

**Responses to NRC Requests for Information on
Type C Containment Isolation Valve
Leak-tight Performance
March 28, 2011**

This document addresses the December 3, 2009 NRC request for additional information (RAI). In addition, in response to an NRC email of September 30, 2010 documenting a conference call of September 29, 2010, this document also includes references to RG-1.163, DG-1220, and the Standard Technical Specifications as applicable to the local leak rate testing (LLRT) "grace period" for extension of Type C testing intervals. Responses made to comments made during a conference call conducted on December 15, 2010 are also included.

Attached to this document are (1) EPRI Report No. 1022599, "Type C Containment Isolation Valve Performance", January 2011 and (2) NEI 94-01, Revision 3 (a mark-up copy of NEI 94-01 R2A).

Request for Additional Information (RAI)

The December 2009 RAI concludes with the following paragraphs:

"Based on the above, the NRC staff's view is that tests are not supposed to be scheduled automatically using the interval plus grace period to routinely stretch the interval to the next refueling outage after the sixty months (5 years) allowed interval. The NEI appears to be interpreting that the grace period is a permanent interval extension to allow plants on a 24-month cycle to test every third refuel outage. The NRC staff disagrees with this interpretation. As stated clearly in the *Federal Register*, the NRC is open to submittals from licensees as more performance-based data is available.

In the letter dated September 2, 2009, the NEI provided performance-based data which the NRC staff believes is inadequate to conclude that Type C component performance has improved or sustained. This letter states that based on past NEI and Appendix J Owners Group surveys, the penetration leakages did not result in violation of combined penetration leakage limit of 0.6La. The NRC staff disagrees in that being within the leakage limit of 0.6La does not necessarily indicate that Type C leakage performance of the valves has improved or maintained, when compared to their performance before and during the early stages of Option B implementation.

- Please submit such data coupled with a technical basis to justify your request.
- Also, provide a discussion on the net benefits to the industry based on risk impact and reduced testing."

RAI Response:

Introduction and Summary

The basic issue that is being addressed in the RAI and in this response is the 15-month allowable extension contained in Section 10.1 of NEI 94-01 for scheduling LLRTs of Type C containment isolation valves on extended intervals. The Final Rule¹ for 10 CFR Part 50, Appendix J, Option B (1995) allowed a 25% (15-month "grace period") margin in testing frequency requirements for intervals of 60 months. As stated above in the RAI, "...The NRC staff's view is that tests are not supposed to be scheduled automatically using the interval plus grace period to routinely stretch the interval to the next refueling outage after the sixty month (5 years) allowed interval". This position was incorporated in Revision 2A of NEI 94-01 (Nov. 2008). Industry objected to it because it limited extended testing intervals for plants on two-year fuel cycles to less than 60 months (two fuel cycles) instead of the previously used 75 (60+15) month extended intervals associated with three fuel cycle outages. Moreover, the aforementioned Final Rule also states:

"In establishing the 5-year test interval for LLRTs, the NRC has designed a cautious, evolutionary approach as data are compiled to minimize the uncertainty now believed to exist with respect to LLRT data. The NRC's judgment, based on risk assessment and deterministic analysis, continues to be that the limited database on unquantified leakages and common mode and repetitive failures introduces significant uncertainties into the probabilistic risk analysis. The NRC will be open to submittals from licensees as more performance-based data are developed."

In order to reduce the uncertainty and thereby allow for increasing the allowable extended interval, LLRT leaktight performance data was obtained from industry which validated the risk impact assessment of EPRI TR-104285, "Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals", August 1994. It is believed that this validated assessment justifies increasing allowable extended LLRT intervals to the 120 months specified in NEI 94-01, Revision 0. It is requested that the allowable extended interval for Type C LLRTs be increased only to 75 months, to be conservative (also as a "cautious evolutionary approach"), with a permissible extension (for non-routine emergent conditions) of nine months (84 months total). Increasing the allowable extended interval to 75 months will obviate any need for plants on 24-month fuel cycles to routinely employ a permissible extension period. A marked-up copy of NEI 94-01R2A with changes to the allowable extended interval from 60 months to 75 months is attached. It is intended that this guideline be reissued as NEI 94-01Revision 3 upon approval of this request. Consideration may be given to increasing the allowable extended interval to 120 months in the future.

¹ Federal Register September 26, 1995, Volume 60, No. 186, Page 49502

Data

Data collected in 2010 covering the period of 1996-2010 for leak-tight performance of Type C containment isolation valves on extended intervals is presented in EPRI report No. 1022599, "Type C Containment Isolation Valve Performance", January 2011 attachment (1) to this document. This report concludes that the leak-tight performance of Type C containment isolation valves tested on extended intervals after 1995 is significantly better than the leak-tight performance of the general population of Type C valves tested before 1995. These pre-1995 local leak rate tests were conducted prior to the implementation of Appendix J, Option B and NEI 94-01. The failure rate² for valves tested on extended intervals (after implementation of NEI 94-01 in 1995) was about an order of magnitude less than that reported in EPRI TR-104285 and in NUREG-1493 for the general population of valves tested before the 1995 time frame. Specifically, since 1995, 148 of the 2055 extended interval tested valves exhibited leakage above the plant-specified administrative limits ("failures"). Failure rates were determined for each of the 26 reporting units, and the average failure rate of all 2055 valves was determined to be $5.5E-3$ failures/valve-year or $6.3E-7$ failures/valve-hr. Performance of valves in two plants studied in NUREG-1493 before 1995 indicated failure rates of $5E-2$ /yr ($5.7E-6$ /hr) and $8.6E-2$ /yr ($9.8E-6$ /hr), respectively. Estimated failure rates of valves in the EPRI report were $8.8E-2$ /yr ($1E-5$ /hr) for check, globe and butterfly valves.

Technical/Risk Basis

As referred to in NEI 94-01, EPRI TR-104285 provided a risk impact assessment of alternative testing intervals for both Integrated Leak Rate Tests (ILRT) and Local Leak Rate Tests (LLRT). Risk involved in conducting Type C LLRTs on extended intervals (using population dose as the metric) was determined using valve leakage performance data obtained from industry by the Nuclear Energy Institute (NEI). This pre-1995 data was very conservatively applied in the risk impact assessment by assuming that the leakage magnitude for a penetration would be that associated with the valve in the penetration that exceeded its administrative limit. As stated previously, the recent (post-1995) failure rate data indicates that the failure rate of Type C valves tested on extended intervals was significantly less than the failure rate for the general population of Type C valves tested pre-1995. The recent data also indicates that this conservative leakage magnitude is only appropriate for the 4.7% of valve failures involving redundant valves in penetrations. It is recognized that the valve-specific performance between these two data collection periods is really not comparable. However, the application of this recent data to the risk impact assessment of EPRI TR-104285 is very appropriate insofar as the underlying objective is to assess the risk involved with testing only those valves that qualify for testing on extended intervals in accordance with NEI 94-01. Therefore, this 1994 risk impact assessment remains conservative and valid.

² A failure is defined as a valve exceeding its administrative leakage limit as defined in Section 10.2 of NEI 94-01.

Following is a tabulation of risk impact due to Type C testing for various extended Type C testing intervals, from the EPRI risk impact assessment:

Table 4, Risk Impact of Type C LLRT Surveillance Intervals

Interval >	24 months – base interval	48 months - extended	60 months - extended	72 months - extended	75* months extended	84* months extended	120 months - extended
PWR Type C dose (1)	4.9E-3	8.8E-3	1.0E-2	1.2E-2	1.22 E-2	1.3E-2	1.6E-2
PWR Type C dose, % of Total (2)	0.0223%	0.04%	0.045%	0.0545%	0.0555%	0.0591%	0.0727%
PWR dose increase, % of total	0	0.0177	0.0227	0.0322	0.0332	0.0368	0.051
BWR Type C dose (1)	4.5E-5	1.1E-4	1.8E-4	2.3E-4	2.48E-4	2.82E-4	5.0E-4
BWR Type C dose, % of Total (2)	0.00231%	0.00564%	0.00923%	0.0118%	0.0127%	0.0145%	0.0256%
BWR dose increase, % of total	0	0.00333	0.00692	0.0097	0.00949	0.0122	0.0233

* Values interpolated from original report table

(1) Dose is quantified in units of person-rem/yr

(2) Total dose represents total integrated risk from all accidents, testing, etc. and is dominated by severe accident phenomena. Risk impact of testing is a small fraction of this. The total dose for representative plants was determined to be about 22 person-rem/year for PWRs and about 1.95 person-rem/year for BWRs.

Inspection of the table indicates that the risk impact associated with restoring (increasing) the nominal Type C extended testing interval grace from 60 months to 75 months with a permissible

extension to 84 months is extremely small, less than 0.014% of the total dose for PWRs and less than 0.0053% for BWRs.

It had been previously requested that the 15-month allowable extension period be reinstated. However, it is recognized that the routine use of permissible extension periods ("grace periods") is not supported by the NRC Staff. Insofar as a 120-month Type C LLRT interval is justified based on risk impact, it is recommended that the current 60-month allowable extended testing interval for Type C LLRTS be increased to 75 months with a permissible extension period of 9 months (total of 84 months) for non-routine emergent conditions.

Benefits

The benefits of increasing the allowable extended testing interval for Type C LLRTS by 15 months from 60 months to 75 months will result in a reduction in the amount of testing required, with commensurate reductions in radiation exposure, personnel time in lining up for tests, draining systems, conducting tests, and the risk involved in performing such testing. As previously noted, this is of particular importance for plants on 24-month fuel cycles. Type C tests on extended intervals could then be performed every third refueling cycle, instead of every other fuel cycle as is presently required to not exceed the 60-month allowable extended interval.

Consideration of relevant sections of other documents:

Regulatory Guide 1.163

Regulatory Position 2:

Section 11.3.2, "Programmatic Controls," of NEI 94-01 provides guidance for licensee selection of an extended interval greater than 60 months or 3 refueling cycles for a Type B or Type C tested component. Because of uncertainties (particularly unquantified leakage rates for test failures, repetitive/common mode failures, and aging effects) in historical Type C component performance data, and because of the indeterminate time period of three refueling cycles and insufficient precision of programmatic controls described in Section 11.3.2 to address these uncertainties, the guidance provided in Section 11.3.2 for selecting extended test intervals greater than 60 months for Type C tested components is not presently endorsed by the NRC staff. Further, the interval for Type C tests for main steam and feedwater isolation valves in BWRs, and containment purge and vent valves in PWRs and BWRs, should be limited to 30 months as specified in Section 3.3.4 of ANSI/ANS-56.8-1994, with consideration given to operating experience and safety significance.

Response: The 30-month limitation on leakage testing intervals for main steam and feedwater isolation valves and containment purge and vent valves has been incorporated in NEI 94-01R2A. Reinstatement of Type C LLRT nominal surveillance intervals to at least 75 months vs. the aforementioned 60 months is the objective of this response.

Draft Regulatory Guide DG-1220:

NEI TR 94-01, Revision 2-A, provides methods that the NRC staff considers acceptable for complying with the provisions of Option B in Appendix J to 10 CFR Part 50, subject to the limitations and conditions provided in Section 4.0 of the NRC FSER and the following regulatory positions:

Response: Industry is not in agreement with the maximum extended interval of 60 months and the 9-month permissible extension change contained in Section 10.1 of NEI 94-01R2A.

Standard Technical Specifications:

Surveillance programs for Type C valve LLRTs are now contained in a licensee's Containment Leak Rate Testing Program, described in Section 5.5.16 of the Standard Technical Specifications.

Regarding extended intervals, the following apply:

SR 3.0.2

The specified Frequency for each SR is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met.

For Frequencies specified as "once," the above interval extension does not apply.

If a Completion Time requires periodic performance on a "once per . . ." basis, the above Frequency extension applies to each performance after the initial performance.

Exceptions to this Specification are stated in the individual Specifications

SR 3.0.2 Bases

SR 3.0.2 establishes the requirements for meeting the specified Frequency for Surveillances and any Required Action with a Completion Time that requires the periodic performance of the Required Action on a "once per . . ." interval.

SR 3.0.2 permits a 25% extension of the interval specified in the Frequency. This extension facilitates Surveillance scheduling and considers plant operating conditions that may not be suitable for conducting the Surveillance (e.g., transient conditions or other ongoing Surveillance or maintenance activities). The 25% extension does not significantly degrade the reliability that results from performing the Surveillance at its specified Frequency.

This is based on the recognition that the most probable result of any particular Surveillance being performed is the verification of conformance with the SRs. The exceptions to SR 3.0.2 are those

Surveillances for which the 25% extension of the interval specified in the Frequency does not apply. These exceptions are stated in the individual Specifications. The requirements of regulations take precedence over the TS. An example of where SR 3.0.2 does not apply is in the Containment Leakage Rate Testing Program. This program establishes testing requirements and Frequencies in accordance with the requirements of regulations. The TS cannot in and of themselves extend a test interval specified in the regulations. As stated in SR 3.0.2, the 25% extension also does not apply to the initial portion of a periodic Completion Time that requires performance on a "once per ..." basis. The 25% extension applies to each performance after the initial performance. The initial performance of the Required Action, whether it is a particular Surveillance or some other remedial action, is considered a single action with a single Completion Time. One reason for not allowing the 25% extension to this Completion Time is that such an action usually verifies that no loss of function has occurred by checking the status of redundant or diverse components or accomplishes the function of the inoperable equipment in an alternative manner.

The provisions of SR 3.0.2 are not intended to be used repeatedly merely as an operational convenience to extend Surveillance intervals (other than those consistent with refueling intervals) or periodic Completion Time intervals beyond those specified.

Response: When Regulatory Guide 1.163 was issued in 1995, NRC permitted extension of LLRT intervals of up to 15 months to accommodate plants on 24-month fuel cycles.

The RAI states:

"Based on the above, the NRC staff's view is that tests are not supposed to be scheduled automatically using the interval plus grace period to routinely stretch the interval to the next refueling outage after the sixty months (5 years) allowed interval. The NEI appears to be interpreting that the grace period is a permanent interval extension to allow plants on a 24-month cycle to test every third refuel outage. The NRC staff disagrees with this interpretation."

As implied from the above, the routine use of a 15-month extension is not supported by the NRC Staff. Therefore, a restoration of the allowable extension intervals for Type C LLRTs to 75 months together with an allowable extension period of 9 months is requested.

Responses to comments made during the December 15, 2010 conference call between NRC, NEI, and EPRI:

No.	NRC Question/Comment	Response	Comments
1	Does EPRI expect to change any of the information in its interim report?	Some changes were made to the report in response to item 5 below. The impact on the results was not significant. If more plant data is received, additional changes will be made	EPRI will encourage industry to submit more testing data. This is not expected in the present time frame for formally responding to the RAI.
2	Regarding the interval extension, is industry asking for a 15-month grace period, or a 75 month interval?	Industry is requesting a increase of the Type C extended testing interval from the 60 months presently in NEI 94-01R2A and RegGuide1.163 to 75 months with a 9-month permissible contingency extension not to be used routinely.	NUREG-1493 and EPRI TR-104285 both supported LLRT extended intervals of up to 120 months. NEI 94-01 (rev. 0) stated 120 months as the maximum extended interval.
3	It may be possible for some plants to violate the 0.6 La criterion for Type B&C tests if a plant's admin limits are selected in a manner that routinely challenges the 0.6 La limit.	NEI 94-01R2A Section 10.2 presently requires admin limits be established and maintained in accordance with ANSI/ANS-56.8-2002 Sections 6.5 and 6.5.1. These requirements, including those for periodic review (e.g., maintenance) are considered to provide sufficient guidance and assurance for compliance.	The reported instances of exceeding administrative limits (failures) on redundant valves were only 4.7% of the reported failures. This is a very small number; as is the pathway leakage rate, and in no case was the 0.6 La criterion exceeded.

No.	NRC Question / Comment	Response	Comments
4	Is the post-1996 data directly comparable with the pre-1995 data?	No. Information provided in EPRI TR-104285 and NUREG-1493 does not support direct plant-to-plant comparison of specific valve performance with present data. A major goal of the post-1996 data collection conducted in 2010 was to address uncertainties referred to in RG1.163 regarding leak-tight performance. The leak-tight performance of valves being tested on extended intervals has been shown to be significantly better than that for the general population of valves used in the 1994 risk impact assessments.	
5	The Plant Data Summary of the Interim Report indicates that plants with only one tested valve or for a shorter testing duration have failure data weighted the same as plants with many valves.	The failure rate weighting calculation has been changed to reflect the total number of valves. The time period that testing has been performed under NEI-94-01 has been already accounted for in the failure rate calculation.	
6	Is data from 29 plants representative of the entire US fleet?	Yes	
7	NRC suggested routine collection of valve leakage performance data from industry. Presently, the only time containment leakage testing information is reported to NRC is if there is a reportable occurrence.	NEI 94-01R2a, Section 12.1 requires owner reporting of test results in accordance with applicable requirements of ANSI/ANS-56.8-2002. These reports include both ILRT reports and post outage reports and are required to be maintained by the plant operator. This information is maintained at plants and is available for inspection.	Data collection feasibility is being studied and considered.

No.	NRC Question/Comment	Response	Comments
8	Concern is expressed about possible primary system leakage heating cooling water in BWR plants.	Primary system leakage monitoring is not within the scope of containment isolation valve leakage testing.	
9	NRC position is that 60 months is the maximum extended interval for testing Type C valves. Increasing this interval will require justification.	EPRI TR-104285 (and NUREG-1493) justified extended LLRT intervals of up to 120 months. The recently collected data shows significantly better performance of valves tested on extended intervals than that assumed in the risk impact assessments that were the basis for 120 month extended intervals. The RAI response addresses the incremental risk in extending the intervals from 60 to 75 and 84 (75+9month contingency) months.	
10	The RAI response should contain language that indicates a revision to NEI-94-01 (NEI-94-01B) will refer to 75 months as the normal maximum Type C LLRT interval with a permissible 9 month extension for contingencies, not to be used routinely.	A mark-up of NEI 94-01R2A with appropriate changes has been provided.	