper corrections) on an hourly basis, which plotted on leakage-time graph permits a least-square line to be determined from which the leakage rate over a 24-hour period is established.

Several equations* have been developed which permit calculation of leakage rate on the basis of pressure readings (without temperature terms), including correction for changes in partial pressure due to humidity variations. Such equations simplify calculations of results and are recommended for consideration in any leakage rate test.

(d) The accuracy of the leakage rate test method and results, in any case, should be verified by superimposing a known leak rate upon the vessel leak rate during part of the test period. Only by this means (or an equivalent method) can the validity of the test results be evaluated. This means of test verification should receive serious consideration in the performance of the final pre-operational leakage rate test.

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*NASA-TN-D1731, "Leak Rate Testing of NASA Plum Brook Reactor Containment Vessel".

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