UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

OCT 10 1980

NOTE TO: Walter Butler

FROM: David D. Reiff

SUBJECT: NRR USER REQUEST ON REACTOR CONTAINMENT INTEGRATED LEAK-RATE TESTING

Enclosed is Revision 4 of the draft User Request provided for your implementation. Please arrange for processing this through NRR to RES, originating, of course, in your office.

This Revision reflects the decisions reached during the meeting held June 13, 1980, with J. Shapaker, J. Pulsipher and representatives from I&E (H. Wong) MPA, (D. Lurie), SD, (G. Arndt) and follow-up to that meeting. After an endorsement from your office, we plan to issue a RFP for the program. It would be helpful in the task descriptions to state what specific actions we expect the contractor to provide such as analyses, specific correlations of data, assessments and comparison of alternative options and recommendations regarding criteria and rule changes.

Another consideration for your branch is to determine if you want to include the research on containment liner channel box as a part of the leak-test RFP. A copy of this User Request is also provided for you, however, in discussions with J. Shapaker, it appears there are several questions to be resolved regarding this action.

Please let use know who you would designate from your branch for liaison and primary technical participation on this activity.

If you have any questions, please call me on 427-4284.

David D. Reiff

David D. Reiff

Enclosure: as stated

cc w/encl.
J. Richardson, RES
G. Bagchi, RES
Y. Huang, NRR
J. Shapaker, NRR
E. Jordan, IE
J. Pulsipher, NRR
D. Lurie, MPA
G. Arndt, SD

see cc's w/o encl. next page

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cc w/o encl
T. Murley, RES
J. Larkins, RES
L. Shao, RES
R. Kenneally, RES
H. Wong, I&E
S. Brown, NRR
W. Anderson, SD

undated

MEMORANDUM FOR: Thomas E. Murley, Acting Director
Office of Nuclear Regulatory Research

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR A SAFETY RESEARCH PROGRAM ON CONTAINMENT INTEGRATED LEAK-RATE TESTING (CILRT)

We have prepared the enclosed request for a safety research program on Containment Integrated Leak-Rate Testing. This research is to support current activities in connection with revisions being considered for Appendix J of 10CFR50, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors.

As discussed with your staff, research will focus on the suggested program description enclosed with this memorandum. We estimate that the task, as described should take between 12 months to 18 months and will be completed for approximately $150,000.

This work is considered as a follow-on to the experience and information to be derived from the Franklin Institute Research Laboratories (FIRL) technical assistance program to review licensee requested exceptions from Appendix J. We plan to amend this contract to have FIRL report on their interpretations of the problems associated with use of Appendix J and to provide their recommendations and conclusions regarding current philosophy and prepared changes. Consequently, to take advantage of the FIRL experience, we would like this program to begin in the last quarter of FY 1981.

Harold R. Denton, Director

Enclosure: User Request

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cc: L. Shao, RES
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J. Richardson, RES
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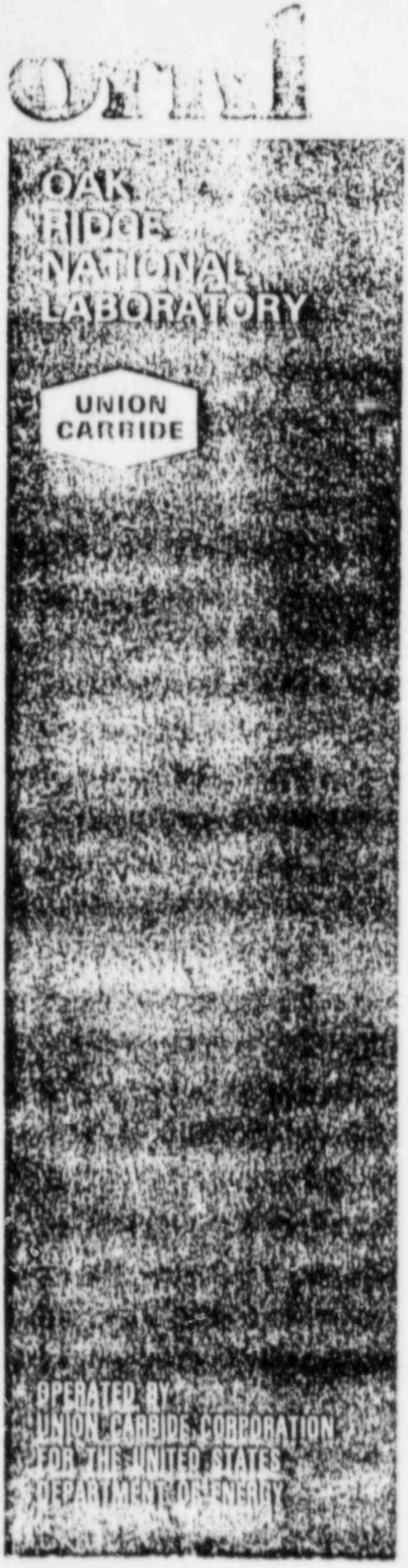
NUREG/CR-3549
ORNL/TM-8909



Evaluation of Containment Leak Rate Testing Criteria

J. R. Dougan

Prepared for the U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Under Interagency Agreement DOE 40-551-75

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December 7, 1982

Mr. Gunter Arndt
Mechanical/Structural Engineering Branch
Division of Engineering Technology
ML 238
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Gunter:

This letter summarizes our progress on the Containment Leak Rate Testing Investigations (Fin. No. B0489) Program for the month of November 1982.

Technical Highlights

An evaluation of the formulation of the leak rate equation proposed by EXTRAN was initiated. The fundamental difference between the EXTRAN equation and the ANSI/ANS equation is in the determination of the temperature term. Both equations provide an approximation so an evaluation was begun to determine if the differences were significant.

Only one set of leak rate data has been used in the evaluation so far, but certain trends are observable. In every case but one the difference between the temperature terms in the two equations was approximately two percent or less. In one case the difference was almost twenty percent, but the temperature terms were so small that the twenty percent difference had a negligible effect on the leak rate. In fact, it seems that the only time a significant difference is likely to occur in the leak rates will be when the leak rates are extremely small (approaching zero). These observations are preliminary and may change as additional data are evaluated.

A search of the Nuclear Safety Information Center (NSIC) computer file has been conducted to identify the License Event Reports (LERs) pertaining to Type A leak rate tests. Copies of the LERs will be obtained soon and reviewed. An additional search of the NSIC computer file will be conducted at a later time to identify LERs pertaining to Type B and C leak rate tests.

Research Request for
A Safety Research Program
on Containment Integrated Leak
Rate Testing (CILRT)

undated

I. INTRODUCTION

Appendix J of 10 CFR 50, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," established the test requirements for verification of integrity of primary reactor containments and the acceptance criteria for such tests. These requirements have been subject to varying interpretation. Consequently, several changes to Appendix J have been under consideration by NRC.

These changes have been identified in the USNRC Memorandum from E. Case to R. Minogue, dated May 24, 1978, Subject: Proposed Changes to Appendix J 10 CFR 50. Some of these changes require extensive review and analysis for resolutions of controversial options. This program is to investigate the merits of some specific rule changes proposed by the May 24, 1978 memorandum and provide recommendations for their resolution.

The specific issues to be addressed include the following:

1. Containment Integrated Leak-Rate Test (CILRT) Pressure
2. CILRT Frequency
3. CILRT Duration
4. Isolation Valve Leak Testing
5. Static Mechanical Barrier Leak Testing
6. Criteria for Individual Component Leak-Rate Limits
7. CILRT Reporting Requirements
8. Supplemental CILRT Verification

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Program Description:

In the conduct of CILRT, it appears that the rules of 10 CFR 50, Appendix J are subject to various enterpretations by the licensees. It is desirable to provide guidance and criteria that encourages consistent test methods for leak testing. In addition, it is practical to have the leak test results reviewed and evaluated on a more consistent and equitable basis than current procedures permit.

The impact of proposed CILRT changes on design, construction and operation of the nuclear power plant is required to provide the basis for licensing actions on existing and new plants. This data base is to support NRC licensing positions in connection with the American National Standard on "Containment System Leakage Testing Requirements."

In conducting the tasks, the vendor is to incorporate the reliability estimates associated with the proposed techniques for measurements of leak rate. Of particular interest are recommendations to have reliability estimates associated with future estimates of leak rate, the accuracy of the leak rate and the condition of containment and its leakage rate (degradation) during the interval between leak tests.

A. Task Descriptions:

(1) Containment Integrated Leak Rate Test (CILRT) Pressure - (Reference Appendix J, III A-2)

Containment tests have been conducted at the design basis accident pressure or at a reduced pressure. At issue is whether reduced pressure testing provides adequate assurance of containment integrity. Difficulties have been encountered in defining the correlation of results at peak pressure

with results at reduced pressure. There is a need to resolve the question of whether to make testing at peak pressure mandatory or to permit reduced pressure testing.

1.1 Review and analyze plant leak-rate data to identify the problems associated with low-pressure testing.

1.2 Review the foreign experience and data as provided by NRC and provide conclusions regarding their experience and philosophy of low-pressure testing.

1.3 Assess validity and methods for extrapolation of low-pressure test results to accident pressure.

1.4 Discuss the advantages and disadvantages of the high- and low-pressure tests and provide recommendations to NRC regarding changes to Appendix J.

2. Containment Integrated Leak-Rate Test Frequency - Appendix J (III.D.1(a))

The frequency of performing containment integrated leak-rate tests is based on the 10-year service period. The beginning of this period is based on the date of commerical operation of the plant. Any delay in the licensing of a plant following the performance of the preoperational CILRT would extend the time interval for the first periodic CILRT. The time interval between successive CILRTs is not specifically stated. Perhaps a CILRT should not have to be performed in conjunction with the 10-year in-service inspection outage. Under consideration is to provide technical support to revise Appendix J to establish a frequency for performing CILRTs without reference to the 10-year service period.

2.1 Review the test experience and recommend acceptable test frequency with technical support.

Need to be more specific to Cont. work scope. There is a lot of work (YSK)

2.2 Evaluate the impact on the test conclusions of the different methods of data analysis and test techniques.

3. Containment Integrated Leak-Rate Test Duration (CILRT)

Provide more guidance for steering contractors. (YSK)

3.1 Provide an analysis for determining acceptable duration of CILRT test.

3.2 Develop (provide) a method of analysis and guidelines for determining acceptable duration

4. Isolation Valve Leak Testing - Appendix J, III.D.2. & III. D.3

4.1 Review the local leak-rate (types B and C) test data and identify those valves requiring above average maintenance for compliance with Appendix J.

Should be plant-specific; varies from plant to plant, can't be done (YSK)
A sticky problem - test by air, supt press, water. (what about H,O seal loss on earthquake)

4.2 Examine the feasibility and practicality of conducting local leak-rate rate (types B and C) tests during plant operation. Appendix J permits Type B (explicit by) and implies Type C tests during operation. Desire continuous maintenance program to be encouraged leak detection/testing during plant operation.

4.3 Explore regulatory criteria and techniques to encourage cont. inservice leak test

5. Static Mechanical Barrier-Leak Testing (III.B.3 & III.C.3

Section III.D. of Appendix J requires that Type B tests (except personnel air-lock tests) be performed during each reactor shutdown for refueling or other convenient intervals but in no case at intervals greater than 2 years. This periodic retest requirement is not practical in view of the large number of local leak-rate tests that have to be performed during a refueling outage or other convenient intervals. Some incentives need to be provided to encourage local leak testing during plant operation. The level of containment safety will be increased by the early identification of excessive leakage in those barriers more susceptible to degradation. ~~Consideration should be given to revise Appendix J to permit Type B testing~~ throughout a plant operating cycle.

Consider deletion

5.1 Review current industrial practices and determine existing controls for individual penetrations and valve leakage.

6. Criteria for Individual Component-Leak Rate Limits - Section III.B.3 & III.C.3

Do we really need Q-ES work here? YSH.

Appendix J regarding individual limits on local leak-rate tests only replaces a limit on the combined leakage for all local leak-rate tests. Under consideration is to allow local leak-rate tests to be conducted throughout a plant operating cycle; in this context, it is appropriate to place individual limits on the leakage from a single penetration or isolation valve. These limits will provide guidance on the need to increase the test frequency and/or institute repairs. Therefore, it is proposed that Appendix J be revised to require licensees to establish individual leakage-rate limits on the measured leakage through components within the scope of the local leak-rate test program. Concern over dominance of one path of leakage symptomatic of larger problem. (YSH)

6.1 Identify acceptance criteria for individual leakage rate, time span or interval for individual test schedule and calculation methods to establish continued leakage.

6.2 Review and identify for the different types of valves, problems which may be peculiar to these; provide recommendations for criteria and/or requirements to facilitate the review of CILRT.

7. Containment Integrated Leak-Rate Testing (CILRT) Reporting Requirements Good.

7.1 Provide recommendations on reporting requirements with respect to format and test results for integrated and local leak-rate tests (V.B)

8. Supplemental CILRT Verification

Appendix J requires that a supplemental leak-rate test be performed to verify the measurements of a containment leak rate. The CILRT test is repeated after completion of the initial CILRT by introducing a known

leak rate from the containment by direct leakage through an orifice to atmosphere. The new measurements of leakage from containment should not vary more than 25% from the initial test leakage rate for adequate verification. At issue is whether such a test is useful and whether the criteria are adequate.

8.1 Reassess acceptable supplemental CILRT verification test and test acceptance criteria and provide recommendations for impact of deletion of this test.

RESULTS

The tasks outlined in this program should provide recommendations for technically defensible criteria and changes for 10 CFR 50 Appendix J. In addition, they should result in arriving at an understanding of the impact of the proposed CILRT changes or design, construction, and operation of the nuclear power plant. Also, licensing actions on existing and new plants will be supported by the data base developed. The data base also will support the NRC position on the America National Standard on "Containments System Leakage Testing Requirements."

Research Request for
A Safety Research Program
on Containment Liner Channel Boxes

I. INTRODUCTION

Appendix J of 10CFR 50, Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors, established the test requirements for verification of leak tight integrity of the primary reactor containment.

As a construction convenience, weld channels are placed around the containment liner weld, usually inside the containment, to provide for leak testing of the containment liner welds. These channel boxes are not designed or constructed to the criteria used for the containment shell or liner. Several problems have been associated with their use, and their continued use is in question. If the channel box is vented (or left open), then there is a potential for moisture collection which could lead to local corrosion in the area. Degradation of the weld and liner may occur and the reliability of the containment is challenged. If the channel box is not vented and a LOCA occurs, large forces are introduced to the area. The potential exists for the liner to distort locally in the area of the channel box. This could fail the channel box and then could present a challenge to the liner weld. In addition to these considerations, the weld channel box also permits future leak tests of the weld, if such a test becomes desirable. On the other hand, the channel box obscures the weld, thereby, impeding ultrasonic or other testing of the weld.

II. PROGRAM DESCRIPTION

The objective of this program is to evaluate the methods for assuring containment liner weld integrity. Its purpose is to resolve the questions on use and disposition of the channel box. With regard to existing plants, the question is whether to seal off the channel box or to have it open to the atmosphere. With regard to new plants, there is a need to decide whether or not to permit the continued use of channel boxes.

A. Task Description

scoping study will be conducted to evaluate the contributions of weld channel box to the overall problems of maintaining containment integrity. The desirability of using these boxes will be examined in concert with investigation of alternative techniques. Since many existing plants use these boxes in a number of variations of design, surveillance methods for weld integrity of existing installations will be explored.

A typical design will be analyzed. The construction, materials and test methods will be studied along with alternative methods (such as acoustic emission) to check the liner weld integrity. Among the approaches to be included are temporary fixtures along with modification to existing channel boxes.

B. Projected Results

The results will provide analyses, experience and recommendations for establishing guidelines, technical specifications, and branch technical positions. An optimum solution with respect to either sealing the box closed or leaving them open would be defined. In addition, if channel boxes are

retained the results will impact the future design and qualification for more effective use of channel boxes.