INSPECTION PROCEDURE 70307

CONTAINMENT INTEGRATED LEAK RATE TEST PROCEDURE REVIEW

PROGRAM APPLICABILITY: 2513, 2515 (BASIC)

70307-01 INSPECTION OBJECTIVES

01.01 Ascertain if the licensee's procedure for the performance of Containment Integrated Leak Rate Tests (CILRTs) complies with regulatory requirements, guidance, and licensee commitments.

01.02 Evaluate the technical adequacy of this procedure to determine containment leak tight integrity.

70307-02 INSPECTION REQUIREMENTS

02.01 Obtain an approved copy of the licensee procedure to be used in performing the CILRT.

02.02 Review all regulations, licensee commitments, and guidance pertaining to all CILRTs (Type A tests including both as found (AF) and as left (AL) conditions).

02.03 Verify that all of the following prerequisites required to commence the CILRT are included in the licensee's test procedure:

a. For containment structures that are new construction (preparing to undergo the preoperational CILRT) or have undergone major repairs, the following tests shall be satisfactorily performed:

Tests	New Construction	Major Repairs
Pressure strength test	yes	yes
Local leak rate test	yes	yes
Containment isolation system function test	yes	no

b. A general inspection of the accessible portions of the interior and exterior containment surfaces shall be performed satisfactorily.

c. The containment area survey for temperature differentials and humidity shall be or has been performed with sensing devices being placed in locations representative of their assigned subvolumes.

d. All test instruments are within calibration at the initiation of the CILRT.

e. Vacuum release devices shall be verified to operate within 10% of their design pressures for internal and external loading to ensure containment protection from under pressure.

f. For licensees utilizing the Reference-Vessel method of leakage rate determination, a reference system leakage measurement shall be performed by the absolute method to qualify the system's vacuum retention.

g. The containment structure shall be properly closed out according to licensee procedure.

02.04 Ensure that each applicable plant system is to be aligned in accordance with one of the following criteria:

a. All systems required to maintain the plant in a safe condition shall be operable and in their normal modes.

b. Closed systems that would rupture as the result of a loss of coolant accident (LOCA) shall be vented to containment.

c. Any system open to containment under post LOCA conditions shall be opened or vented to containment prior to and during the test.

d. Any system that would be normally operating under post LOCA conditions is not required to be vented during the test.

e. Any system or component sensitive to damage from high pressures or pressure differentials shall be isolated or removed from containment.

f. All other systems containing fluids that are or may become pressurized shall be depressurized and isolated from containment.

02.05 Review the CILRT procedure to determine if the procedural requirements and precautions include the following items:

a. The proper licensee response to all excessive leakage paths - detected before or during the CILRT

b. The sequencing of the reduced pressure test and the peak pressure test when conducting the preoperational CILRT (if performing the reduced pressure test)

c. Containment pressurization requirements:

1. the minimum and maximum pressurization for CILRTs

2. isolation and venting of the pressurization source from containment upon reaching test pressure

3. observation of pressure/temperature stabilization prior to commencing the leakage rate measurement

d. Logging of required test parameters and observations

e. Test data plot for absolute method leakage rate determinations

f. Test duration

g. Supplemental verification test leakage rate and test period

h. Correction for LLRT penalty factors

i. Determination of satisfactory test results for both the AF and AL conditions.

70307-03 INSPECTION GUIDANCE

General Guidance. The proper performance of a CILRT requires an indepth test procedure which provides detailed guidance for the alignment and operation of all systems and equipment inside and penetrating the primary containment. Without adequately aligning all systems, artificial leak rate results may be obtained, which in no way reflect the containment's leak tight integrity. Therefore, the inspector should develop a thorough understanding of CILRT practices and procedures prior to the performance of this review.

03.01 Specific Guidance

a. Inspection Requirement 02.01. For the preoperational CILRT, an approved test procedure satisfying FSAR testing commitments should be made available by the licensee approximately 60 days prior to its use.

b. Inspection Requirement 02.02

1. The regulatory basis for CILRTs is found in 10 CFR 50, Appendix J, ANSI N45.4-1972 and the facility's technical specifications (TS). Additional guidance is provided in ANSI/ANS-56.8-1981 as well as IE Bulletins 82-04 and 84-01 and IE Information Notices 79-33, 81-20, 82-40, and 83-23.

2. The term Type A test is synonymous with CILRT. Type A tests are performed for preoperational plants and periodically for operational units. Preoperational testing is only concerned with determining the AL containment condition. The AL condition is that at the completion of the test sequence. This test is performed to ensure that the containment leak tight integrity is in a satisfactory state prior to starting power operations.

In performing the periodic Type A test, the licensee is required to determine both the AF and AL conditions of the containment structure. The AF condition is that at the time of reactor shutdown preceding the Type A test.

This test is performed to disclose the normal state of the containment leak tight integrity and to determine if there is any abnormal deterioration of the containment structure occurring.

c. Inspection Requirement 02.03a

1. Pressure tests for strength (hydrostatic or pneumatic pressure) are required to be performed for new construction plants and for those that have undergone major repairs which require strength welding. This test is performed to determine whether the containment structure complies with specified strength and design criteria of the TS. These test results shall be within specification prior to the initiation of leakage rate tests.

2. (a) Prior to commencing the preoperational CILRT, it is generally recommended that Type B and C LLRTs be performed on all appropriate penetrations to provide an indication of how leak tight the containment structure can be made.

   (b) Any major containment modification or repair shall be followed by either Type B or C LLRTs, as applicable, for the area affected by the modification. In certain cases, LLRTs would not be an appropriate retest, but rather, a Type A test (CILRT) is necessary.

3. Containment isolation system function tests shall be performed prior to the preoperational CILRT in order to verify that these systems operate properly and that they do not require any repairs or modifications.

d. Inspection Requirement 02.03b

1. A general inspection of the accessible portions of the containment structure and components is performed to determine if there is any evidence of structural deterioration which may affect either the containment structural integrity or leak tight integrity. If evidence of deterioration exists, no CILRTs shall be performed until all repairs and retests are complete.

2. The inspector shall ensure that enough specific guidance is provided in the procedure to permit personnel to adequately inspect the containment.

e. Inspection Requirement 02.03c

1. (a) The temperature survey of the containment structure is performed to permit the accurate measurement of containment temperatures and thermal variations in order to improve the accuracy of the overall weighted containment temperature. The survey should indicate where the temperature readings were taken for each subvolume, the conditions under which they were taken

(e.g., fans operating or secured and heat loads in the area), and establish an acceptance criteria for the final location of the sensor in each subvolume (e.g., placed where the temperature is within 2°F of the subvolume average).

(b) This information is essential for ensuring that the sensor location is representative of its assigned subvolume and furthermore, for ensuring that post pressurization temperature/pressure stabilization has occurred in containment to the extent necessary to permit an accurate leakage rate measurement.

2. If the Reference-Vessel method of leakage testing is used, the temperature pattern of containment is essential, as the reference vessels must be located in regions which are representative of the temperature of the subvolume each vessel represents.

3. If many thermal variations are detected, fans or other means of air circulation may be used to equalize temperatures in these regions. In using these methods, caution must be employed during pressurization, as the load on these components is generally a function of air density. In addition, the fans must be kept in the same operating mode during the CILRT as they were during the temperature survey.

f. Inspection Requirement 02.03d

1. All test equipment shall be calibrated over a normal range of conditions that will be experienced during the CILRT. Correction factors should be determined for each sensing device prior to initiation of the CILRT.

2. All calibrations shall be traceable to NBS Standards.

3. Calibration of instruments used in the CILRT shall have been performed no more than 6 months before the CILRT.

4. Original position checks of all test equipment shall be performed after installation and prior to pressurization. These checks shall have been performed within one month of commencing the CILRT.

g. Inspection Requirement 02.04

1. The system alignments for the CILRT are performed to reflect the conditions that would exist after a design basis LOCA.

2. To ensure proper system alignment for the preoperational CILRT, perform an inspector review of all recommended lineups for systems penetrating the primary containment. Prior to the performance of periodic CILRTs, the inspector shall review the effect and basis of all system alignment changes from those initially prescribed in the

preoperational test procedure. Verify that no artificial leakage barriers exist.

3. Closure of containment isolation valves (CIVs) for the CILRT shall be directed to be accomplished by normal operation without any exercising (valve cycling) or adjustments (e.g., no tightening of the valve packing after closure by the motor).

4. Repairs of any maloperating or leaking CIVs are to be made as necessary. The pre-repair leakage rate is to be measured to determine the LLRT penalty factor (discussed in section 03.01h.3 of this procedure).

5. All systems which are normally fluid and may be drained, may have the fluid driven off by the LOCA, or will not maintain the fluid seal for 30 days after the accident shall be vented and drained to the extent necessary to expose the CIV seals to the containment atmosphere during the CILRT.

h. Inspection Requirement 02.05a

1. Any excessive leakage path detected prior to commencement of the CILRT shall be measured through an LLRT, repaired, and then remeasured. Excessive leakage could be defined as that which would meet any of the following criteria:

   (a) that which could potentially cause the failure of the Appendix J criteria for combined local leakage rates.

   (b) that which exceeds vendor specifications for the leakage of boundaries or valves.

   (c) and that which exceeds the licensee's commitments for allowable leakage rates.

2. Any excessive leakage path detected during the CILRT, including the supplemental verification test, shall result in termination of the CILRT. The local leak rate shall be measured before and after repair of the penetration that is leaking. The leaking penetration may be blanked off and repaired after completion of the CILRT (per section 03.01h.4 of this procedure). After the corrective action is complete, the CILRT shall be restarted from the beginning of the test.

3. All excessive leakage paths are to be measured before and after repair so that an LLRT penalty factor can be calculated which will permit the determination of the containment's AF condition.

   The LLRT penalty factor is the difference between the minimum pathway leakage rates of a penetration before and after repair. The minimum pathway leakage would be the smaller leakage rate of in-series valves tested individually, one-half the leakage rate for in-series valves

tested simultaneously and the combined leakage rate for valves tested in parallel.

The LLRT penalty factor is added to the CILRT leakage rate to determine the AF containment integrated leakage rate.

4. If a penetration leaks excessively and cannot be repaired prior to the CILRT, it may be blanked off. The LLRT penalty factor is required to be determined for this penetration in order to characterize the AF condition. In addition, the AL integrated leakage rate must also be adjusted to compensate for the leakage that will exist through this penetration after its repair. This is done by adding the post repair local leak rate of this penetration to the CILRT results.

i. Inspection Requirement 02.05c.1

1. The pressure limits to be maintained while conducting CILRTs are as follows:

(a) Reduced pressure CILRT Pd > P $\geq$ .5Pa - 1 psig.

(b) Peak pressure CILRT Pd > P $\geq$ Pa - 1 psig.

P is the CILRT test pressure (at any time during the test)

Pd is the containment system design pressure

Pa is the calculated peak internal containment pressure related to the design basis accident and specified in the TS or associated bases.

2. All LLRTs performed for component repairs in conjunction with the CILRT are to be conducted at Pa.

j. Inspection Requirement 02.05c.3. Upon completion of pressurizing the containment, sufficient time must be permitted prior to the leakage rate measurement so that temperature (T) and pressure (P) can equilibrate. Containment pressure will act as a damping harmonic function until P and T equilibrate, hence, any measurements of P and T made for leakage rate calculations prior to this time would yield an erroneous leakage rate measurement due to this harmonic nature.

The criteria for P and T stabilization (equilibration) are:

1. The stabilization time period must be at least 4 hours long.

2. The weighted average containment air temperature, averaged over the last hour, should not deviate by more than 0.5°F/hr (0.3°C/hr) from the average rate of change of the weighted average containment air temperature averaged over the last four hours.
[i.e., ΔT (last 2 hrs) - ΔT(last 4 hrs) $\leq$ .5°F]

k. Inspection Requirement 02.05d. During the performance of the leakage rate test, the licensee is required to log atmospheric and containment pressure, temperature, dewpoint temperature, and liquid level (e.g., suppression pool or pressurizer level) on an hourly basis. All pertinent observations shall also be logged.

l. Inspection Requirement 02.05e

1. The leakage rate determined from absolute method leak rate calculations shall be determined periodically. The test data shall be plotted against time to obtain a statistically averaged leakage rate through a linear least squares fit of the data.

   This plotting of data is to be conducted continuously during the test to disclose any gross variations in data or leak rates. These variations could be indicative of an erroneous reading, failed test instrumentation, or a penetration failure.

m. Inspection Requirement 02.05f

1. The leakage rate test period, for any method, shall extend to 24 hours of retained internal pressure, unless it can be adequately demonstrated that the leakage rate can be determined during a shorter test period.

2. The only abbreviated test period leakage rate test currently permitted by the NRC is the BN-TOP-1 method. The duration of a successful CILRT by this method is based upon the magnitude and trend of the measured data and calculated leakage rates. The leakage rate must be fairly stable and the two sided (97.5%) Upper Confidence Limit (as discussed in section 03.01p2 of this procedure) for the total time analysis must be less than 0.75 La, where La is the maximum allowable leakage rate at pressure Pa as specified in the TS or associated bases. In addition, at least 20 data points shall have been taken at approximately equal intervals and the test must last at least 6 hours.

3. If regulation and BN-TOP-1 are conflicting, then regulation shall take precedence (e.g., when using BN-TOP-1 methods, the total time AF and AL Type A test results must meet the 0.75 La limit using the appropriate statistical and error analysis).

n. Inspection Requirement 02.05g. The method of the supplemental verification test is not prescribed, but the test must be conducted over a sufficient duration to yield a change in leakage rate from the Type A test. If the BN-TOP-1 method is being used, this verification test period must be at least one half the length of the Type A Test. The leakage rate shall be determined from the slope of the linear least squares fit of the graph of the leakage rate versus time. Enough data

points must be taken to give accurate leakage rate results (taking only two or three data points is always insufficient).

o. Inspection Requirement 02.07. All LLRT penalty factors are to be calculated in accordance with section 03.01h.3 of this procedure. Verify that the LLRT penalty factors are calculated for each penetration requiring repair or adjustment and that these penalty factors have been summed with the CILRT result to find the AF leakage rate.

p. Inspection Requirement 02.05i

1. For peak pressure (Pa) and reduced pressure (Pt) the associated maximum allowable leakage rates (La/Lt) are defined in the licensee's TS and operating license. The acceptance criteria are, at a minimum, as conservative as the following equation:

   Lam(Ltm) - 0.75 La(Lt)

   and for the preoperation peak pressure test, Lam should also be less than or equal to Ld, where:

   Lam = total measured containment leakage rate at Pa
   Ltm = total measured containment leakage rate at Pt
   Ld = design leakage rate at Pa

   The values for Lam(Ltm) in the above equations must include the LLRT penalty factor and a value for random instrument error when determining if the CILRT was satisfactory.

2. Licensees are required to correct Ltm(Lam) for random instrument errors through addition of the calculated absolute value of the error. Though no particular method is generally required, some licensees have committed in their TS to the application of Upper Confidence Limits (UCL) set at a 95% probability in order to account for the instrument error. The UCL is a value calculated by measuring the standard deviation from the slope of the least squares linearization of the test data within which a certain fraction of all values may be reasonably expected to lie.

3. In addition, the supplemental integrated leak rate verification test is required to be performed to validate the Type A test. To prove the Type A test acceptable, the following criteria must be met:

   Lam(Ltm) - (Lc -Lo) $\leq$ 0.25 La(Lt), where:

   Lam(Ltm) is the raw integrated leakage rate obtained with no correction for instrument errors or LLRT correction factors included unless repairs or adjustments were made in between the times of performance of the two tests,

Lc is the composite leakage rate measured during the verification test, and

Lo is the known orifice leakage rate or the negative of the controlled pump back injection rate.

70307-04 REFERENCES

10 CFR 50, Appendix A, Criteria 52, 53, 54, 55, 56, and 57.

10 CFR 50, Appendix J.

Memorandum from R. J. Mattson to J. H. Sniezek, "Clarification of Appendix J Requirements - Definition of Type A Test Failures," January 11, 1982.

Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment," March 10, 1971.

Regulatory Guide 1.68, Rev. 2, "Initial Test Program for Water-Cooled Nuclear Power Plants," August, 1978.

Regulatory Guide 1.141, "Containment Isolation Provisions," April, 1978.

ANSI N45.4-1972, "Leakage - Rate Testing of Containment Structures for Nuclear Reactors."

ANS-56.2 ANSI N271-1976, "Containment Isolation Provisions for Fluid Systems."

ANSI/ANS-56.8-1981, "Containment System Leakage Testing Requirements." Topical Report BN-TOP-1, Revision 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants," Bechtel Corporation.

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