

MAR 24 1994

MEMORANDUM FOR: John T. Larkins, Executive Director
Advisory Committee on Reactor Safeguards
FROM: C. J. Heltemes, Jr., Deputy Director
for Generic Issues and Rulemaking
Office of Nuclear Regulatory Research
SUBJECT: PERFORMANCE-BASED CONTAINMENT LEAKAGE TEST RULEMAKING

Enclosed for your review is a Commission paper forwarding a proposed rule that amends Appendix J of 10 CFR Part 50 by including an option for performance-based containment leakage testing. This option may be voluntarily adopted by licensees, if they desire to do so, and allows a flexible and new approach to containment testing based on operational experience and the latest technical information and methods.

The rulemaking package does not include the Regulatory Guide and industry guidance document at this time, however, the expected framework of the implementation guidance is discussed. The Regulatory Guide, and the NUMARC guidance document it is expected to endorse, will be provided to you by June 7, 1994. We request ACRS comments at its July 1994 meeting.

The Office of Nuclear Reactor Regulation, and Office of the General Counsel have received this Commission paper for concurrence. Their concurrence is anticipated before April 15, 1994, based on staff discussion.

The staff contact for this rulemaking is Moni Dey (492-3730).

ORIGINAL SIGNED BY

C. J. Heltemes, Jr. Deputy Director
for Generic Issues and Rulemaking
Office of Nuclear Regulatory Research

Enclosure:

1. Commission Paper

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GENERAL PDR

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FOR: The Commissioners

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: PROPOSED REVISION TO 10 CFR PART 50, APPENDIX J,
"CONTAINMENT LEAKAGE TESTING," TO ADOPT PERFORMANCE-ORIENTED
AND RISK-BASED APPROACHES

PURPOSE:

To obtain Commission approval of a proposed revision to Appendix J to 10 CFR Part 50, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," as part of the "Marginal-to-Safety" initiative to allow licensees to adopt performance-oriented and risk-based approaches to containment testing.

SUMMARY:

Within the framework of the "marginal to safety" program, Appendix J is being revised. The proposed rule is performance-oriented and risk-based, and less prescriptive. For example, the frequency of leak rate testing is proposed to be reduced. Licensees will have the option to comply with a new option or continue with the current rule. Increases in the allowable containment leak rate will be addressed in a separate, parallel effort, scheduled for completion by August 1995.

BACKGROUND:

The NRC published in the Federal Register, for comment, a proposed revision to Appendix J on October 29, 1986 (51 FR 39541). The proposed final rule was forwarded to the Commission for approval via SECY-91-348, dated October 25, 1991. Difficulties in complying with the backfit rule (10 CFR 50.109), and knowledge of a separate effort to revise Appendix J through the "marginal-to-safety" initiative, eventually caused the Executive Director for Operations (EDO) to withdraw the revision from further consideration on February 22, 1993; the Commission concurred on March 1, 1993.

Contact: Moni Dey, RES
492-3730

The present rulemaking is part of the program for eliminating requirements that are marginal to safety. The NRC proposed (57 FR 4166) on February 4, 1992, that the existing containment testing rule was a potential candidate for modification to make the regulation less prescriptive and more performance-oriented and risk-based. On the basis of staff analyses of public comments on the proposal (SECY-92-263), the Commission approved and announced (57 FR 55156) its plans to initiate rulemaking for developing a performance-oriented and risk-based regulation for containment testing requirements. The staff informed the Commission of its efforts to develop the framework of performance-based regulation, and the staff's plans to apply proposed procedures (PRA technology and Safety Goals) more comprehensively to the body of regulations in SECY-93-028, dated February 5, 1993. In January 1993, the staff published (58 FR 6196) a general framework for developing performance-oriented and risk-based regulations and, at a public workshop on April 27 and 28, 1993, invited discussion of the framework and specific proposals for modifying containment testing requirements. Industry and public comments on the proposals, and other recommendations and innovative ideas raised at the public workshop, were documented in the proceedings of the workshop.

In SECY-94-____, dated March __, 1994, the staff requested Commission approval of policies, framework and procedures for institutionalizing a continuing program for Regulatory Improvement including activities in the "Marginal-to-Safety" initiative. A plan of action for efforts to modify Appendix J were also provided in the SECY paper. The Commission approved the policies, framework, and procedures in a staff Requirements Memorandum dated March __, 1994. This framework and policies approved by the Commission have guided the proposed revision to Appendix J.

DISCUSSION:

In SECY-94-036, dated February 17, 1994, "Staff Plans for Revising 10 CFR Part 50, Appendix J, "Containment Leakage Testing," and for Handling Exemption Requests," the staff informed the Commission of its efforts to develop a revision to Appendix J including the specific modifications the staff intended to pursue.

The proposed revision is performance based (insofar it is less prescriptive), is based on risk insights, and offers incentives to improve component performance, and allows flexibility in the methods of compliance. The leak testing requirements, especially testing frequency, is based on the past performance of the components being tested. Components that exhibit an acceptable leak rate history may be tested less frequently than is specified in the current Appendix J.

One of the most troublesome aspects of the present Appendix J is the number of exemptions that the staff must process because of the detailed requirements in the regulation. This consumes considerable staff and licensee resources. The proposed revision allows the adoption of an option that is less prescriptive, and contains only performance requirements. This proposed revision is modeled in the format of 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants." The proposed rule itself is succinct and the detailed guidance and directions for implementing the new Appendix J

is contained in a regulatory guide and an industry document endorsed by the regulatory guide. Probabilistic risk analysis, where appropriate, is used to determine the component test frequencies and the most safety-significant components.

Description of Alternatives and Impacts

The proposed rule included in Enclosure 1 would apply to all NRC licensees who operate light water power reactors. The proposed rule would allow licensees the option of continuing to comply with the current Appendix J or to adopt the new performance-based standards.

The staff's analyses and recommendations for the proposed rule are based upon the insight gained through the use of probabilistic risk assessment techniques and the significant data base of practical, hands-on operating experience gained since Appendix J was promulgated in 1973. This operating experience provides hard evidence of the activities necessary to conduct Appendix J testing, and the costs of those activities both in monetary terms and occupational radiation exposure.

The results of the present effort documented in draft NUREG-1493 (Enclosure 7), which are based on NUREG-1150, confirm the previous observations, of insensitivity of population risks from severe reactor accidents to containment leak rates.

The alternatives, and rationale for determining the preferred alternative, have been developed after consideration of many comments already provided to the NRC in response to several notices requesting comments on general policies and framework, and the specific proposed revisions to Appendix J. These comments are highlighted in the Statement of Consideration of the proposed rule (Enclosure 1) and summarized in Enclosure 2.

Current Appendix J Achievements and Costs

The current Appendix J requirements have achieved the regulatory safety goal of GDC Criterion 16 of assuring an essentially leak-tight boundary between the power reactor system and the external environment. Costs associated with complying with current Appendix J requirements are estimated to be \$165,000 for a complete battery of Type B/C tests, and \$1,890,000 for Type A tests. Over the average reactor's remaining lifetime of 20 years, the present value of all remaining leak testing at a five percent discount rate is about \$7 million per reactor. Estimates of the remaining industry-wide costs of implementing current Appendix J requirements range from \$720 to \$1,080 million, approximately 75 percent of which could be averted with a performance-based rule.

Alternatives

Specific alternatives for modifying the current Appendix J were identified by the public in response to the NRC's Federal Register notice (58 FR 6196). Those whose characteristics matched the NRC's established criteria for the marginal to safety program were selected for further review. From these, the following four were selected for detailed analysis and comparison against the

No Action Alternative: (A) increase the allowable containment leak rate, (B) decrease the frequency of leak rate testing, (C) combine Alternatives A and B, and (D) require the use of an on-line containment status monitoring system.

The No Action Alternative

This alternative does not require the NRC to take any action, i.e., the NRC could conclude that the current Appendix J requirements are marginal to safety but do not need to be modified. By allowing requirements with marginal impact on safety, but which impose a significant cost on licensees, to remain in effect is to essentially misallocate a portion of the NRC's and the industry's resources on activities for which there is no commensurate return in safety. The real cost then may be in missed opportunities to focus those resources to areas where the return in terms of added public safety is higher. Estimates of the cost of remaining Appendix J tests range from \$720 to \$1,080 million. Taking no action would forego saving approximately 75 percent of that cost.

Alternative A - Increase Allowable Containment Leak Rate

This alternative defines a new risk-basis and allows utilities the flexibility to request increases in the allowable leak rate from the containment system. Currently, containment leak rates are typically established at 0.1 and 1.0 percent per day of containment volume for PWRs and BWRs, respectively.

The results of the present effort found that population risks from severe reactor accidents are insensitive to containment leak rates. Specific findings include:

- Allowable leakage can be increased approximately two orders of magnitude (100 - 200 fold) with marginal impact on population dose estimates from reactor accidents.
- Calculated population risks are several orders of magnitude below the NRC's Safety Goals for all reactors considered.
- Increases in the allowable leak rate is estimated to have a negligible impact on occupational exposure.

The uncertainties associated with these conclusions due to limitations of PRAs are discussed in the enclosed Technical Supporting Document (Enclosure 7, Draft NUREG-1493). Relaxing the allowable leak rate is estimated to reduce future industry testing costs by \$50 to \$110 million, a ten percent decrease in overall leak-rate testing costs.

Alternative B - Decrease the Frequency of Leak Testing

The second alternative defines a new risk-based regulation by utilizing the performance history of components (containment, penetrations, valves) as the means to justify an increase in the testing interval for Type A, B, and C tests. Currently, three Type A tests are conducted in every ten year period; and Type B (except airlocks, which are tested more frequently) and C tests are conducted on a frequency not to exceed two years.

Reducing the frequency of Type A tests (ILRTs) from the current three per ten years to one per 20 years leads to a marginal impact on risk. Specific findings include:

- The fraction of leakages detected only by ILRTs is small, on the order of a few percent.
- Reducing frequency of ILRT testing from three per ten years to one per 20 years leads to a marginal increase in risk.
- ILRTs also test the strength of the containment structure. No alternative to ILRTs have been identified to provide assurance that the containment structure will withstand pressures during design-basis accidents.
- At a frequency of one test per ten years, industry-wide occupational exposure would be reduced by 0.087 person-sievert (8.7 person-rem) per year. A frequency of one test per 20 years would result in an industry-wide reduction in occupational exposure of 0.11 person-sievert (11 person-rem) per year.

Based on analyses of North Anna and Grand Gulf data, performance-based alternatives to current LLRT methods are feasible with marginal impact on risk. Specific findings include:

- Type B and C tests detect a very large fraction, over 97 percent, of containment leakages.
- Virtually all leakage paths are identified by LLRTs of containment isolation valves (Type C tests).
- Based on the detailed evaluation of the experience of a single 2-unit station, almost no correlation of failures with type of valve or plant service could be found.
- For the 20 years of remaining operations, changing the Type B/C test frequency only is estimated to reduce industry-wide occupational exposure by 0.72 person-sievert (72 person-rem) per year. If 20-year license extension is assumed, the estimate is 0.75 person-sievert (75 person-rem) per year.

Reducing the frequency of ILRTs will reduce future industry testing costs by approximately \$330 to \$660 million if tests are conducted once per ten years versus the current three per ten years. These savings represent about 65 percent of the remaining costs of current Appendix J requirements. The industry-wide cost savings for a frequency of one test per 20 years are estimated to be \$410 million to \$820 million. These savings represent about 80 percent of the remaining costs of current Appendix J requirements. Performance-based LLRT alternatives are estimated to reduce future industry testing costs by \$40 million to \$55 million. These savings represent about five percent of the total remaining costs of Appendix J testing.

Alternative C - Require On-Line Monitoring of Containment

The third alternative considers the use of on-line monitoring systems as an adjunct to current tests. Currently, there is no requirement for OLM systems. This alternative would result in monitoring of containment to detect unintentional breaches of containment integrity. This alternative might be combined with any other alternative.

Studies discussed in draft NUREG-1493, "Performance-Based Containment Leak Test Program," find that, based on operating experience, OLM would not significantly reduce the risk to the public from nuclear plant operation and, thus, cannot be justified solely on risk-based considerations. Specific findings include:

- Continuous monitoring methods exist which appear technically capable of detecting leaks in reactor containments within one day to several weeks. OLM systems are in use or planned in several European countries.
- OLM systems are only capable of detecting leaks in systems that are open to the containment atmosphere during normal operation (approximately ten percent of the mechanical penetrations).
- The technical and administrative objectives of OLM systems and Type A tests are different.
- OLM cannot be considered as a complete replacement for Type A tests since it cannot challenge the structural and leak-tight integrity of the containment system at elevated pressures.
- Analysis of experience history indicates limited need for, and benefit of, OLM in the U.S.

Requiring the use of OLM systems is estimated to increase future industry costs by approximately \$240 to \$400 thousand per reactor.

Conclusion

The staff recommends that, based on the risks and costs evaluated, a combination of Alternatives A and B (allowing for an increase in the leak rate and a decrease in the frequency of testing) is the preferred alternative.

The staff had initially planned to establish a risk-based performance standard for containment tests, i.e., the allowable containment leakage rate, in the performance-oriented rule that would replace the existing Appendix J of 10 CFR 50. A risk-based allowable leakage rate would be based on an evaluation, using PRA, of the sensitivity and significance of containment leakage to risk, and determining an appropriate containment leakage limit commensurate with its significance to total public risk. However, this would entail a major change in policy and restructuring of the current licensing basis, and therefore, the staff plans to develop a modification of the performance standard (allowable leakage level) separate from modifications of testing requirements. The allowable leakage rate will be modified as part of the staff's efforts for revising source terms and updating regulatory guides (R.G.s 1-3 and 1-4) for

calculating doses to the public. The staff plans to provide the Commission with final proposed revisions to documents used for calculating allowable containment leakage rate by June, 1995. The staff recommends the Commission approved the proposed rule (included in Enclosure 1) with the following features:

- General: (1) Make Appendix J less prescriptive and more performance oriented; (2) Move details of Appendix J tests to a regulatory guide as guidance; (3) Endorse approved industry standard on guidance on the conduct of containment tests; (4) Allow voluntary adoption of the new regulation, i.e., current detailed requirements in Appendix J will continue to be acceptable for compliance with the modified rule.
- Leakage Limits: Acknowledge the less risk-significant nature of allowable containment leakage. (Licensees may pursue an increase in allowable leak rate through technical specification modification proposals based upon new and revised NRC regulatory guides, including new severe accident source terms and new information on the reduced risk significance of containment leakage.)
- Type A Test Interval: (1) Based on the limited value of integrated leak-rate tests (ILRTs) in detecting significant leakages from penetrations and isolation valves, revise the objective of the ILRT from one of primarily detecting leakage to one of primarily assuring the integrity of the containment system structure; (2) The guidance document should establish test intervals based on plant-specific and industry-wide data limited to not exceed the interval for testing of pressure vessels in the nuclear steam supply system.
- Type B & C Test Interval: (1) Allow local leak rate test (LLRTs) intervals to be established based on the experience history of each component; (2) Provide quantitative and qualitative criteria for establishing test intervals in a guidance document (encourage the use of Individual Plant Examination [IPE] results).

COORDINATION:

The Office of the General Counsel has no legal objection to this paper.

RECOMMENDATION:

That the Commission:

1. Approve the Notice of Proposed Rulemaking (Enclosure 1) and draft NUREG-1493 (Enclosure 7) for publication.
2. Certify that this rule, if promulgated, will not have a negative economic impact on a substantial number of small entities in order to satisfy requirements of the Regulatory Flexibility Act, 5 U.S.C. 605(b).
3. Note:
 - a. The rulemaking would be published in the Federal Register for a sixty-day public comment period;

- b. A draft regulatory analysis will be available in the Public Document Room (Enclosure 3);
- c. A draft environmental assessment and a finding of no significant impact have been prepared (Enclosure 4);
- d. The Chief Counsel for Advocacy of the Small Business Administration will be notified of the Commission's determination pursuant to the Regulatory Flexibility Act of 1980 (5 U.S.C. 605(b)), that this rule will not have a significant economic effect on a substantial number of small entities.
- e. This proposed rule reduces information collecting requirements that are subject to the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 et seq.). This rule has been submitted to the Office of Management and Budget for review and approval of the paperwork requirements.
- f. A public announcement will be issued (Enclosure 6);
- g. The appropriate Congressional Committees will be informed (Enclosure 5); and
- h. Copies of the Federal Register Notice of proposed rulemaking and the draft NUREG-1493 will be distributed to all Commission power reactor permittees and licensees, and other interested parties.

James M. Taylor
Executive Director
for Operations

Enclosures:

- 1. Federal Register Notice + disk
- 2. Summary of Public Comments
- 3. Draft Regulatory Analysis
- 4. Draft Environmental Assessment
- 5. Draft Congressional Letters
- 6. Draft Public Announcement
- 7. Draft NUREG-1493