OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX Y
OAK RIDGE, TENNESSEE 37830

May 4, 1983

Mr. Gunter Arndt
Mechanical-Structural Engineering Branch
Division of Engineering Technology
NL 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 April 1983.

Technical Highlights

The proposed revision to Appendix J has been reviewed. The need for a revision has been growing for many years, as has been evidenced by the large number of exemption requests, changes in testing procedures, and questions on interpretation. The original Appendix J, issued in 1973, contained several specific requirements for test parameters, such as the stabilization period and the test duration. The inclusion of such requirements severely inhibited the ability of the Appendix to be adaptable to changes in leak rate technology. In general, the Appendix should specify the items to be tested, the frequency of the tests, the acceptability criterion for the tests, procedures for handling failed tests, and the process for reporting the results. An industry-generated standard (ANSI/ANS-56.8-1981) is available to define the various technicalities of the test methods and this document should be referenced in the Appendix. Any changes or additional requirements to the ANSI standard would be dealt with through the use of a Regulatory Guide. In this manner, Appendix J would be insulated against the technological changes inherent in any field of testing. Thus, any revisions necessitated by technological change would be handled through a revision to the Regulatory Guide and not Appendix J, a much less stringent process. The proposed revision to Appendix J that was reviewed during this reporting period has been found to be satisfactory with regard to these points.

Several aspects of the proposed revision to Appendix J have been reviewed in light of the reported test results, exemption requests, and interviews. These aspects include the Type A test pressure, Type A test frequency, Type A test duration, verification testing, local leak testing, and the reporting requirements. Valve test temperatures and the waiting period following valve closure are two additional aspects that have not been reviewed as yet.

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The issue of the Type A test pressure concerns the use of a reduced test pressure (currently allowed under Appendix J) of at least one-half of the full test pressure. The proposed revision to Appendix J allows only the full pressure test. The advantages of conducting a reduced pressure test versus a full pressure test are that it is less hazardous due to the lower pressure, it has less risk of component damage, and it generally should be cheaper. The disadvantages of a reduced pressure test are that the desired leak rate is not directly measured and the extrapolation factors used to determine the full pressure leak rate may be erroneous due to changes in the leak paths and the flow characteristics.

A study of the available test reports revealed 23 reduced pressure tests, 17 of which were part of the preoperational tests conducted with full pressure tests to develop the required correlation. Therefore reduced pressure tests were used only six times to determine the leak rate. Of the 17 plants which conducted reduced pressure tests, five of the plants measured higher leakages at the reduced pressure than at full pressure. Two of these five plants measured significantly higher leakages at the reduced pressure, and one plant recorded a negative leakage at the full pressure. Only three of the plants indicated a continued use of the reduced pressure test.

Of the 12 plants that measured higher leakages at the higher pressure, only two continued to use the reduced pressure tests to determine the leak rate. One plant failed its verification check, but no reasons were apparent as to why the remaining nine plants chose to discontinue the reduced pressure tests. Most likely the difficulty in validating the extrapolation equations, the potential for changing leak paths and characteristics over time (which would invalidate previously determined correlations) and the dissatisfaction of the regulatory agencies with reduced pressure testing prompted the utilities to use the full pressure tests. Recognizing that the difficulties involved in defining a valid correlation and that the potential for error over time outweigh the economical benefits and given the relative apathy of the utilities with regard to this matter, the case for reduced pressure testing appears to be waning. Thus it appears justifiable and logical to eliminate reduced pressure testing as an alternative means of determining the leak rate.

Concerning the frequency of Type A tests, the available information indicates that the utilities, almost without exception, have conducted the tests every three to four years. Deviations from this pattern have been noted but are not considered critical. This frequency is in accordance with Appendix J as currently written and is also in accordance with the proposed revision to Appendix J. The frequency of three to four years seems to coincide well with the normal plant shutdown routine so it should be maintained. An increase in the frequency of the tests in the case of a failed test is also logical and justifiable and both the current and proposed versions of Appendix J have this requirement. An additional requirement in the proposed revision to Appendix J is that if a Type A test fails solely due to a specifically identified (and subsequently corrected) Type B or C tested leak path, then the increase in testing frequency will apply only to the Type B or C test schedule, not the

Type A. This requirement penalizes the Type B or C tests, not the Type A test, since the Type B or C tested leak path caused the failure. This requirement is necessary and probably will be welcomed by the utilities due to the economics involved.

The duration of Type A tests has been the subject of much discussion since these tests were initiated. In the early days of containment testing, leak rate tests were conducted from a minimum of 24 hours to a maximum of several days. The reasoning behind the minimum of 24 hours is not completely clear, although the general consensus is that the 24 hour minimum time period eliminated any diurnal effects on the early steel containments. In any event, the minimum time period of 24 hours was adopted and continues to form the fundamental approach of the Nuclear Regulatory Commission. However, there does not appear to be technical justification for the minimum test period of 24 hours. In fact, several industry sources have shown that successful CILRTs can be conducted in much less time. The NRC has recognized this fact and has approved CILRTs of less than 24 hours. But some utilities still feel constrained to use the 24 hour test due to their Technical Specifications. And although criteria for determing the duration of a CILRT have been published, no specific criteria have been agreed upon as final.

The proposed revision to Appendix J removes the stigma of a 24 hour test duration. The duration of the test should be dependent on the behavior of the recorded data and not an arbitrary time period. The new test duration criteria will be best specified in an industry-generated standard or a Regulatory Guide. The new definition of test duration probably will incorporate requirements for a minimum number of data points and a minimum time duration. The measured leakage rate probably will be required to meet some quantitative limits on stability for a specified length of time before the test may be concluded. Additional criteria may be factored in to provide a test duration such that a high probability will exist for the successful completion of the verification test. Additional work is required in determining the quantitative limits on the leak rate stability and the minimum time duration.

The requirements for verification testing remain unchanged from the current Appendix J to the proposed revision of Appendix J. Verification testing represents one means of checking the validity of the information obtained during the Type A test. A verification test should not be expected to provide added confidence in the accuracy of the measured leak rate. A verification test only indicates the ability of the measurement system (pressure and temperature sensors, etc) to approximately reproduce earlier results, including any inherent errors. This type of test verifies the system by which a result is obtained but does not necessarily verify the result. The requirement that the difference between the results of the Type A test and the results of the verification test be less than one-fourth of the maximum allowable leakage per 24 hours is adequate for this purpose.

Local leak tests (Type B and C) represent perhaps the most important aspect of leak testing. For containments which were found to have leak rates higher than the allowable, in every case but one the leakage was through a Type B or C tested leak path. The one exception involved holes inadvertently drilled through the liner. Because practically all Type A

test leakage problems are caused by Type B and C tested leak paths, more stringent requirements on the Type B and C test programs should lead to better Type A tests. One method of tightening the requirements on Type B and C tests is by increasing the frequency of the tests based on the failure rate. However the failure rate in the past has been dependent on all leak paths taken as an aggregate. An extreme leak path could be covered up by other paths that did not leak much so that the aggregate was acceptable. Specifying allowable leak rates for all components would alleviate this problem. And since most reported Type B and C test results are the "as-left" results, it would also be beneficial to require the "as-found" leakage measurements to be reported as well. Thus trouble spots could more easily be recognized and corrective action taken.

The requirements for reporting the results of the leak rate tests should include the allowable leak rate, the measured leak rate (both "as-found" and "as-left") the verification test results, the results of the Type B and C tests, and a chronology of events during the Type A test. Also, a description of the instrumentation plus location diagrams, a description of the test methodology and the recorded data,preferably both tabulated and graphed should be included. This sort of documentation would enable the Nuclear Regulatory Commission to make a better assessment of a plant's leak testing program. Potential problem areas can be seen more readily in this manner and proper corrective measures taken.

Review of the test temperature for valves and the waiting period following the valve closure will be accomplished during the next reporting period, and work will continue an the comparison of the proposed revision to Appendix J and ANSI/ANS-56.8-1981.

Expenditures

	Oct.	Nov.	Dec.	Jan.	Feb.	March	April
Expenditure ($K)	7.2	8.9	7.8	8.9	9.2	9.4	9.4*
Cumulative ($K)**	14.2	23.1	30.9	39.8	49.0	58.4	67.8

* Estimated
** Program Total

Sincerely,

D. J. Naus

DJN:ege

cc: J. R. Dougan

ROUTING AND TRANSMITTAL SLIP

Date 3/5/85

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. J Shapaker J Huang		
2. D Kirkpatrick D Lurie		
3. W. Rekito H. Whitener		
4. F. Maura J. Tapia		
5. A. D'Angelo		

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As Requested	For Correction	Prepare Reply
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Comment	Investigate	Signature
Coordination	Justify	

REMARKS

F.Y.I.

If you have any comments, let me know, and I will pass them on to Jim Dougan.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)

G. Arndt, RES

Room No.—Bldg. 238 NL

Phone No. 35860

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File Note:

April 22, 1983 Arndt call to Dougan

1. Status of contract: Although not apparent from reports submitted so far, ORNL is easily on schedule & on budget. Judgements are considered possible on all questions, except not yet on: (#7) Test temp for values, (#8) valve waiting period before testing. These are considered resolvable. The ANS meeting paper and Mr. Reytblatt have consumed more ORNL time than was realized, but have not yet jeopardized the project schedule or budget. (Naus?)

2. Reytblatt subcontract: Mr Reytblatt sent letter requesting completion of contract report. Copy sent to me (received later in day).

ROUTING AND TRANSMITTAL SLIP

Date: 5/10/83

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. J. Shepaker J. Hwang		
2. D. Kirkpatrick D. Lurie		
3. W. Rekib H. Whitener		
4. F. Mauro J. Tapia		
5. A. D'Angelo		

Action	File	Note and Return
Approval	For Clearance	Per Conversation
As Requested	For Correction	Prepare Reply
Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

REMARKS

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FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Gunter Arndt, RES	238 NL
	Phone No. 35860

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* GPO : 1981 O - 361-529 (143)

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