



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**  
OFFICE OF NUCLEAR REACTOR REGULATION

6.2.6 CONTAINMENT LEAKAGE TESTING

REVIEW RESPONSIBILITIES

Primary - Containment Systems Branch (CSB)

Secondary - None

I. AREAS OF REVIEW

Information describing the reactor containment leakage testing program is reviewed by the CSB for conformance to 10 CFR Part 50 Appendix J and General Design Criteria 52, 53 and 54.

The CSB review of the reactor containment leakage testing program covers the following specific areas:

1. Containment integrated leakage rate tests (Type A tests as defined by Appendix J), including pretest requirements, general test methods, acceptance criteria for preoperational and periodic leakage rate tests, provisions for additional testing in the event of failure to meet acceptance criteria, and scheduling of tests.
2. Containment penetration leakage rate tests (Type B tests as defined by Appendix J), including identification of containment penetrations, general test methods, test pressures, acceptance criteria, and scheduling of tests.
3. Containment isolation valve leakage rate tests (Type C tests as defined by Appendix J), including identification of isolation valves, general test methods, test pressures, acceptance criteria, and scheduling of tests.
4. Technical specifications pertaining to containment leakage rate testing are reviewed at the operating license (OL) stage.

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**USNRC STANDARD REVIEW PLAN**

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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In addition to the tests described above, CSB reviews the special leakage testing programs that may be needed for the secondary containments for plants using the dual containment concept. Dual containments are proposed for some plants because of site limitations. The intent of the dual containment is to collect and process reactor containment leakage. Testing programs to ensure that leakage will be contained as proposed by applicants using this kind of containment are reviewed by CSB (see SRP Section 6.2.3).

## II. ACCEPTANCE CRITERIA

The reactor containment leakage rate testing program, as described in the SAR, will be acceptable if it meets the requirements stated in Appendix J to 10 CFR Part 50. Appendix J provides the test requirements and acceptance criteria for preoperational and periodic leak testing of the reactor containment, and of systems and components which penetrate the containment. Exceptions to Appendix J requirements will be reviewed on a case-by-case basis.

Conformance with the requirements of Appendix J constitutes an acceptable basis for satisfying the requirements of the following General Design Criteria applicable to containment leakage rate testing:

(a) General Design Criterion 52, "Capability for Containment Leakage Rate Testing"

General Design Criterion 52 as it relates to the reactor containment and exposed equipment being designed to accommodate the test conditions for the containment integrated leak rate test (up to the containment design pressure).

(b) General Design Criterion 53, "Provisions for Containment Testing and Inspection"

General Design Criterion 53 as it relates to the reactor containment being designed to permit appropriate inspection of important areas (such as penetrations), an appropriate surveillance program, and leak testing at the containment design pressure of penetrations having resilient seals and expansion bellows.

(c) General Design Criterion 54, "Piping System Penetrating Containment"

General Design Criterion 54 as it relates to piping systems penetrating primary reactor containment being designed with a capability to determine if valve leakage is within acceptable limits.

10 CFR Part 100, § 100.11 requires that as an aid in evaluating a proposed nuclear power plant site, an applicant should assume the expected demonstrable leak rate from the containment. Nuclear power plant leak testing experience shows that a design leak rate of 0.1% per day provides adequate margin above typically measured containment leak rates and is compatible with current leak test methods and test acceptance criteria. Therefore, the minimum acceptable design containment leakage rate shall not be less than 0.1% per day.

10 CFR Part 100, § 100.1 addresses factors to be considered when evaluating nuclear power plant sites, and includes the safety features that are engineered into the facility. The secondary containment of dual-type containments, which provide for a controlled, filtered release to the environs of leakage from the

primary reactor containment, is such an engineered safety feature, whose effectiveness must be periodically verified as required by Appendix J in Section IV.B. In so doing, the leakage limit of the secondary containment is acceptable if it is based on the limit used in the analysis of the secondary containment depressurization time. The test should be conducted at each refueling or at intervals not exceeding 18 months. The test limit should be consistent with the limit used for direct leakage in the analysis of the radiological consequences by Accident Evaluation Branch (AEB). Potential bypass leak paths (identified in accordance with Branch Technical Position CSB 6-3, "Determination of Bypass Leakage Paths in Dual Containment Plants") should be locally leak tested in accordance with the requirements of Appendix J.

Appendix J in Section III.A.1 (a) requires that no adjustments be made to the containment prior to the performance of the containment integrated leak rate test (CILRT) so that the containment can be tested in a close to the "as is" condition as practical. Instrumentation lines that penetrate containment, however, are sometimes isolated for the CILRT. To assure that they are included in the test, the following should be done. Leak testing of instrumentation lines that penetrate containment may be done in conjunction with either the local leak rate tests or the containment integrated leak rate test. Instrumentation lines that are not locally leak tested should not be isolated from the containment atmosphere during the performance of the CILRT. The measured leakage rates from instrumentation lines that are locally leak tested should be added to the CILRT result. Provisions should be made to assure that instrumentation lines isolated during the CILRT are restored to their operable status following the test.

Appendix J in Section III.A.1(d) addresses the opening of systems for the containment integrated leak rate test if they are open to the containment atmosphere under post-accident conditions and become an extension of the boundary of the containment. In this regard, leak testing of hydrogen recombiner systems located outside containment should be included in the local leak rate test program. A local leak test should be done at the time of the CILRT and the measured leak rate added to the CILRT result. Alternately, the recombiner system may be open to the containment atmosphere during the performance of the CILRT.

All leakage tests, performed by either pneumatic or hydrostatic means, should have the capability to quantify the leakage rates either explicitly or by a conservative bounding method to satisfy test acceptance criteria in Appendix J.

Appendix J in Section III.C.1 prescribes methods for conducting the containment isolation valve leak rate tests. At the construction permit (CP) stage, the applicant should identify all containment isolation valves that will be locally (Type C) leak tested with the test pressure applied in a direction opposite to that which would occur under accident conditions, and commit to justify at the OL stage, that such testing will result in equivalent or more conservative results.

With regard to the application of Section III.C.1 of Appendix J for leak testing of main steam isolation valves in boiling water reactor plants, a test pressure of less than  $P_a$  and the test acceptance criteria should be justified and included in the plant Technical Specifications.

Hydrostatic testing of containment isolation valves is permissible if the line is not a potential containment atmosphere leak path, and may be found acceptable

if it can be demonstrated in accordance with the requirements of Section III.C of Appendix J, that a liquid inventory is available to maintain a water seal (while assuming the single failure of any active component) during the post-accident period. Limits for liquid leakage should be assigned to these valves based on analysis and included in the plant Technical Specifications.

Leak testing, to assure that containment integrity is restored following the test, vent and drain (TVD) connections that are used to facilitate local leak testing and the performance of the containment integrated leak rate test, should be under administrative control, and should be subject to periodic surveillance, to assure their integrity and verify the effectiveness of administrative controls.

The testing requirements for BWR drywell steam bypass are discussed in SRP Section 6.2.1.1.C.

### III. REVIEW PROCEDURES

At the CP stage, the CSB will review the preliminary design provisions that will permit containment leak testing to be done in accordance with the requirements of Appendix J. In some instances, however, the applicant may not be able to address specific aspects of the leak testing program because of incomplete designs. Under these circumstances the CSB will review design criteria, and other commitments, that will assure compliance with the requirements of Appendix J. In addition, the CSB will review the applicant's rationale for concluding that the requirements of Appendix J will be met.

At the OL stage, the CSB reviews the containment final design and verifies that the containment leak testing program meets the requirements of Appendix J. In addition, the CSB reviews the plant Technical Specifications for completeness and for conformance to Appendix J.

The review of the reactor containment leakage rate test program at the OL stage specifically includes the following:

#### 1. Containment Integrated Leakage Rate Test (Type A Test)

Those systems not vented or drained should be identified and the reason for not venting or draining should be stated. Piping and instrumentation diagrams and process flow drawings are used by the reviewer to confirm that in the vented and drained condition, the isolation valves are exposed to the test air pressure and differential pressure, i.e., the systems are vented and drained both upstream and downstream of the containment isolation valves.

#### 2. Containment Penetration Leakage Rate Test (Type B Test)

All containment penetrations should be listed in the test program. By reference to piping and instrumentation diagrams, the reviewer confirms that all penetrations have been listed. The program should identify any penetration not requiring leakage testing and the reason for not requiring a test should be stated. The reviewer confirms that those penetrations not requiring testing cannot result in leakage to the atmosphere during normal operation or a LOCA.

Test pressures for containment penetrations should be stated in the test program and in the Technical Specifications. The test pressure is acceptable if it is the maximum calculated containment accident pressure.

### 3. Containment Isolation Valve Leakage Rate Test (Type C Test)

All containment isolation valves requiring a Type C test should be listed in the test program. By reference to the piping and instrumentation diagrams, the reviewer confirms that all isolation valves to be tested have been listed.

Test pressures for isolation valve Type C tests should be included in the test program and Technical Specifications.

Special testing procedures for dual-type containments should be identified.

CSB assures that the applicant has provided a leakage testing program and has specified the maximum leakage which may occur from bypass (or dilution) leakage for dual-type containments. Potential leakage paths which bypass the annulus or the auxiliary building areas or may leak directly to atmosphere must be identified. The total amount of containment bypass leakage to the environment must be specified and included in the technical specifications. The reviewer determines that the test provisions are adequate to confirm the bypass leakage specified.

Preoperational and periodic test reports are primarily reviewed by the Office of Inspection and Enforcement.

## IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that his evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

The staff concludes that the containment leak testing program is acceptable and meets the requirements of General Design Criteria 52, 53 and 54; Appendix J to 10 CFR Part 50; and 10 CFR Part 100. This conclusion is based on the following: [The reviewer should discuss each item of the regulations or related set of regulations as indicated.]

1. The applicant has met the requirements of (cite regulation) with respect to (state limits of review in relation to regulation) by (for each item that is applicable to the review state how it was met and why acceptable with respect to the regulation being discussed):
  - a. meeting the regulatory positions in Regulatory Guide(s) \_\_\_\_;
  - b. providing and meeting an alternative method to regulatory positions in Regulatory Guide \_\_\_\_, that the staff has reviewed and found to be acceptable;
  - c. meeting the regulatory position in BTP \_\_\_\_;

- d. using calculational methods for (state what evaluated) that have been previously reviewed by the staff and found acceptable; the staff has reviewed the impact parameters in this case and found them to be suitably conservative or performed independent calculations to verify acceptability of their analysis; and/or
- e. meeting the provisions of (industry standard number and title) that have been reviewed by the staff and determined to be appropriate for this application.

2. Repeat discussion for each regulation cited above.

## V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding NRC staff plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

## VI. REFERENCES

1. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors."
2. 10 CFR Part 50, Appendix A, General Design Criterion 52, "Capability for Containment Leakage Rate Testing."
3. 10 CFR Part 50, Appendix A, General Design Criterion 53, "Provisions for Containment Testing and Inspection."
4. 10 CFR Part 50, Appendix A, General Design Criterion 54, "Systems Penetrating Containment."
5. 10 CFR Part 100, "Reactor Site Criteria."