3.0 SURVEILLANCE REQUIREMENTS

3.5 Containment Test

Applicability

Applies to containment leakage and structural integrity.

Objective

To verify that the:

(1) potential leakage from containment is within acceptable limits, and

(2) structural performance of all important components in the containment prestressing system is acceptable.

Specifications

(1) Containment Building Leak Rate Tests

Tests shall be conducted to assure that leakage of the primary reactor containment and associated systems is maintained within allowable leakage rate limits. Periodic surveillance shall be performed to assure proper maintenance and leak repair of the containment structure and penetrations during the plant's operating life.

Definitions of terms used in the leak rate testing specifications:

Leakage rate - for test purposes is that leakage of containment air which occurs in a unit of time. Stated as a percentage of weigt of the original content of containment air at the leakage rate test pressure that escapes to the outside atmosphere during a 24 hour test period.

Maximum allowable leakage rate (L_a) - the design basis leakage rate of 0.1% by weight of the containment atmosphere per 24 hours at a pressure of 60 psig.

Overall integrated leakage rate - that leakage rate which is obtained from a summation of leakage through all potential leakage paths including containment welds, valves, fittings, and components which penetrate containment.

Acceptable criteria - the standard against which test results are to be compared for establishing the functional acceptability of the containment as a leakage limiting boundary.

(2) Integrated Leak Rate Test (Type A Test)

a. Introduction

Type A tests are intended to measure the reactor containment overall integrated leakage rate at periodic intervals.

b. Pretest Requirements

A general inspection of the accessible interior and exterior surfaces of the containment structures and components shall be performed prior to any Type A test to uncover any evidence of structural deterioration which may affect either the containment structural integrity or leak-tightness. If there is evidence of structural deterioration, the Type A tests shall not be performed until corrective action is taken in accordance with repair procedures, non-destructive examinations, and tests as specified in the applicable code specified in 10 CFR Part 50.55a at the commencement of repair work. Such structural deterioration and corrective actions taken shall be reported as part of the Type A test report.

During the period between the initiation of the containment inspection and performance of the Type A test, no repairs or adjustments shall be made so that the containment can be tested in as close to the "as is" condition as practical. During the period between the completion of one Type A test and the initiation of the containment inspection for the subsequent Type A test, repairs or adjustments shall be made to components whose leakage exceeds that specified in the Technical Specifications as soon as practical after identification. This requirement is interpreted not to preclude performance of Type B and Type C testing and required repairs prior to initiation of the containment inspection and the performance of the Type A test.

If during a Type A test, potentially excessive leakage paths are identified which interfere with satisfactory completion of the test, or which result in the Type A test not meeting the acceptance criteria, the Type A test shall be temporarily suspended. Thereafter, repairs and/or adjustments to equipment shall be made and the Type A test resumed. The corrective action taken, the change in leakage rate resulting from the repairs and overall integrated leakage determined from the Type A and local leak rate tests shall be included in a report submitted to the Commission.

Closure of containment isolation valves for the Type A test shall be accomplished by normal operation and without any preliminary exercising or adjustments (e.g., no tightening of valve after closure by valve motor). Repairs of maloperating or leaking valves shall be made as necessary. Information on any valve closure malfunction or valve leakage that requires corrective action before the test, shall be included in the Type A Leak Test Report submitted to the Commission.

The containment test conditions shall stabilize for a period of approximately 4 hours prior to the start of the leakage rate test.

Those portions of the fluid systems that are part of the reactor coolant pressure boundary and are open directly to the containment atmosphere under post-accident conditions and become an extension of the boundary of the containment shall be opened or vented to the containment atmosphere prior to and during the test. Portions of closed systems inside containment that penetrate containment and rupture as a result of a loss of coolant accident shall be vented to the containment atmosphere. All vented systems shall be drained of water or other fluids to the extent necessary to assure exposure of the system containment isolation valves to containment air test pressure and to assure they will be subjected to the post-accident differential pressure. Systems that are required to maintain the plant in a safe condition during the test shall be operable in their normal mode, and need not be vented. Systems that are normally filled with water and operating under post-accident conditions, such as the containment heat removal system and the component cooling water system, need not be vented. However, the containment isolation valves in the systems defined in this section shall be tested in accordance with Section 3.5(4). The measured leakage rate from these tests shall be reported to the Commission.

c. Test Methods

All Type A tests shall be conducted in accordance with the provisions of 10 CFR Part 50, Appendix J.

The accuracy of any Test A shall be verified by a supplemental test. The supplemental test method selected shall be conducted for sufficient duration to establish accurately the change in leakage rate between the Type A test and the supplemental Type A test. Results from the supplemental test are acceptable provided the difference between the supplemental test data and the Type A test data is within 0.25 L_a. If results are not within 0.25 L_a, the reason shall be determined, corrective action taken, and a successful supplemental test performed.

Test leakage rates shall be calculated using absolute values corrected for instrument error.

d. Acceptance Criteria

The maximum allowable leakage rate shall not exceed 0.1%.

The total measured leakage rate at a pressure of 60 psig shall be less than 0.75 L_a. If local leakage measurements are taken to effect repairs in order to meet 0.75 L_a acceptance criteria, these measurements shall be taken at a pressure of 60 psig.

If two consecutive Type A tests fail to meet the acceptance criteria, not withstanding the requirements of the testing frequency, a Type A test shall be performed at each refueling outage or approximately every 18 months, whichever occurs first, until two consecutive Type A tests meet the acceptable criteria, after which time the normal testing frequency schedule may be resumed.

e. Testing Frequency

A set of three Type A tests shall be performed, at approximately equal intervals during each 10 year service period. The third test of each set shall be conducted when the plant is shutdown for the 10-year in-service inspections.

The performance of Type A tests shall be limited to periods when the plant facility is non-operational and secured in the shutdown condition under administrative control and in accordance with the safety procedures defined in the license.

(3) Containment Penetrations Leak Rate Tests (Type B Tests)

a. Introduction

Type B tests are intended to detect local leaks and to measure leakage across each pressure-containing or leakage limiting boundary for the containment penetrations.

b. Test Methods

Type B tests shall be performed by local pneumatic pressurization of the containment penetrations, either individually or in groups, at a pressure of 60 psig.

Examination shall be performed by halide leak-detection method or by other equivalent test methods such as measurement of the rate of makeup required to maintain the test volume at 60 psig.

c. Acceptance Criteria

The combined leakage rate of all penetrations and valves subject to Type B and Type C tests shall be less than or equal to 0.6 L_a.

If at any time it is determined that a leakage rate is greater than 0.6 L_a, repairs shall be initiated immediately. If repairs are not completed and conformance to the acceptance criteria is not demonstrated within 48 hours, the reactor shall be shut down and depressurized until repairs are completed and the local leakage meets this acceptance criteria.

The results of personnel access lock door seal tests at 5 psig shall not exceed .01 L_a.

d. Testing Frequency

Type B tests shall be performed during each refueling outage, or other convenient intervals, but in no case at intervals greater than 2 years, except the personnel access lock (PAL) which will be tested as follows:

(i) Every six months the entire PAL assembly shall be leak tested at 60 psig.

(ii) If the PAL is opened during periods when containment integrity is not required, the PAL door seals shall be leak tested at 5 psig at the end of such periods and the entire PAL assembly shall then be leak tested at 60 psig within two weeks of achieving the required condition for containment integrity.

(iii) If the PAL is opened during the interval between the six-month tests when containment integrity is required, the PAL door seals shall be leak tested at a pressure not less than 5 psig within 72 hours. If the PAL is opened more frequently than once per 72 hours, the door seals shall be leak tested at a pressure of 5 psig at least once every 72 hours during the period of frequent openings.

e. Penetrations to be Tested [(1)]

(i) Equipment Hatch

(ii) Personnel Access Lock

(iii) Mechanical Penetrations M-1 through M-99

(iv) Fuel Transfer Tube (Mechanical Penetration M-100)

(v) Electrical Penetrations

A-1	B-9	D-6	F-2	E-HCV-383-3A
A-2	B-10	D-7	F-4	E-HCV-383-3B
A-4	B-11	D-8	F-5	E-HCV-383-4A
A-5	C-1	D-9	F-6	E-HCV-383-4B
A-6	C-2	D-10	F-7	
A-7	C-4	D-11	F-8	
A-8	C-5	E-1	F-9	
A-9	C-6	E-2	F-10	
A-10	C-7	E-4	F-11	
A-11	C-8	E-5	G-1	
B-1	C-9	E-6	G-2	
B-2	C-10	E-7	G-3	
B-4	C-11	E-8	G-4	
B-5	D-1	E-9	H-1	
B-6	D-2	E-10	H-2	
B-7	D-4	E-11	H-3	
B-8	D-5	F-1	H-4	

(4) Containment Isolation Valves Leak Rate Tests (Type C Tests)

a. Introduction

Type C tests are intended to measure containment isolation valve leakage rates.

b. Test Methods

Type C tests shall be performed by local pressurization with air or nitrogen at a pressure of 60 psig. The pressure shall be 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 the tests for a pressure applied in a different direction will provide equivalent or more conservative results. Each valve to be tested shall be closed by normal operation and without any preliminary exercising or adjustments (e.g., no tightening of valve after closure by valve motor).

c. Acceptance Criteria

The combined leakage rate of all penetrations and valves subject to Type B and Type C tests shall be less than or equal to 0.6 L_a.

If at any time it is determined that a leakage rate is greater than 0.6 L_a, repairs shall be initiated immediately. If repairs are not completed and conformance to the acceptance criteria is not demonstrated within 48 hours, the reactor shall be shut down and depressurized until repairs are completed and the local leakage meets this acceptance criteria.

d. Testing Frequency

Type C tests shall be performed during each refueling outage, or other convenient intervals, but in no case at intervals greater than 2 years.

e. Penetrations to be Tested[1]

M-2	M-31	M-52
M-7	M-38	M-53
M-8	M-39	M-57
M-11	M-40	M-58
M-14	M-42	M-69
M-15	M-43	M-73
M-18	M-44	M-74
M-19	M-45	M-79
M-20	M-46	M-80
M-22	M-47	M-87
M-24	M-48	M-88
M-25	M-50	M-HCV-383-3
M-50	M-51	M-HCV-383-4

(5) Special Testing Requirements

Any major modification or replacement of a component which is part of the containment boundary shall be followed by either Type A, Type B, or Type C tests as applicable for the area affected by the modification and shall meet the applicable acceptance criteria. Minor modifications, or replacements, performed directly prior to the conduct of a scheduled Type A test do not require a separate test.

(6) Report on Test Results

Leak rate tests shall be the subject of a summary technical report submitted to the Commission approximately three months after the conduct of each test. The report shall be titled "Reactor Containment Building Integrated Leak Rate Test".

The report shall contain an analysis and interpretation of the Type A test results and a summary analysis of periodic Type B and Type C tests that were performed since the last Type A test.

Leakage test results from Type A, B, and C tests that failed to meet the applicable acceptance criteria shall be reported in a separate summary report approximately three months after the conduct of these tests. The Type A test report shall include an analysis and interpretation of the test data, the least-squares fit analysis of the test data (Type A tests only), the instrumentation error analysis (Type A tests only), and the structural conditions of the containment or components, if any, which contributed to the failure in meeting the acceptance criteria. Results and analyses of the supplemental verification test employed to demonstrate the validity of the leakage rate test measurements shall also be included.

(7) Surveillance for Prestressing System

a. Surveillance Requirements

210 dome tendons and 616 wall tendons shall be inspected for symptoms of material deterioriation or force reduction. Inspections will be performed on three dome tendons, one from each layer, and on three helical tendons of each orientation.

The tendons shall be inspected as follows:

(i) Lift-off readings shall be taken on each of the tendons selected to determine the load existing in the tendon at the time of the inspection. At each surveillance period, readings may also be taken on the load cells of the special instrumented tendons. Force reductions on the surveillance tendons and on the instrumented tendons will be compared. If good correlation exists between these two groups of tendons through several surveillance periods, consideration will be given to eliminating some lift-off readings and monitoring of the load cells as an alternative. Each selected tendon shall be completely detensioned and examined for broken wires and any evidence of damage or deterioration of anchorage hardware.

(ii) One wire from each of three helical tendons and one wire of a dome tendon shall be removed. Each removed wire shall be carefully examined over its entire length for evidence of corrosion or other deleterious effects. Tensile tests shall be made on at least three samples cut from each of the four wires removed, one at each end and one at mid-length, the samples being of a maximum length practical for testing. In special cases, the use of fatigue tests and accelerated corrosion tests may be considered.

(iii) Comparisons shall be made between the quality control records and each of the surveillance inspection records for each of the surveillance tendons.

After completion of the tendon surveillance the individual detensioned tendons shall be retensioned to a force commensurate with the average wire stress indicated by the last lift-off reading for that tendon.

b. Acceptance Criteria

(i) The tendon force determined by the lift-off test shall be considered adequate if it is not less than the force shown on the appropriate lower limit curve of USAR Figure 5.10-4, as adjusted for wire removal, for the elapsed time between the original prestressing and the particular surveillance period. These lower limit curves have been generated by calculating the difference between the anticipated tendon force at end of plant life and the minimum tendon force to meet the design requirements. One half of this difference has been added to the anticipated total loss of prestress at the end of plant life and the curves have been drawn to meet this limit. Since the lock-off force on individual tendons is varied to compensate for elastic shortening of the structure, the tendon force at 70% of ultimate strength, rather than the actual lock-off force shall be taken as the initial prestress force. An allowable limit of not more than one defective tendon out of the total sample population is acceptable, provided an adjacent tendon on each side of the defective tendon is tested and is found to meet the criteria. Should one of the adjacent tendons be also found defective, the Commission shall be notified in accordance with Regulatory Guide 1.16, "Reporting of Operating Information".

(ii) No unexpected change in corrosion conditions or grease properties.

(iii) All three tensile tests on any one wire indicate an ultimate strength at least equal to the specified minimum ultimate strength of the wire. If a single test on any wire showns an ultimate strength less than the specified minimum, the Commission will be notified in accordance with Regulatory Guide 1.16, "Reporting of Operating Information".

c. Corrective Action

If the above acceptance criteria are not met, an immediate investigation shall be made to determine the cause(s) for the non-conformance to the criteria, and results will be reported to the Commission within 90 days.

d. Testing Frequency

The tendons in the prestressing system shall be inspected once every five years.

Basis

The containment is designed for an accident pressure of 60 psig.[2] While the reactor is operating, the internal environment of the containment will be air at approximately atmospheric pressure and a maximum temperature of about 120°F. With these initial conditions the temperature of the steam-air mixture at the peak accident pressure of 60 psig is 288°F.

Prior to initial operation, the containment was strength-tested at 69 psig and then was leak tested. The design objective of the pre-operational leakage rate test has been established as 0.1% by weight for 24 hours at 60 psig. This leakage rate is consistent with the construction of the containment, which is equipped with independent leak-testable penetrations and contains channels over all inaccessible containment liner welds, which were independently leak-tested during construction.

Safety analyses have been performed on the basis of a leakage rate of 0.1% of the free volume per day of the first 24 hours following the maximum hypothetical accident. With this leakage rate, a reactor power level of 1500 MWt, and with minimum containment engineered safety systems for iodine removal in operation (one air cooling and filtering unit), the public exposure would be well below 10 CFR Part 100 values in the event of the maximum hypothetical accident.[3] The performance of a periodic integrated leakage rate test during plant life provides a current assessment of potential leakage from the containment.

The reduced pressure (5 psig) test on the PAL is a conservative method of testing and provides adequate indication of any potential containment leakage path. The test is conducted by pressurizing between two resilient seals on each door. The test pressure tends to unseat the resilient seals which is opposite to the accident pressure that tends to seat the resilient seals. The six month test ensures the overall PAL integrity at 60 psig.

The frequency of the periodic integrated leakage rate test (Type A test) is keyed to the refueling schedule for the reactor, because this test can only be performed during refueling shutdowns.

The specified frequency of periodic integrated leakage rate tests is based on three major considerations. First is the low probability of leaks in the liner because of the test of the leak-tightness of the welds during erection and conformance of the complete containment to a low leak rate at 60 psig during pre-operational testing, which is consistent with 0.1% leakage at design basis accident conditions and absence of any significant stresses in the liner during reactor operation. Second is the more frequent testing, at the full accident pressure, of those portions of the containment envelope that are most likely to develop leaks during reactor operation (penetrations and isolation valves) and the low value (0.60) of the total leakage that is specified as acceptable from penetrations and isolation valves. Third is the tendon stress surveillance program, which provides assurance that an important part of the structural integrity of the containment is maintained.

A reduction in prestressing force and changes in physical conditions are expected for the prestressing system. Allowances have been made in the reactor building design for the reduction and changes. The inspection results for each tendon shall be recorded on the forms provided for that purpose and comparison shall be made with the previous test results and the initial quality control records. Force-time trend lines will also be established and maintained for each of the surveillance tendons.

If the force-time trend line, as extrapolated, falls below the predicted force-time curve for one or more surveillance tendons, then before the next scheduled surveillance inspection, an investigation shall be made to determine whether the rate of force reduction is indeed occurring for other tendons. If the rate of reduction is confirmed, the investigation shall be extended so as to identify the cause of the rate of force reduction. The extension of the investigation shall determine the needed changes in the surveillance inspection schedule and the criteria and initial planning for corrective action. If the force-time trend lines of the surveillance tendons at any time exceed the upper bound curve of the band on the force-time graph, an investigation shall be made to determine the cause.

3.0 SURVEILLANCE REQUIREMENTS
3.5 Containment Tests (Continued)

If the comparison of the corrosion conditions, including chemical tests of the corrosion protection material, indicates larger than expected change in the conditions from the time of installation or last surveillance inspection, an investigation shall be made to detect and correct the causes.

The prestressing system is a necessary strength element of the plant safeguards and it is considered desirable to confirm that the allowances are not being exceeded. The technique chosen for surveillance is based upon the rate of change of force and physical conditions so that the surveillance can either confirm that the allowances are sufficient or require maintenance before minimum levels of force or physical conditions are reached. The end anchorage concrete is needed to maintain the prestressing forces. The design investigations have concluded that the design is adequate and this has been confirmed by tests. The prestressing sequence has shown that the end anchorage concrete can withstand loads in excess of those which result when the tendons are anchored. Further, the containment building was pressure tested to 1.15 times the maximum design pressure.

References

(1) USAR, Section 5.9.1

(2) USAR, Section 5.1.1

(3) USAR, Section 14.15

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Reference 3, entitled "Omaha Public Power District, Fort Calhoun Station Unit No. 1, Reactor Containment Building Leak Rate Test, Supplementary Report, June 1973", has been removed from the Technical Specifications. This deletion encompassed the cover sheet, Table of Contents, and the six (6) Reference 3 pages.

DISCUSSION

The proposed changes to Technical Specification Section 3.5 are to ensure that reactor containment building leak rate testing (Type A integrated test, Type B and Type C local tests) is performed in accordance with and as specified by 10 CFR Part 50, Appendix J, as amended, given the existing design limitations of the Fort Calhoun Station Unit No. 1.

The Type A test will be conducted as specified in 10 CFR Part 50, Appendix J. This integrated test will be conducted on the containment building and those systems which are considered part of the containment boundary and potential leakage paths.

The performance of the Type A test with the plant in a refueling shutdown condition may result in leakage paths in certain safety related systems which normally would not exist during power operation. These paths may exist in the SI system which will be at a pressure greater than the test pressure if required to operate during a DBA. These leakage paths are repairable without any local leak testing and do not contribute to the failure of the Type A test.

The local leakage Type B tests (electrical penetrations, mechanical penetration sleeve welds, equipment hatch, fuel transfer tube, and personal access lock) are conducted as specified in 10 CFR Part 50, Appendix J, with the exception of the testing of the personnel access lock (PAL). The penetrations to be tested have been clarified to identify penetration M-100 as the fuel transfer tube.