INSPECTION PROCEDURE 70313

CONTAINMENT INTEGRATED LEAK RATE TEST SURVEILLANCE

PROGRAM APPLICABILITY: 2513, 2515 (BASIC)

70313-01 INSPECTION OBJECTIVE

01.01 Ascertain through inspector observation, records review and independent calculations whether the containment integrated leak rate test (CILRT) is being properly conducted.

01.02 Independently verify the acceptability of test results through on-the-spot analysis and further indepth, independent analysis.

70313-02 INSPECTION REQUIREMENTS

02.01 Ensure that the following prerequisites are met before commencing containment pressurization of all CILRTs (Type A tests): [See section 03.02a for explanations for the preoperational and operational Type A tests, including as found (AF) and as left (AL) conditions.]

a. For containment structures that are new construction (preparing to undergo the pre-operational CILRT) or have undergone major repairs the following tests shall have been 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 is satisfactorily complete.

c. The containment area survey for temperature differentials and humidity is or has been performed for the conditions which exist throughout the CILRT (e.g., fans operating or secured,

no heat loads (pre-op), or heat loads (decay heat) and sensing devices are in place in locations representative of their assigned subvolume.

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

e. Each applicable plant system is aligned in accordance with one of the following criteria:

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

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

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

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

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

6. All other systems containing fluids that are, or may become, pressurized from external pressure sources shall be depressurized and isolated from containment.

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

g. 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.

h. The containment structure is properly closed out according to licensee procedure.

i. The current licensee procedure that describes the method of decompression for personnel exposed to pressurization is on hand, if personnel entry into the pressurized containment is allowed.

j. The most recent, approved version of the licensee's procedure for CILRT is available and in use by all test crew members.

02.02 Verify that the licensee properly responds to all excessive leakage paths detected before or during the CILRT.

02.03 Ensure that the reduced pressure test and the peak pressure test are performed sequentially during the preoperational CILRT (if performing the reduced pressure test).

02.04 Monitor the containment pressurization and ensure the following:

a. Personnel are aware of the minimum and maximum pressurization requirements for CILRTs.

b. The pressurization source, upon reaching test pressure, is isolated from containment and vented.

c. Pressure-temperature stabilization is observed prior to commencing the leakage-rate measurement.

02.05 Ensure that during the leakage-rate measurement the licensee is observing all CILRT requirements by verifying the following:

a. All required plant parameters are being recorded, at a minimum, on an hourly basis.

b. The test log is being properly maintained with all pertinent observations being logged and with personnel responsible for the correctness for the observations so attesting in the log.

c. The CILRT meets the minimum time requirement for test duration.

d. Leakage-rate computations for the absolute method are performed periodically. The leak rate test data shall be plotted against time to calculate a statistically averaged leakage rate.

e. The supplemental verification test complies with the change in leakage rate and test period requirements.

02.06 Determine the CILRT leakage rates obtained through use of either the CILRT program ("A Computer Program For Containment Integrated Leak Rate Testing") or other NRC accepted methods of analysis and compare with the licensee's initial results.

02.07 Verify that the proper LLRT correction factors are included in the CILRT results.

02.08 Determine if the CILRT was satisfactory for both the AF and the AL containment conditions.

02.09 If either the AF or AL condition is determined to be a failure, verify that the licensee is aware of the ensuing consequences and requirements.

70313-03 INSPECTION GUIDANCE

General Guidance. The proper witnessing and evaluation of a CILRT requires an indepth understanding of containment system testing, as well as a good understanding of the plant specific containment systems and components. To achieve this balance necessitates the utilization of both regional and resident NRC inspectors in observing the performance of the CILRT. Generally, the regional inspector shall perform the majority of the inspection and should only request resident inspector assistance for the performance or

certain prerequisite requirements including a check of system alignments.

03.01 Specific Guidance. This section is provided to supply a more detailed explanation of the source and method of implementation for each specific inspection requirement. The references for the applicable sources given in parenthesis after each requirement are listed in section 70313-04 of this procedure.

a. Inspection Requirement 02.01

1. 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 as left (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 proceeding 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.

   (refs: b-sections III.A.1 V.B.2 and V.B.3, c, and f-sections 4.1 and 4.2)

2. All test prerequisites shall be verified as being met through observing the initialing (signing off) of all requirements for the CILRT in its associated procedural record. The initials shall be those of an authorized person attesting to the completion of the particular requirement.

b. Inspection Requirement 02.01a

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 Technical Specifications (TS). These test results shall be within specification prior to the initiation of leakage-rate tests.

   (refs: f-section 4.3, h-section 3.2)

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 can be made.

(refs: f-section 4.1, h-section 3.2)

(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, LLRT's would not be an appropriate retest, but rather, a Type A test (CILRT) is necessary.

(ref: b-section IV.A.)

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.

(ref: h-section 3.2.1.2)

c. Inspection Requirement 02.01b

1. A general inspection of the accessible portions of the containment structure and components shall be 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.

(ref: b-section V.A.)

2. To verify that this inspection is satisfactorily complete, a review should be performed of the containment inspection procedure and its results. Ensure that enough specific guidance is provided in the procedure to permit personnel to adequately inspect the containment. The procedure and results should be compared with the licensee's TS and Final Safety Analysis Report (FSAR).

d. Inspection Requirement 02.01c

1. (a) The temperature survey of the containment structure is performed to permit the accurate measure 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 sensor locations in each subvolume (e.g., the sensor may be placed where the temperature is within 2°F of the subvolume average).

(b) This information is essential 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 is representing.

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. For this reason, it is recommended that licensees perform two surveys, one with fans secured and one with fans operating, to cover either possibility.

(refs: f-sections 4.6, 7.4, h-section 5.5.1)

e. Inspection Requirement 02.01d

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

(refs: f-section 6.2 and 6.3, h-section 4.2.3)

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. An in-site check of all test equipment shall be performed after installation and prior to pressurization. These checks shall be within one month of initiation of the CILRT.

(ref: h-section 4.2.2)

4. An inspector check of the methods used, the raw data, and the results of the calibrations and in-situ checks of at least 20% of the instrumentation used for the CILRT should be performed to verify proper equipment calibration.

f. Inspection Requirement 02.01e

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, perform an inspector walkdown on 100% of the containment penetrations for external systems normally pressurized to containment and on 10% of the systems vented to containment during the CILRT. Determine if the valve alignments have been conducted in accordance with the procedure and verify that no artificial leakage barriers have been erected. In addition, an analysis of how systems are aligned should be performed to determine if the licensee is properly employing the requirements.

3. To verify proper vent paths, the inspector should ensure that vent valve orifice plugs (valve caps) are removed, as well as, the vent valve being open.

4. Closure of containment isolation valves (CIVs) for the CILRT shall 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).

   (ref: b-section III.A.1.(b))

5. Repairs of any maloperating or leaking CIVs shall be made as necessary. The pre-repair leakage rate is to be measured to determine the LLRT correction factor (discussed in section 03.01i3 of this procedure).

   (ref: b-section III.A.1.(b))

6. All systems which are normally fluid filled 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. However, systems that are required for proper conduct of the CILRT or to maintain the plant in a safe condition need not be vented or drained. Systems that are not vented and drained during the CILRT and which could become exposed to the containment atmosphere during a LOCA must undergo LLRTs with their leakage rate determined using minimum pathway leakage added to the CILRT correction factor (discussed in section 03.01i3 of this procedure).

   (refs: b-section III.A.1.(d), III.B.3.(b), and h-section 3.2.1.5)

7. Due to the detailed plant specific knowledge necessary to rapidly walkdown system alignments, it is recommended that the resident inspector shall assist in this inspection by exclusively performing these walkdowns. This would enable the regional inspectors to concentrate more on generic CILRT requirements.

g. Inspection Requirement 02.01i. Exposure of personnel to pressurized air and return to normal atmospheric pressures

during the course of containment structure leakage-rate testing shall be governed by approved decompression procedures involving a controlled depressurizing rate and waiting periods at intermediate pressures. For exposures of no longer than 200 min. at pressures not greater than 14.3 psig., no intermediate holding periods or decompression stops are required provided the time period of pressure reduction in the air lock to atmospheric level is not less than 30 sec. For exposure to pressurization in excess of 14.3 psig, and for exposure periods including repetitive exposure within 12 hr. the practices should conform to those stipulated in Section 1.5, Diving Tables of the U.S. Navy Diving Manual, NAVSHIPS 250-538, January 1959. Local and State regulations should also be consulted.

(ref: f-section 7.5)

h. Inspection Requirement 02.02

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

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

   (b) that which exceeds licensee commitments for allowable leakage rates.

   (c) and that which exceeds vendor specifications for that boundary or valve.

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 03.02i4 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 correction factor can be calculated which will permit the determination of the containment's AF condition.

   The LLRT correction 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 correction 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.

   (refs: b-section III.A.1, f-section 4.2, and h-section 3.2)

i. Inspection Requirement 02.04a

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

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

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

      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.

      (refs: b-section III.A.4 and h-section 3.2.2)

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

      (refs: b-section III.B.2, C.2. and h-section 3.3.2)

j. Inspection Requirement 02.04c. 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. Contain pressure will act as a damping harmonic function until P and T equilibrate, hence, and 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. After reaching test pressure, the weighted average containment air temperature, averaged over the last hour, shall not deviate by more than 0.5°F/hr from the average rate of change of the weighted average containment air temperature averaged over the last four hours. Or,

   $|\Delta T/\text{hour (last hr)} - \Delta T/\text{hour (last 4 hrs)}| \leq .5°F/\text{hour}$

   (refs: b-section III.A.1.c and h-section 5.3.1.3)

k. Inspection Requirement 02.05a. During the performance of the leakage rate test, the licensee is required to record atmospheric and containment pressure, temperature, dewpoint temperature and liquid level (e.g., suppression pool or pressurizer level).

l. Inspection Requirement 02.05c

   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 given in reference i. The duration for a successful CILRT by the BN-TOP-1 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 (per section 03.02p2 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 associate 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.

      (refs: f-section 7.6 and i-section 2.3)

   3. If regulation and BN-TOP-1 are conflicting, 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).

m. Inspection Requirement 02.05d

   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 test 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.

(ref: f-section 7.9)

2. The inspector should independently verify and plot the leakage rates. The technique for independent calculations is located in ref. f section 7.9.

n. Inspection Requirement 02.05e. 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 BN-TOP-1 is being used, the verification test must be at least one half the length of the Type A test conducted. 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).

(ref: b-section III.A.3.b)

o. Inspection Requirement 02.07. All LLRT penalty factors are to be calculated in accordance with step 03.01i3 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 02.08

1. For peak (Pa) and reduced (Pt) containment internal pressures the associated maximum allowable leakage rates (La/Lt) are defined in the licensee's technical specifications (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 preoperational 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.

(ref: b-section III.A)

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.

(refs: b-section III.A.3(c), h-section 5.74,l)

3. In addition, the supplemental integrated leak rate verification test is required to be performed to validate the Type A test result. 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 corrections 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 of the verification test.

(ref: b-section III.A.3.b)

70313-04 REFERENCES

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

b. 10 CFR 50, Appendix J.

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

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

e. Regulatory Guide 1.141, "Containment Isolation Provisions."

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

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

h. ANSI/ANS-56.8-1981, "Containment System Leakage Testing Requirements."

i. Topical Report BN-TOP-1, Revision 1, "Testing Criteria for Integrated Leakage Rate Testing of Primary Containment Structures for Nuclear Power Plants," Bechtel Corporation.

END