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NUCLEAR ENERGY INSTITUTE

INDUSTRY GUIDELINE FOR

IMPLEMENTING PERFORMANCE-BASED

OPTION OF 10 CFR PART 50, APPENDIX J

December 8, 2005

Deleted: July 26, 1995

**REVISION 1 TO INDUSTRY GUIDELINE FOR
IMPLEMENTING PERFORMANCE-BASED
OPTION OF 10 CFR PART 50, APPENDIX J**

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ACKNOWLEDGMENTS

This guidance document, Industry Guideline for Implementing Performance-Based Option of 10 CFR 50, Appendix J, NEI 94-01, Revision 1, was developed by the Nuclear Energy Institute (NEI) Type A Integrated Leakage Rate Test Interval Extension Task Force. We appreciate the direct participation of the many licensees who contributed to the development of the guideline and the participation of the balance of the industry that reviewed and submitted comments to improve the document clarity and consistency. The dedicated and timely effort of the many Task Force participants, including their management's support of the effort, is greatly appreciated.

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NEI also wishes to express its appreciation to the Electric Power Research Institute (EPRI) who devoted considerable time and resources to the development of this revised industry Appendix J guideline.

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FOREWORD

The purpose of this guidance is to assist licensees in the implementation of Option B to 10 CFR 50, Appendix J, “Leakage Rate Testing of Containment of Light Water Cooled Nuclear Power Plants,” and in extending Type A Integrated Leak Rate Test (ILRT) surveillance intervals beyond ten years.

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In response to NRC data gathering inquiries, the industry collected, evaluated, and provided summary data that supported the NRC’s independent data analysis of NUREG-1493. To support this 2005 revision, many licensees responded to an NEI request and provided pertinent leakage rate testing experience information covering the period from 1995 to 2005.

Deleted: Licensees can minimize the redundant and overlapping engineering and evaluation efforts associated with these related regulatory requirements by internal coordination. NEI will continue to monitor these and other activities to provide focus on opportunities for safety improvement and cost avoidance.¶

EXECUTIVE SUMMARY

This document, NEI-94-01, revision 1, describes an acceptable approach for implementing the optional performance-based requirements of Option B to 10 CFR 50, Appendix J: includes provisions for extending Type A ILRT intervals to up to fifteen years and incorporates the regulatory positions stated in Regulatory Guide 1.163 (September 1995). It delineates a performance-based approach for determining Type A, Type B, and Type C containment leakage rate surveillance testing frequencies. Justification of extending test intervals is based on the performance history and risk insights.

This guideline discusses the performance factors that licensees must consider in determining test intervals. It does not address how to perform the tests because these details can be found in existing documents (e.g., ANSI/ANS-56.8-1994). The performance crit~~erion~~ for Type A tests is a performance leakage rate (as defined in this guideline) of less than 1.0L_a. Extension of Type A test intervals are allowed based upon two consecutive successful Type A tests and other requirements stated in Section 9.2.3 of this guideline. These additional requirements include supplemental inspections and a confirmatory plant-specific risk impact assessment. Type A testing shall be performed at a frequency of at least once per 15 years. If the Type A performance leakage rate is not acceptable, the performance criterion is not met, and a determination should be performed to identify the cause of unacceptable performance and determine appropriate corrective actions. Once completed, acceptable performance should be reestablished by demonstrating an acceptable performance leakage rate before resuming operation and by performing another successful Type A test within 48 months following the unsuccessful Type A test. Following these successful Type A tests, the surveillance frequency may be returned to at least once per 15 years. Extensions of Type B and Type C test intervals are allowed based upon completion of two consecutive periodic as-found tests where the results of each test are within a licensee's allowable administrative limits. Intervals may be increased from 30 months up to a maximum of 120 months for Type B tests (except for containment airlocks) and up to a maximum of 60 months for Type C tests. If the Type B and C test results are not acceptable, the test frequency should be set at the initial test intervals. Once the cause determination and corrective actions have been completed, acceptable performance may be reestablished and the testing frequency returned to the extended intervals as specified in this document.

Containment airlock(s) shall be tested at an internal pressure of not less than P_a prior to a preoperational Type A test. Subsequent periodic tests shall be performed at a frequency of at least once per 30 months. When containment integrity is required, airlock door seals should be tested within 7 days after each containment access. For periods of multiple containment entries where the airlock doors are routinely used for access more frequently than once every 7 days (e.g., shift or daily

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- Deleted:** criteria for Type A tests is
- Deleted:** 1.0L_a .
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- Deleted:** consideration of performance factors as described in Section 11
- Deleted:** 10
- Deleted:** If the As-found Type A results are not acceptable, a determination should be performed to identify the cause of unacceptable performance and determine appropriate corrective actions.
- Deleted:** performing a Type A test
- Deleted:** within
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- Deleted:** e prior

inspection tours of the containment), door seals may be tested once per 30 days during this time period.

The performance factors that have been identified as important and should be considered in establishing testing intervals include past performance, service, design, safety impact, and cause determination as described in Section 11.3.1.

If a licensee considers extended test intervals of greater than 60 months for Type B tested components, the review should include the additional considerations of as-found tests, schedule and review as described in Section 11.3.2.

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Finally, this document discusses the general requirements for recordkeeping for implementation of Option B to Appendix J.

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APPENDIX A

NRC Rule for Implementing
Performance-Based Leakage Test
Requirements

LIST OF ILLUSTRATIONS

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1 **1.0 INTRODUCTION**

2
3 **1.1 Background**

4
5 Containment leakage rate testing is performed in accordance with 10 CFR
6 50, Appendix J, “Leakage Rate Testing of Containment of Light Water Cooled
7 Nuclear Power Plants.” Appendix J specifies containment leakage testing
8 requirements, including the types of tests required. In addition, for each type of
9 test, Appendix J discusses leakage rate acceptance criteria, test methodology,
10 frequency of testing, and reporting requirements. The specific testing requirements
11 are discussed in a variety of sources, including Technical Specifications,
12 Containment Leakage Rate Testing Program, Final Safety Analysis Reports
13 (FSARs), National Standards (e.g., ANSI/ANS-56.8–1994, “Containment System
14 Leakage Testing Requirements”), and licensee/NRC correspondence. These
15 documents require that periodic testing be conducted to verify the leakage integrity
16 of the containment and those containment systems and components that penetrate
17 the containment.

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18
19 The reactor containment leakage test program includes performance of an
20 Integrated Leakage Rate Test (ILRT), also known as a Type A test; and
21 performance of Local Leakage Rate Tests (LLRTs), also known as either Type B or
22 Type C tests. The Type A test measures overall leakage rate of the primary reactor
23 containment. Type B tests are intended to detect leakage paths and measure
24 leakage for certain primary reactor containment penetrations. Type C tests are
25 intended to measure containment isolation valve leakage rates.

26
27 In 1995, the NRC amended the regulations to provide an Option B to the
28 10CFR50, Appendix J. Option B is a performance-based approach to Appendix J
29 leakage testing requirements. This option, in concert with NEI 94-01, Revision 1,
30 allows licensees with good ILRT performance history to reduce the Type A
31 Integrated Leakage Rate Test (ILRT) frequency from three tests in 10 years to at
32 least one test in 15 years. The initial 1995 relaxation of ILRT frequency was based
33 on the NRC risk assessment contained in “Performance-Based Containment Leak-
34 Test Program (NUREG-1493) and EPRI Risk Impact Assessment of Revised
35 Containment Leak Rate Testing Intervals (TR-104285) both of which found that
36 there was a very low increase in risk associated with increasing ILRT surveillance
37 intervals to ten years. Furthermore, the NRC assessment stated that there was an
38 imperceptible increase in risk associated with increasing ILRT intervals up to
39 twenty years. In 2001, many licensees began to submit requests for one-time ILRT

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40 interval extensions beyond ten years, and it was deemed appropriate to assess the
41 risk involved in extending ILRT intervals beyond ten years. EPRI Product No.
42 1009325, Revision 1, “Risk Impact Assessment of Extended Integrated Leak Rate
43 Testing Intervals” demonstrated that generically there is little risk associated with
44 extension of ILRT intervals of up to fifteen years. However, plant-specific
45 confirmatory risk impact assessments are required.

46
47 _____ For Type B and Type C tests, Option B, in concert NEI 94-01, revision 1
48 allows licensees to reduce testing frequency on a plant-specific basis based on
49 experience history of each component, and established controls to ensure continued
50 performance during the extended testing interval.

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51
52 Generally, a FSAR describes plant testing requirements, including
53 containment testing. In some cases, FSAR testing requirements differ from those of
54 Appendix J. In many cases, Technical Specifications were approved that
55 incorporated exemptions to provisions of Appendix J. Additionally, some licensees
56 have requested and received exemptions after their Technical Specifications were
57 issued. The alternate performance-based testing requirements contained in Option
58 B of Appendix J will not invalidate such exemptions.

59
60 _____ Plants that have elected to invoke 10CFR50, Appendix J, Option B in concert
61 with NEI 94-01 (1995) and Regulatory Guide 1.163 (1995) and who do not wish to
62 extend ILRT surveillance intervals beyond ten years are not required to comply
63 with this current revision of NEI 94-01, revision 1.

64 65 **1.2 Discussion**

66
67 This guideline describes an approach that may be used to meet the alternate
68 testing requirements described in Option B to Appendix J. The performance history
69 of containment, penetrations, and containment isolation valves is used as the
70 means to justify extending test intervals for containment Type A, Type B, and Type
71 C tests. This guideline provides a method for determining the extended test
72 intervals based on performance.

73
74 Under Option B, test intervals for Type A, Type B, and Type C testing may be
75 determined by using a performance-based approach. Performance-based test
76 intervals are based on consideration of operating history of the component and
77 resulting risk from its failure. Performance-based for Appendix J refers to both the
78 performance history necessary to extend test intervals as well as the criteria
79 necessary to meet the requirements of Option B. The performance-based approach
80 to leakage rate testing discussed in NUREG-1493, “Performance-Based Leak-Test

81 Program,” concludes that the impact on public health and safety due to extended
82 intervals is negligible. EPRI Product No. 1009325, Revision 1, “Risk Impact
83 Assessment of Extended Integrated Leak Rate Testing Intervals” concludes that
84 reducing the frequency of Type A tests (ILRTs) from the current 3 per 10 years to 1
85 per 15 years leads to a small increase in risk. The approach of the EPRI Risk
86 Impact Assessment included compliance with appropriate current risk-informed
87 guidance of Regulatory Guide 1.174 (1998), “An Approach for Using Probabilistic
88 Risk Assessment in Risk-Informed Decisions in Plant-Specific Changes to the
89 Licensing Basis.”

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90 Type A tests focus on verifying the leakage integrity of a passive containment
91 structure. Type B and C testing focuses on assuring that containment penetrations
92 are essentially leak tight. These tests collectively satisfy the requirements of
93 10CFR50, Appendix J, Option B summarized as follows: “These test requirements
94 ensure that (a) leakage through these containments or systems and components
95 penetrating these containments does not exceed allowable leakage rates specified in
96 the Technical Specifications and (b) integrity of the containment structure is
97 maintained during its service life.”

98 2.0 PURPOSE AND SCOPE

99
100 This guideline describes an acceptable method for implementing the optional
101 performance-based requirements of Appendix J. This method uses industry
102 performance data, plant-specific performance data, and risk insights in
103 determining the appropriate testing frequency. Licensees may elect to use other
104 suitable methods or approaches to comply with Option B, but must obtain NRC
105 approval prior to implementation.

106
107 The approach described in this guideline to implement Appendix J, Option B
108 includes:

- 109 • Continued assurance of the leakage integrity of the containment without
110 adversely affecting public health and safety;

- 111 • A framework to acknowledge good performance;

Deleted: <#>Licensee flexibility to implement cost-effective testing methods;¶
Deleted: ; and

- 112 • Utilization of risk and performance-based methods, including an awareness
113 of the plant-specific risk impact of extension of ILRT intervals of up to fifteen
114 years;

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- 115 • An awareness of and attention to supplemental means of assessing and
116 maintaining containment integrity, particularly for ILRT interval extensions
117 beyond ten years. Specifically, this includes the Maintenance Rule and
118 the

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123 | ASME Boiler and Pressure Vessel Code, Section XI, Subsections IWE/IWL
124 | inspections and

- 125 | • Licensee flexibility to implement cost-effective testing methods.

126 |
127 | This guideline delineates the basis for a performance-based approach for
128 | determining Type A, Type B, and Type C containment leakage rate surveillance
129 | testing frequencies. It does not address how to perform the tests because these
130 | details can be found in existing documents (e.g., ANSI/ANS 56.8-1994).

131 |
132 |

Deleted: Licensees that select Option B are urged to coordinate the implementation of Appendix J, as described in this guideline, with their plans for implementation of the Maintenance Rule and other changes in the regulations as they are finalized.

133 | **3.0 RESPONSIBILITY**

134 |

135 | Each licensee should determine if the requirements of the initial Appendix J
136 | (Option A) or the alternate requirements (Option B) are most appropriate for its
137 | facility. If a licensee elects to implement the Option B requirements, the guidance
138 | described in this document has been reviewed and endorsed by the NRC as an
139 | acceptable method of implementing the requirements.

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140 |

141 | In addition, if a licensee elects to adopt Option B, it may elect to adopt the
142 | requirements that apply to a specific category of tests (i.e., Type A, or Type B and
143 | Type C tests) only.

144 |

145 | Plants that have elected to adopt 10CFR50, Appendix J, Option B in concert
146 | with NEI 94-01 (1995) and Regulatory Guide 1.163 (1995) and who do not wish to
147 | extend ILRT surveillance intervals beyond ten years are not required to comply
148 | with this current revision of NEI 94-01, revision 1.

149 |

150 |

151 | **4.0 APPLICABILITY**

152 |

153 | This guideline is applicable to licensees holding an operating license issued in
154 | accordance with 10 CFR 50.21(b) and 50.22, and 10 CFR Part 52, Subpart C.

155 |

156 | Industry operating experience and plant modifications that may affect Type
157 | A, Type B, and Type C testing program(s) should be reviewed to assure test and
158 | maintenance programs are appropriately adjusted to reflect these changes.

159 | **5.0 DEFINITIONS**

160 |

161 | Definitions of most commonly accepted terms used in this guideline may be
162 | found in ANSI/ANS-56.8-1994. The following additional term and its definition is
163 | used in this guideline:

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164
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172
173
174

- The performance leakage rate is calculated as the sum of the Type A upper confidence limit (UCL) and as-left minimum pathway leakage rate (MNPLR) leakage rate for all Type B and Type C pathways that were in service, isolated, or not lined up in their test position (i.e., drained and vented to containment atmosphere) prior to performing the Type A test. In addition, leakage pathways that were isolated during performance of the test because of excessive leakage must be factored into the performance determination. The performance criterion for Type A tests is a performance leak rate of less than 1.0La.

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175 **6.0 GENERAL REQUIREMENTS**

176
177 Option B of 10 CFR 50, Appendix J states: “Type A tests to measure the
178 containment system overall integrated leakage rate must be conducted under
179 conditions representing design basis loss-of-coolant accident containment peak
180 pressure. A Type A test must be conducted (1) after the containment system has
181 been completed and is ready for operation and (2) at a periodic interval based on the
182 historical performance of the overall containment system as a barrier to fission
183 product releases to reduce the risk from reactor accidents. A general visual
184 inspection of the accessible interior and exterior surfaces of the containment system
185 for structural deterioration which may affect the containment leak-tight integrity
186 must be conducted prior to each test, and at a periodic interval between tests based
187 on the performance of the containment system. The leakage rate must not exceed
188 the allowable leakage rate (La) with margin, as specified in the Technical
189 Specifications. The test results must be compared with previous results to examine
190 the performance history of the overall containment system to limit leakage.”

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191
192 A review of leakage rate testing experience indicates that only a small
193 percentage of Type A tests have exhibited excessive leakage. Furthermore, the
194 observed leakage rates for the few Type A test failures were only marginally above
195 current limits. These observations, together with the insensitivity of public risk to
196 containment leakage rate at these low levels, suggest that for Type A tests,
197 intervals may be established based on performance. The Type A test is the primary
198 means to detect containment leakage that is not detectable by the Type B and Type
199 C testing programs, and is also used to verify at periodic intervals the accident
200 leakage (La) assumptions in the accident analysis.

Deleted: in part, that a Type A test which measures both the containment system overall integrated leakage rate at the containment pressure and system alignments assumed during a large break loss of coolant accident (LOCA), and demonstrates the capability of the primary containment to withstand an internal pressure load may be conducted at a periodic interval based on the performance of the overall containment system. The leakage rate must not exceed what is allowed as specified in a plant's Technical Specifications.

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201
202 An LLRT is a test performed on Type B and Type C components. An LLRT is
203 not required for the following cases:

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- 204
- 205 • Primary containment boundaries that do not constitute potential primary
206 containment atmospheric pathways during and following a Design Basis
207 Accident (DBA);
 - 208 • Boundaries sealed with a qualified seal system; or,
 - 209 • Test connection vents and drains between primary containment isolation
210 valves which are one inch or less in size, administratively secured closed and
211 consist of a double barrier.
- 212
213
214

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Deleted: would not be detected

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Deleted: Specific details of Type A test requirements are discussed in ANSI/ANS 56.8-1994.

215 For Type B and Type C tests, intervals shall be established based on the
216 performance history of each component. Performance criterion for each component
217 is determined by designating an administrative leakage limit for each component in
218 the Type B and Type C testing program. The acceptance criteria for Type B and
219 Type C tests is based upon demonstrating that the sum of leakage rates at DBA
220 pressure for containment penetrations and valves that are testable, is less than the
221 total allowable leakage rate specified in the plant Technical Specifications.
222

223 Primary containment barriers sealed with a qualified seal system shall be
224 periodically tested to demonstrate their functionality in accordance with the plant
225 Technical Specifications. Specific details of the testing methodology and
226 requirements are contained in ANSI/ANS 56.8–1994 and should be adopted by
227 licensees with applicable systems. Test frequency may be set using a performance
228 basis in a manner similar to that described in this guideline for Type B and Type C
229 test intervals. Leakage from containment isolation valves that are sealed with a
230 qualified seal system may be excluded when determining the combined leakage rate
231 provided that:
232

- 233 • Such valves have been demonstrated to have fluid leakage rates that do
234 not exceed those specified in the technical specifications or associated
235 bases, and
236
- 237 • The installed isolation valve seal-water system fluid inventory is
238 sufficient to assume the sealing function for at least 30 days at a pressure
239 of 1.10 Pa.

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242 7.0 UTILIZATION OF EXISTING PROGRAMS

243 Licensees should use existing industry programs, studies, initiatives and
244 data bases, where possible.
245
246

247 8.0 TESTING METHODOLOGIES FOR TYPE A, B AND C TESTS

248 Type A, Type B and Type C tests should be performed using the technical
249 methods and techniques specified in ANSI/ANS-56.8–1994, or other alternative
250 testing methods that have been approved by the NRC. However, because
251 ANSI/ANS 56.8–1994 is not performance-based, certain exceptions and clarification
252

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253 to methods, techniques and definitions contained in that document are required.
254 These are discussed in the following paragraphs.

255 ~~Test intervals in ANSI/ANS 56.8–1994 are not performance-based. This~~
256 ~~guideline should be implemented when establishing test intervals for Type A, Type~~
257 ~~B and Type C testing.~~

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258
259 All Appendix J pathways must be properly drained and vented during the
260 performance of the ILRT, with the following exceptions:

- 261
262 • Pathways in systems which are required for proper conduct of the Type A
263 test or to maintain the plant in a safe shutdown condition during the Type
264 A test;
- 265
266 • Pathways in systems that are normally filled with fluid and operable
267 under post-accident conditions;
- 268
269 • Portions of the pathways outside primary containment that are designed
270 to Seismic Category I and at least Safety Class 2; or,
- 271
272 • For planning and scheduling purpose, or ALARA considerations,
273 pathways which are Type B or C tested within the previous 30 calendar
274 months need not be vented or drained during the Type A test.

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275
276 The proper methods for draining and venting are specified in ANSI/ANS 56.8–1994.

277
278 It should be noted that the Type B or C tests performed on those pathways
279 must test all of its containment barriers. This includes bonnets, packings, flanged
280 joints, threaded connections, and compression fittings. If the Type B or C test
281 pressurizes any of the pathway's containment barriers in the reverse direction, it
282 must be shown that test results are not affected in a nonconservative manner by
283 directionality. The ~~as-found~~ and the ~~as-left~~ leakage rate for all pathways that are
284 not drained and vented must be determined by Type B and Type C testing within
285 the previous 30 calendar months of the time that the Type A test is performed and
286 must be added to the Type A leakage rate UCL to determine the overall L_a
287 surveillance acceptance criteria in accordance with the definition in ANSI/ANS
288 56.8–1994.

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289
290 The ~~as-found~~ Type A test results described in ANSI/ANS 56.8–1994 are
291 defined to include the positive differences between the ~~as-found~~ and ~~as-left~~ LLRT
292 leakage rates for each pathway tested and adjusted prior to the performance of the
293 Type A test (leakage savings). For purposes of determining an acceptable Type A

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294 test for operability considerations, the definitions and discussions found in
295 ANSI/ANS 56.8–1994 for as-found Type A leakage rate should be followed.

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296
297 However, because of the performance-based emphasis on Type A testing,
298 criteria for Type A tests have been defined differently, and do not use the leakage
299 savings value. The performance criteria use a calculated performance leakage rate,
300 which is defined as the sum of the Type A UCL and as-left MNPLR leakage rate for
301 all Type B and Type C pathways that were in service, isolated or not lined up in
302 their test position (i.e., drained and vented to containment atmosphere) prior to
303 performing the Type A test. In addition, any leakage pathways that were isolated
304 during performance of the test because of excessive leakage must be factored into
305 the performance determination. If the pathway leakage can be determined by a
306 local leakage rate test, the as-left MNPLR for that leakage path must also be added
307 to the Type A UCL. If the pathway leakage cannot be determined by local leakage
308 rate testing, the performance criteria for the Type A test were not met.

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309
310 ANSI/ANS 56.8–1994 also specifies surveillance acceptance criteria for Type
311 B and Type C tests. The ANSI/ANS 56.8–1994 definition is that the combined
312 leakage rate for all penetrations subject to Type B or Type C tests is limited to less
313 than or equal to $0.60L_a$, when determined on a MNPLR basis from as-found LLRT
314 results; and limited to less than or equal to $0.60L_a$, as determined on a Maximum
315 Pathway Leakage Rate (MXPLR) basis from the as-left LLRT results.

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316
317 Due to the performance-based nature of Option B to Appendix J and this
318 guideline, it is recommended that acceptance criteria for the combined as-found
319 leakage rate for all penetrations subject to Type B or Type C testing be the same as
320 that defined in ANSI/ANS 56.8–1994, with the following additions. The combined
321 as-left leakage rates determined on a MXPLR basis for all penetrations shall be
322 verified to be less than $0.60L_a$ prior to entering a mode where containment integrity
323 is required following an outage or shutdown that included Type B and Type C
324 testing only. The combined as-found leakage rates determined on a MNPLR basis
325 for all penetrations shall be less than $0.60L_a$ at all times when containment
326 integrity is required. These combined leakage rate determinations shall be done
327 with the latest leakage rate test data available, and shall be kept as a running
328 summation of the leakage rates.

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330 **9.0 DETERMINING PERFORMANCE-BASED TEST INTERVAL FOR** 331 **TYPE A TESTS**

332 **9.1 Introduction** 333

334
335 Determination of the surveillance frequency of Type A tests is based upon
336 satisfactory performance of leakage tests that meet the requirements of Appendix J.
337 Performance in this context refers to both the performance history necessary to
338 determine test intervals as well as overall criteria needed to demonstrate leakage
339 integrity performance. Performance is also used as a basis for demonstrating
340 negligible impact on public health and safety.

341
342 The purpose of Type A testing is to verify the leakage integrity of the
343 containment structure. The primary performance objective of the Type A test is not
344 to quantify an overall containment system leakage rate. The Type A testing
345 methodology as described in ANSI/ANS-56.8-1994, and the modified testing
346 frequencies recommended by this guideline, serves to ensure continued leakage
347 integrity of the containment structure. Type B and Type C testing assures that
348 individual penetrations are essentially leak tight. In addition, aggregate Type B
349 and Type C leakage rates support the leakage tightness of primary containment by
350 minimizing potential leakage paths. A review of performance history has concluded
351 that almost all containment leakage is identified by local leakage rate testing.

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352
353 This section discusses a method to determine a testing frequency for Type A
354 testing based on performance. The extended test interval is based upon industry
355 performance data that was compiled to support development of Option B to
356 Appendix J, and is intended for use by any licensee. In adopting extended test
357 intervals recommended in this guideline, a licensee should perform Type A testing
358 in accordance with recommended industry practices. Additional technical
359 information concerning data analysis may be found in NUREG-1493 and EPRI
360 Product No. 1009325, Revision 1, "Risk Impact Assessment of Extended Integrated
361 Leak Rate Testing Intervals".

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362
363 Consistent with standard scheduling practices for Technical Specifications
364 Required Surveillances, intervals for recommended Type A testing given in this
365 section may be extended by up to 15 months. This option should be used only in
366 cases where refueling schedules have been changed to accommodate other factors.

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367 9.1.1 Performance Criteria

368
369 Performance criteria for establishing Type A test intervals should provide
370 both the standard against which performance is to be measured and basis for
371 determining that performance is acceptable. Because of the performance-based
372 emphasis on Type A testing, the criteria to determine extended Type A test
373

374 intervals have been defined differently than the surveillance acceptance criteria
375 discussed in ANSI/ANS 56.8-1994. This is to make the performance leakage rate
376 more of an indicator of the overall condition of containment leakage integrity.
377

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378 The performance criteria for Type A test allowable leakage is a performance
379 leakage rate of less than $1.0L_a$. This allowable performance leakage rate is
380 calculated as the sum of the Type A UCL and as-left MNPLR leakage rate for all
381 Type B and Type C pathways that were in service, isolated, or not lined up in their
382 test position (i.e., drained and vented to containment atmosphere) prior to
383 performing the Type A test. In addition, leakage pathways that were isolated
384 during performance of the test because of excessive leakage must be factored into
385 the performance determination. If the leakage can be determined by a local leakage
386 rate test, the as-left MNPLR for that leakage path must also be added to the Type
387 A UCL. If the pathway leakage cannot be determined by local leakage rate testing,
388 the performance criteria are not met.

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389 Performance criteria do not include addition of the positive differences
390 between the as-found MNPLR and the as-left MNPLR for each pathway tested and
391 adjusted prior to Type A testing (total leakage savings). Total leakage savings are
392 identified through performance of Type B and Type C testing and do not contribute
393 significantly to performance of a Type A test. Failure of Type B and Type C test
394 components found during performance of a Type A test should be reviewed for cause
395 determination and corrective actions. If the pathway leakage cannot be determined
396 by local leakage rate testing, the Type A performance criteria are not met.

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398 9.1.2 Test Interval

400 Extensions in test intervals are allowed based upon two consecutive, periodic
401 successful Type A tests and requirements stated in Section 9.2.3 of this guideline.
402 The elapsed time between the first and the last tests in a series of consecutive
403 passing tests used to determine performance shall be at least 24 months.
404

Deleted: consideration of performance factors as described in Section 11.3, "Plant-Specific Testing Program Factors."

405

406 9.2 Type A Test

407

408 9.2.1 Pretest Inspection and Test Methodology

409 Prior to initiating a Type A test, a visual examination shall be conducted of
410 accessible interior and exterior surfaces of the containment system for structural
411 problems that may affect either the containment structure leakage integrity or the
412 performance of the Type A test. This inspection should be a general visual
413 inspection of accessible interior and exterior surfaces of the primary containment
414 and components. It is recommended that these inspections be performed in
415

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416 | conjunction or coordinated with the ASME Boiler and Pressure Vessel Code, Section
417 | XI, Subsection IWE/IWL required examinations.

418 |
419 | ANSI/ANS ~~56.8-1994 testing~~ methodology states that pathways open to the
420 | primary containment atmosphere under post-DBA conditions shall be drained and
421 | vented to the primary containment atmosphere during a Type A test. There are
422 | three exceptions discussed in ANSI/ANS 56.8-1994 that allow penetrations to be
423 | tested under the LLRT program and the results added to the Type A leakage rate
424 | Upper Confidence Limit (UCL). One exception states that pathways in systems
425 | that are required for proper conduct of the Type A test or to maintain the plant in a
426 | safe condition during the Type A test may be operable in their normal mode. Proper
427 | outage planning should identify systems that are important to shutdown safety. A
428 | sufficient number of systems should be available so as to minimize the risk during
429 | the performance of the Type A test.

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430 |
431 | For planning and scheduling purposes, or ALARA considerations, licensees
432 | may want to consider not venting and draining additional penetrations that are
433 | capable of local leakage rate testing. It should be noted that the Type B or C tests
434 | performed on those pathways must test all of its containment barriers. This
435 | includes bonnets, packings, flanged joints, threaded connections, and compression
436 | fittings. If the Type B or C test pressurizes any of the pathway's containment
437 | barriers in the reverse direction, it must be shown that test results are not affected
438 | in a non-conservative manner by directionality. The as-found and the as-left
439 | leakage rate for all pathways that are not drained and vented must be determined
440 | by Type B and Type C testing within the previous 30 calendar months of the time
441 | that the Type A test is performed and must be added to the Type A leakage rate
442 | UCL to determine the overall L_a surveillance acceptance criteria in accordance with
443 | the definition in ANSI/ANS 56.8-1994.

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445 |
446 | **9.2.2 Initial Test Intervals**

447 |
448 | A preoperational Type A test shall be conducted prior to initial reactor
449 | operation. If initial reactor operation is delayed longer than 36 months after
450 | completion of the preoperational Type A test, a second preoperational Type A test
451 | shall be performed prior to initial reactor operations.

452 |
453 | The first periodic Type A test shall be performed within 48 months after the
454 | successful completion of the last preoperational Type A test. Periodic Type A tests
455 | shall be performed at a frequency of at least once per 48 months, until acceptable
456 | performance is established in accordance with Section 9.2.3. The interval for
457 | testing should begin at initial reactor operation. Each test interval begins upon
458 | completion of a Type A test and ends at the start of the next test.

459
460 If the test interval ends while primary containment integrity is either not
461 required or it is required solely for shutdown activities, the test interval may be
462 extended indefinitely. However, a successful Type A test shall be completed prior to
463 entering the operating mode requiring primary containment integrity.

464 9.2.3 Extended Test Intervals

465
466 Type A testing shall be performed during a period of reactor shutdown at a
467 frequency of at least once per 15 years based on acceptable performance history.
468 Acceptable performance history is defined as successful completion of two
469 consecutive periodic Type A tests where the calculated performance leakage rate
470 was less than 1.0 L_a. A preoperational Type A test may be used as one of the two
471 Type A tests that must be successfully completed to extend the test interval,
472 provided that an engineering analysis is performed to document why a
473 preoperational Type A test can be treated as a periodic test. Elapsed time between
474 the first and last tests in a series of consecutive satisfactory tests used to determine
475 performance shall be at least 24 months.
476

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477
478 For purposes of determining an extended test interval, the performance
479 leakage rate is determined by summing the UCL (determined by containment
480 leakage rate testing methodology described in ANSI/ANS 56.8–1994) with as-left
481 MNPLR leakage rates for penetrations in service, isolated or not lined up in their
482 accident position (i.e., drained and vented to containment atmosphere) prior to a
483 Type A test. In addition, any leakage pathways that were isolated during
484 performance of the test because of excessive leakage must be factored into the
485 performance determination. If the pathway leakage can be determined by a local
486 leakage rate test, the as-left MNPLR for that leakage path must also be added to
487 the Type A UCL. If the pathway leakage cannot be determined by local leakage
488 rate testing, the performance criteria for the Type A test are not met.

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489
490 In reviewing past performance history, Type A test results may have been
491 calculated and reported using computational techniques other than the Mass Point
492 method from ANSI/ANS 56.8–1994 (e.g., Total Time or Point-to-Point). Reported
493 test results from these previously acceptable Type A tests can be used to establish
494 the performance history. Additionally, a licensee may recalculate past Type A UCL
495 (using the same test intervals as reported) in accordance with ANSI/ANS 56.8–1994
496 Mass Point methodology and its adjoining Termination criteria in order to
497 determine acceptable performance history. In the event where previous Type A
498 tests were performed at reduced pressure (as described in 10 CFR 50, Appendix J,

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499 Option A), at least one of the two consecutive periodic Type A tests shall be
500 performed at peak accident pressure (P_a).

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501 9.2.3.1 General Requirements for ILRT Interval Extensions 502 Beyond Ten Years

503 Type A ILRT intervals of up to fifteen years are allowed by this
504 guideline. The Risk Impact Assessment of Extended Integrated Leak
505 Rate Testing Intervals, EPRI report 1009325, Revision 1, November
506 2005, indicates that, generically, the risk impact associated with ILRT
507 interval extensions for intervals up to fifteen years is small. However,
508 plant-specific confirmatory analyses are required. In addition,
509 although the historical containment leak-tight performance has been
510 very good, a few instances of degradation have occurred and have been
511 detected by supplemental means other than Type A ILRTs. These
512 means include ASME Boiler and Pressure Vessel Code Section XI,
513 Subsection IWE/IWL examinations and Maintenance Rule inspections.
514 The following paragraphs summarize the additional requirements for
515 extending ILRT intervals beyond ten years.

516 9.2.3.2 Supplemental Inspection Requirements

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517 To provide continuing supplemental means of identifying
518 potential containment degradation, a general visual examination of
519 accessible interior and exterior surfaces of the containment for
520 structural deterioration that may affect the containment leak-tight
521 integrity must be conducted prior to each Type A test and at periodic
522 intervals between Type A tests as specified by the applicable year and
523 addenda of the ASME Boiler and Pressure Vessel Code, Section XI,
524 Subsections IWE and IWL.

525 9.2.3.3 Plant-Specific Confirmatory Analyses

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526 To provide plant-specific assurance of the acceptability of the
527 risk impact of extending ILRT intervals up to a maximum of fifteen
528 years, a confirmatory risk impact assessment is required. The
529 assessment should be performed using the approach and methodology
530 described in EPRI Report 1009325, Revision 1, "Risk Impact
531 Assessment of Extended Integrated Leak Rate Testing Intervals".

538 | The analysis is to be performed by the licensee and retained in the
539 | plant documentation and records as part of the basis for extending the
540 | ILRT interval.

542 | 9.2.4 Containment Repairs and Modifications

543 |
544 | Repairs and modifications that affect the containment leakage integrity
545 | require leakage rate testing (Type A testing or local leakage rate testing) prior to
546 | returning the containment to operation. Testing may be deferred to the next
547 | regularly scheduled Type A test for the following repairs or modifications:

- 549 | o Welds of attachments to the surface of steel pressure-retaining
550 | boundary;
- 551 | o Repair cavities, the depth that does not penetrate required design steel
552 | wall by more than 10%, or
- 553 | o Welds attaching to steel pressure-retaining boundary penetrations where
554 | the nominal diameter of the welds or penetrations do not exceed one
555 | inch.

558 | 9.2.5 Surveillance Acceptance Criteria

560 | The as-found Type A test leakage rate must be less than the acceptance
561 | criterion of $1.0 L_a$ given in the plant Technical Specifications. Prior to entering a
562 | mode where containment integrity is required, the as-left Type A leakage rate shall
563 | not exceed $0.75 L_a$. The as-found and as-left values are as determined by the
564 | appropriate testing methodology specifically described in ANSI/ANS 56.8-1994.

567 | 9.2.6 Corrective Action

569 | If the Type A performance leakage rate is not acceptable, the performance
570 | criterion is not met, and a determination should be performed to identify the cause
571 | of unacceptable performance and determine appropriate corrective actions. Once
572 | completed, acceptable performance should be reestablished by demonstrating an
573 | acceptable performance leakage rate before resuming operation and by performing
574 | another successful Type A test within 48 months following the unsuccessful Type A
575 | test. Following these successful Type A tests, the surveillance frequency may be
576 | returned to at least once per 15 years.

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Deleted: If the As-found Type A results are not acceptable, then a determination should be performed to identify the cause of unacceptable performance and determine appropriate corrective actions. Cause determination and corrective action should reinforce achieving acceptable performance. Once the cause determination and corrective actions have been completed, acceptable performance should be reestablished by performing a Type A test within 48 months following the unsuccessful Type A test. Following a successful Type A test, the surveillance frequency may be returned to once per 10 years. ¶

580 Performance criteria do not include addition of the positive differences
581 | between the as-found MNPLR and the as-left MNPLR for each pathway tested and
582 | adjusted prior to Type A testing (total leakage savings). Total leakage savings are
583 | identified through performance of Type B and Type C testing and do not contribute
584 | significantly to performance of a Type A test. As discussed in Section 9.2.3, leakage
585 | paths detected during a Type A test that are caused by failures of Type B and Type
586 | C test components are not required to be included in determination of adequate
587 | performance and Type A test intervals. However, if the pathway leakage cannot be
588 | determined by local leakage rate testing, the Type A performance criteria are not
589 | met. Corrective actions for Type B and Type C failures should be taken in
590 | accordance with Sections 10.2.1.4, 10.2.2.3, or 10.2.3.4 of this guideline.
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594 **10.0 DETERMINING PERFORMANCE-BASED TEST FREQUENCIES FOR**
595 **TYPE B AND TYPE C TESTS**

596
597 **10.1 Introduction**

598
599 This section discusses the method to determine extended test intervals for
600 Type B and Type C tests based on performance. It presents a range of acceptable
601 intervals based upon industry data that have been analyzed through a process
602 similar to that used by NRC in NUREG-1493, and have been reviewed for safety
603 significance. Individual licensees may adopt a testing interval and approach as
604 discussed in this guideline provided that certain performance factors and
605 programmatic controls are reviewed and applied as appropriate. Programmatic
606 controls may be necessary to ensure that assumptions utilized in analysis of the
607 industry data are reasonably preserved at individual facilities.
608

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609 The range of recommended frequencies for Type B and Type C tests are
610 discussed in Section 11.0. The proposed frequencies are in part based upon
611 industry performance data that was compiled to support the development of Option
612 B to Appendix J, and a review of their safety significance. A licensee should develop
613 bases for new frequencies based upon satisfactory performance of leakage tests that
614 meet the requirements of Appendix J. Additional considerations used to determine
615 appropriate frequencies may include service life, environment, past performance,
616 design, and safety impact. Additional technical information concerning the data
617 may be found in NUREG-1493.
618

619 Consistent with standard scheduling practices for Technical Specifications
620 Required Surveillances, intervals for the recommended surveillance frequency for
621 Type B and Type C testing given in this section may be extended by up to 25
622 percent of the test interval, not to exceed 15 months.
623

624 **10.2 Type B and Type C Testing Frequencies**

625
626 The testing interval for each component begins after its Type B or Type C
627 test is completed and ends at the beginning of the next test. If the testing interval
628 ends while primary containment integrity is not required or is required solely for
629 cold shutdown or refueling activities, testing may be deferred; however, the test
630 must be completed prior to the plant entering a mode requiring primary
631 containment integrity.
632

633 Leakage rates less than the administrative leakage rate limits are considered
634 acceptable. Administrative limits for leakage rates shall be established and

635 documented for each Type B and Type C component prior to the performance of
636 local leakage rate testing. The administrative limits assigned to each component
637 should be specified such that they are an indicator of potential valve or penetration
638 degradation. Administrative limits for airlocks may be equivalent to the
639 surveillance acceptance criteria given for airlocks in Technical Specifications.

640
641 Administrative limits are specific to individual penetrations or valves, and
642 are not the surveillance acceptance criteria for Type B and Type C tests. Due to the
643 performance-based nature of Option B to Appendix J and this guideline, it is
644 recommended that acceptance criteria for the combined leakage rate for all
645 penetrations subject to Type B or Type C testing be defined as follows:

- 647 • The combined as-left leakage rates determined on a MXPLR basis for all
648 penetrations shall be verified to be less than $0.60L_a$ prior to entering a
649 mode where containment integrity is required following an outage or
650 shutdown that included Type B and Type C testing only. These combined
651 leakage rate determinations shall be done with the latest leakage rate test
652 data available, and shall be kept as a running summation of the leakage
653 rates. Deleted: As
- 654 • The as-found leakage rates, determined on a MNPLR basis, for all newly
655 tested penetrations when summed with the as-left MNPLR leakage rates
656 for all other penetrations shall be less than $0.60L_a$ at all times when
657 containment integrity is required. Deleted: As
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659
660 The surveillance acceptance criteria for airlocks are as specified in Technical
661 Specifications, and administrative limits do not apply. In addition, there is other
662 leakage rate testing specified in the Technical Specifications that contain
663 Surveillance Acceptance Criteria and Surveillance Frequencies, for example, vent
664 and purge valves and BWR main steam and feedwater isolation valves. This
665 guideline does not address the performance-based frequency determination of those
666 surveillances.

667
668 If no plant-specific technical specifications are in effect for BWR and PWR
669 containment purge and vent valves and/or BWR main steam and feedwater
670 isolation valves, the interval for Type C tests should be limited to 30 months.

671 672 673 **10.2.1 Type B Test Intervals** Deleted: ¶ 674 ¶

675 **10.2.1.1 Initial Test Intervals (Except Containment Airlocks)**

676

677 Type B tests shall be performed prior to initial reactor operation.
678 Subsequent periodic Type B tests shall be performed at a frequency of at least once
679 per 30 months, until acceptable performance is established per Section 10.2.1.2.
680

681 **10.2.1.2 Extended Test Intervals (Except Containment Airlocks)**

682
683 The test intervals for Type B penetrations may be increased based upon
684 completion of two consecutive periodic as-found Type B tests where results of each
685 test are within a licensee’s allowable administrative limits. Elapsed time between
686 the first and last tests in a series of consecutive satisfactory tests used to determine
687 performance shall be 24 months or the nominal test interval (e.g., refueling cycle)
688 for the component prior to implementing Option B to Appendix J. An extended test
689 interval for Type B tests may be increased to a specific value in a range of
690 frequencies from greater than once per 30 months up to a maximum of once per 120
691 months. The specific test interval for Type B penetrations should be determined by
692 a licensee in accordance with Section 11.0.

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694 **10.2.1.3 Repairs or Adjustments (Except Containment Airlocks)**

695
696 In addition to the periodic as-found Type B test, an as-found Type B test
697 shall be performed prior to any maintenance, repair, modification, or adjustment
698 activity if the activity could affect the penetration’s leak tightness. An as-left Type
699 B test shall be performed following maintenance, repair, modification or adjustment
700 activity. In addition, if a primary containment penetration is opened following as-
701 found testing, a Type B test shall be performed prior to the time primary
702 containment integrity is required. If the as-found and as-left Type B test results
703 are both less than a component’s allowable Administrative Limit, a change in test
704 frequency is not required. If as-found or as-left test results are greater than the
705 allowable administrative limit, provisions of Section 10.2.1.4 apply.

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706
707 Frequency for a Type B testing shall be in accordance with Section 10.2.1.1 if
708 the penetration is replaced or engineering judgment determines that modification of
709 the penetration has invalidated the performance history. Testing shall continue at
710 this frequency until adequate performance is established in accordance with Section
711 10.2.1.2.

713 **10.2.1.4 Corrective Action**

714
715 If Type B test results are not acceptable, then the testing frequency should be
716 set at the initial test interval per Section 10.2.1.1. In addition, a cause
717 determination should be performed and corrective actions identified that focus on
718 those activities that can eliminate the identified cause of failure¹ with appropriate
719 steps to eliminate recurrence. Cause determination and corrective action should
720 reinforce achieving acceptable performance. Once the cause determination and
721 corrective actions have been completed, acceptable performance may be

¹ A failure in this context is exceeding an administrative limit and not the total failure of the penetration. Administrative limits are established at a value low enough to identify and allow early correction of potential total penetration failures.

722 reestablished and the testing frequency returned to the extended interval in
723 accordance with Section 10.2.1.2.

724
725 Failures of Type B penetrations discovered during performance of a Type A
726 test should be considered as failures of a Type B test for purposes of cause
727 determination and corrective action. This includes failures of penetrations that
728 were not previously identified by a Type B testing program.

730 10.2.2 Containment Airlocks

732 10.2.2.1 Test Interval

734 Containment airlock(s) shall be tested at an internal pressure of not less than
735 P_{ac} prior to a preoperational Type A test. Subsequent periodic tests shall be
736 performed at a frequency of at least once per 30 months. Containment airlock tests
737 should be performed in accordance with ANSI/ANS-56.8-1994. In addition,
738 equalizing valves, door seals, and penetrations with resilient seals (i.e., shaft seals,
739 electrical penetrations, view port seals and other similar penetrations) that are
740 testable, shall be tested at a frequency of once per 30 months.

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741
742 Airlock door seals should be tested prior to a preoperational Type A test.
743 When containment integrity is required, airlock door seals should be tested within 7
744 days after each containment access.

745
746 For periods of multiple containment entries where the airlock doors are
747 routinely used for access more frequently than once every 7 days (e.g., shift or daily
748 inspection tours of the containment), door seals may be tested once per 30 days
749 during this time period.

750
751 Door seals are not required to be tested when containment integrity is not
752 required, however they must be tested prior to reestablishing containment
753 integrity. Door seals shall be tested at P_{a} or at a pressure stated in the plant
754 Technical Specifications.

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756 10.2.2.2 Repairs or Adjustments of Airlocks

757
758 Following maintenance on an airlock pressure-retaining boundary, one of the
759 following tests shall be completed:

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- 760
761 • Airlock shall be tested at a pressure of not less than P_{a} ; or
762

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763 | • Leakage rate testing at P_a shall be performed on the affected area or
764 | component.

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765 | **10.2.2.3 Corrective Action**

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766 |
767 | If containment airlock Type B test results are not acceptable, then a cause
768 | determination should be performed and corrective actions identified that focus on
769 | those activities that can eliminate the identified cause of a failure² with appropriate
770 | steps to eliminate recurrence. Cause determination and corrective action should
771 | reinforce achieving acceptable performance.

773 | **10.2.3 Type C Test Interval**

775 | **10.2.3.1 Initial Test Interval**

776 |
777 | Type C tests shall be performed prior to initial reactor operation.
778 | Subsequent periodic Type C tests shall be performed at a frequency of at least once
779 | per 30 months, until adequate performance has been established consistent with
780 | Section 10.2.3.2.

782 | **10.2.3.2 Extended Test Interval**

783 |
784 | Test intervals for Type C valves may be increased based upon completion of
785 | two consecutive periodic as-found Type C tests where the result of each test is
786 | within a licensee's allowable administrative limits. Elapsed time between the first
787 | and last tests in a series of consecutive passing tests used to determine performance
788 | shall be 24 months or the nominal test interval (e.g., refueling cycle) for the valve
789 | prior to implementing Option B to Appendix J. Intervals for Type C testing may be
790 | increased to a specific value in a range of frequencies from 30 months up to a
791 | maximum of 60 months. Test intervals for Type C valves should be determined by a
792 | licensee in accordance with Section 11.0.

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794 | **10.2.3.3 Repairs or Adjustments**

795 |
796 | In addition to the periodic as-found Type C test, an as-found Type C test
797 | shall be performed prior to any maintenance, repair, modification, or adjustment
798 | activity if it could affect a valve's leak tightness. An as-left Type C test shall be
799 | performed following maintenance, repair, modification or adjustment activity unless
800 | an alternate testing method or analysis is used to provide reasonable assurance
801 | that such work does not affect a valve's leak tightness and a valve will still perform
802 | its intended function.
803 |

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² A failure in this context is exceeding performance criteria for the airlock, not a total failure.

804 | If ~~as~~-found and ~~as~~-left Type C test results are both less than a valve's
805 | allowable administrative limit, a change of the test frequency is not required. If ~~as~~-
806 | found or ~~as~~-left test results are greater than the allowable administrative limit,
807 | then provisions of Section 10.2.3.4 apply.

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809 | The frequency for Type C testing shall be in accordance with Section 10.2.3.1
810 | if a valve is replaced or engineering judgment determines that modification of a
811 | valve has invalidated the valve's performance history. Testing shall continue at
812 | this frequency until an adequate performance history is established in accordance
813 | with Section 10.2.3.2.

814 | **10.2.3.4 Corrective Action**

817 | ~~If Type~~ C test results are not acceptable, then the testing frequency should be
818 | set at the initial test interval per Section 10.2.3.1. In addition, a cause
819 | determination should be performed and corrective actions identified that focus on
820 | those activities that can eliminate the identified cause of a failure³ with appropriate
821 | steps to eliminate recurrence. Cause determination and corrective action should
822 | reinforce achieving acceptable performance. Once the cause determination and
823 | corrective actions have been completed, acceptable performance may be
824 | reestablished and the testing frequency returned to the extended interval in
825 | accordance with Section 10.2.3.2.

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827 | Failures of Type C valves that are discovered during performance of a Type A
828 | test should be considered as a failure of a Type C test for purposes of cause
829 | determination and corrective action. This includes failures of valves that were not
830 | previously identified by a Type C test.

831

³ A failure in this context is exceeding an administrative limit and not the total failure of the valve. Administrative limits are established at a value low enough to identify and allow early correction of total valve failures.

832 **11.0 BASES FOR PERFORMANCE AND RISK-BASED TESTING**
833 **FREQUENCIES FOR TYPE A, TYPE B, AND TYPE C TESTS**

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834
835 **11.1 Introduction**
836

837 This section provides guidance on establishing leakage testing frequencies
838 and provides information regarding the risk impact of extending leakage rate
839 testing intervals. Extended test intervals in Sections 9.0 and 10.0 have been
840 selected based on performance, and have been assessed for risk impact. The various
841 factors and discussion in this section should be considered when establishing
842 different plant-specific testing frequencies.

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843
844 Section 9.0 provides guidance on extending Type A ILRT surveillance
845 intervals.

846
847 Section 10.0 presents a range of acceptable extended test intervals for Type B
848 and Type C tests. Individual licensees may adopt specific testing intervals of up to
849 60 months as discussed in Section 10.0 without additional detailed analysis
850 provided the performance factors discussed in Section 11.3.1 are considered.
851 Additional programmatic controls are discussed in Section 11.3.2 and should be
852 considered when the extended test intervals are greater than 60 months.

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854 **11.2 Discussion**
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856 Assessments of the risk impact of extending leakage rate testing intervals
857 have been performed at two different times to support similar objectives. The more
858 recent risk impact assessment, completed in 2005, supported optimized ILRT
859 interval extensions of up to fifteen years. The previous assessments completed in
860 1994-1995 supported Type A ILRT extensions of up to ten years, as well as
861 extensions of Type B and Type C testing intervals.

862
863 The objective of the work concluded in 2005 and published as EPRI Product
864 No. 1009325, Revision 1 “Risk Impact Assessment of Extended Integrated Leak
865 Rate Testing Intervals” was to perform a generic risk impact assessment for
866 optimized ILRT intervals of up to fifteen years, utilizing current industry
867 performance data and risk-informed guidance, primarily NRC Regulatory Guide
868 1.174. This risk impact assessment complements the previous EPRI report, TR-
869 104285, Risk Impact Assessment of Revised Containment Leak Rate Testing
870 Intervals. The earlier report considered changes to local leak rate testing intervals
871 as well as changes to ILRT testing intervals. The original risk impact assessment
872 considered the change in risk based on population dose, whereas the revision
873 considered dose as well as large early release frequency (LERF) and containment
874 conditional failure probability (CCFP). The following paragraphs discuss the
875 approach taken and results of this assessment.

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878 **Approach**

879 The first step was to obtain current containment leak rate testing and
880 performance information. This was obtained through an NEI industry-wide
881 survey conducted in 2001. A database was generated using this information
882 supplemented with recent industry failure reports and previous survey
883 information. The data indicate that there were no failures that could result in
884 a risk-significant large early release. This information was used to develop
885 the probability of a pre-existing leak in the containment. This information
886 was further supplemented with an expert elicitation to assist in the
887 determination of the risk-significant large failure magnitude and frequency.

888 Having both the conservative assessment failure probability as well as
889 the expert elicitation, the risk impact was determined for two example
890 plants, a PWR and BWR, with accident classes developed similar to the
891 original EPRI report but with enhancements for assessing changes in LERF.

892 **Results**

893 Using the conservative assumptions concerning the leakage and timing
894 associated with a large early release, the reduction in frequency of the type A
895 ILRT test results in a change in LERF that ranges between the “very small” (
896 < 1E-07) and “small” (1E-07 to 1E-06) risk increase regions of Regulatory
897 Guide 1.174. In the cases where the risk increase is conservatively calculated
898 to be greater than the “very small” region, the total LERF is significantly
899 lower than the Regulatory Guide 1.174 threshold criteria of total LERF less
900 than 1E-05 per year. The core damage frequency remains unchanged.

901 Other figures-of-merit have similar very small changes, including the
902 population dose rate and the conditional containment failure probability
903 (CCFP) changing very little over the range of ILRT interval extensions from 3
904 in 10 years to 1 in 15 years.

905 The use of less conservative expert elicited values for the frequency
906 and magnitude of large early release probabilities, results in even smaller
907 calculated increases to LERF as a result of changes in the ILRT interval
908 extension.

909 As can be seen from the two examples as well as the many plant-
910 specific analyses developed to date to support one-time ILRT interval
911 extensions, these results, and therefore the conclusions derived from them,
912 are generically applicable. However, as required in Sections 9.2.3.1 and
913 9.2.3.3 of this guideline, plant-specific confirmatory risk impact assessments
914 are also required.

915 Defense-in-depth as well as safety margins are maintained through
916 the continued inspection of containment as required by ASME Section XI,
917 Subsections IWE and IWL, and other required inspections, such as those
918 performed to satisfy the Maintenance Rule. In addition, this guideline
919 requires acceptable historical performance of Type A Integrated Leak Rate
920 Tests before integrated leak rate testing intervals can be extended.

921 This risk impact assessment confirms previous (NUREG-1493)
922 conclusions regarding risk in extending ILRT intervals up to fifteen years,
923 using current regulatory guidance and risk-informed concepts.

924 Similar approaches were taken in 1994-1995, although the guidance of
925 Regulatory Guide 1.174 was not available at that time. The following paragraphs
926 discuss these approaches.

927
928 The effect of extending containment leakage rate testing intervals is a
929 corresponding increase in the time that an excessive leak path would exist
930 undiscovered and uncorrected. The degree to which intervals can be
931 extended is a direct function of the potential effects on the health and safety
932 of the public that occur due to an increased likelihood of undiscovered
933 containment leakage.
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938 In order to determine the acceptability of extended testing intervals,
939 the methodology described in NUREG-1493 was applied, with some
940 modifications, to historical representative industry leakage rate testing data
941 gathered from approximately 1987 to 1993, under the auspices of NEI. The
942 range of testing intervals recommended for Type B and Type C testing was
943 evaluated to determine the level of increased risk in the event of an accident.
944 The same methodology was also applied to the 10-year interval for Type A
945 testing. In all cases, the increased risk corresponding to the extended test
946 interval was found to be small and compares well to the guidance of the
947 NRC's safety goals.

948
949 NUREG-1493 provided the technical basis to support rulemaking to
950 revise leakage rate testing requirements contained in Option B to Appendix
951 J. The basis consisted of qualitative and quantitative assessments of the risk
952 impact (in terms of increased public dose) associated with a range of extended
953 leakage rate testing intervals.
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955 NUREG-1493 found the effect of Type B and Type C testing on overall
956 accident risk is small and concluded that:
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- Performance-based alternatives to local leakage rate testing requirements are feasible without significant risk impacts; and
 - Although extended testing intervals led to minor increases in potential off-site dose consequences, the actual decrease in on-site (worker) doses exceeded (by at least an order of magnitude) the potential off-site dose increases.

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NEI, in conjunction with EPRI, undertook a similar study in order to supplement NRC’s rulemaking basis and provide added assurance the more detailed elements in this guideline have an adequate basis. Results of the EPRI study are documented in EPRI Research Project Report TR-104285, “Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals.”

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EPRI developed an abbreviated methodology that was used to assess plant risk impact associated with containment leakage rate testing alternatives currently being proposed by this guideline. The overall approach involved an examination of the risk spectra from accidents reported in PWR and BWR IPEs. Plant risk was quantified for PWR and BWR representative plants. Quantification of the risk considered the consequences from containment leakage in more detail than reported in IPEs. The impact associated with alternative Type B and Type C test intervals, measured as a change in risk contribution to baseline risk, is presented in Table 1. The risk values compare well with the analysis in NUREG-1493.

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The risk model was specifically quantified by using a “failure to seal” probability (as opposed to failure to close considered in IPEs). This required failure rates to be developed for this failure mode. Type B and Type C test data obtained by NEI allowed determination of failure rates where failure is defined as the measured leakage exceeding allowable administrative limits for a specific Type B or Type C component. The failure rate values were used in the containment isolation system fault tree, and used to calculate a failure-to-seal probability. Characterization of baseline risk (in terms of accident sequences that are influenced by containment isolation valve or containment penetration leakage rate) allowed the plant models to calculate the risk impact associated with changes in test intervals.

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As indicated above, historical industry failure rate data was used to develop the component failure to seal probabilities used in the analysis. This approach is quite conservative because these guidelines require demonstration of performance prior to extending the component leakage rate testing interval. The performance demonstration consists of successful completion of two consecutive leakage rate tests to increase the interval from

1002 | 30 to 60 months and three consecutive leakage rate tests to increase the
1003 | interval to greater than 60 months. This takes advantage of the findings of
1004 | NUREG–1493, Appendix A, which suggests that “If the component does not
1005 | fail within two operating cycles, further failures appear to be governed by the
1006 | random failure rate of the component,” and “Any test scheme considered
1007 | should require a failed component pass at least two consecutive tests before
1008 | allowing an extended test interval.” In addition, the penetration failure
1009 | analysis considered components that exceeded the administrative limits as
1010 | failures. The containment leakage rate computation conservatively used
1011 | maximum pathway leak rates derived from the upper bounds of the NEI
1012 | data. Therefore, the analysis is very conservative, and the component
1013 | performance trending provides the necessary confidence demonstration that
1014 | component leakage is being managed at a low level.

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1016 | For Type C test, a bounding analysis was performed that assumed all
1017 | valves have test intervals that were extended to 48, 60, 72 and 120 months.
1018 | For Type B tests, it was assumed that electrical penetrations were tested at a
1019 | nominal 120 months frequency. In addition, it was assumed that some
1020 | portion of the penetrations was tested periodically during the 120 months.
1021 | Airlock tests were assumed to be conducted every 24 months. Blind flanges
1022 | were assumed to be tested after each opening, or at 48–month intervals.

1024 | There are many points of similarity between the NUREG–1493 report
1025 | and the EPRI study, both in methodology and assumptions, reflecting close
1026 | agreement on elements important to safety for containment leakage rate
1027 | testing. The similarity also extends to the results. The EPRI study confirms
1028 | the low risk significance associated with Type A testing intervals of 10 years.
1029 | Similarly, extending the Type B and Type C test intervals to 120 months was
1030 | found acceptable provided the Type B or Type C components have
1031 | successfully passed two consecutive tests, and provided that certain controls
1032 | were imposed on the leakage rate testing program.

1034 | Changing Appendix J test intervals from those presently allowed to
1035 | those in this guideline slightly increases the risk associated with Type A and
1036 | Type B and Type C–specific accident sequences as discussed in Table 1. The
1037 | data suggests that increasing the Type C test interval can slightly increase
1038 | the associated risk, but this ignores the risk reduction benefits associated
1039 | with increased test intervals. In addition, when considering the total
1040 | integrated risk (representing all accident sequences analyzed in the IPE), the
1041 | risk impact associated with increasing test intervals is negligible (less than
1042 | 0.1 percent of total risk). This finding is further reinforced by the
1043 | conservative assumptions used in the analysis. The EPRI study reaffirms
1044 | the conclusion in NUREG–1493 that changes to leakage testing frequencies
1045 | are “feasible without significant risk impact.”

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Table 1

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Risk Results for Type A, Type B, and Type C Test Intervals

<i>Test Type</i>	<i>Risk-Impact Current Test Intervals</i>	<i>Risk-Impact Extended Test Intervals</i>	<i>Comment</i>
<i>PWR Representative Plant Summary</i>			
Type A	<u>The increase in ILRT test intervals from 3 in 10 years to 1 in 15 years results in a small change in LERF that ranges between the “very small” (<1E-07) and “small” (1E-07 to 1E-06) ΔLERF risk increase regions of NRC Regulatory Guide 1.174. In cases where the risk increase is greater than the “very small” region, the total LERF is significantly lower than the Regulatory Guide 1.174 threshold criteria of total LERF < 1E-05 per year. Changes in population dose and CCFP are also very small.</u>		<u>Please refer to EPRI Report 1009325, Revision 1, PWR example discussion for more information.</u>
Type B	«0.001% incremental risk contribution 6.9E-05 person-rem/yr rebaselined risk	<0.001% incremental risk contribution, 1.3E-04 person-rem/yr rebaselined risk. Based on testing with some components tested periodically during time interval months. In addition, blind flanges and penetrations would be removed and retested during every refueling outage. Airlocks to be tested every 24 months.	A range of 0.2 to 4.4 percent is provided for other plants for both Type B and Type C penetrations in NUREG-1493.
Type C	0.022% of total risk 4.9E-03 person-rem/yr	0.04% incremental risk contribution, 8.8E-03 person-rem/yr rebaselined risk, based on 48 month test intervals. 1E-2, 1.2E-2, and 1.64E-2 person-rem/yr risk, based on 60, 72, and 120 month test intervals	A range of 0.2 to 4.4 percent of total risk is provided for other plants for both Type B and Type C penetrations in NUREG-1493.

Deleted: 0.0032% incremental risk contribution, based on 2xL_a leakage¶
 0.035% incremental risk contribution, based on test interval 1 in 10 years¶

Deleted: Compares well with Surry risk contribution of 0.07%. A range of 0.002 to 0.14 percent is reported for other plants in NUREG-1493.

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Table 1 (continued)

<i>BWR Representative Plant Summary</i>				
Type A	<p><u>The increase in ILRT test interval from 3 in 10 years to 1 in 15 years results in a change in LERF that falls in the "very small" (<1E-07) ALERF risk increase region of NRC Regulatory Guide 1.174. Moreover, the total LERF is significantly lower than the Regulatory Guide 1.174 threshold criteria of total LERF < 1E-05 per year. Changes in population dose and CCFP are also very small.</u></p>		<p><u>Please refer to EPRI Report 1009325, Revision 1, BWR example discussion for more information.</u></p>	<p>Deleted: 0.026% incremental risk contribution, based on 2xL_a leakage</p> <p>Deleted: Compares well with the Peach Bottom estimated value of 0.038%. A range of 0.02 to 0.14 percent is reported for other plants in NUREG-1493.</p> <p>Deleted: 0.029% incremental risk contribution, based on test interval 1 in 10 years¶</p>
Type B	<p><0.001% of total risk 8.0E-06 person-rem/yr</p>	<p>0.001%, 1.85E-05 person-rem/yr Based on testing with some components tested periodically during time interval months. In addition, blind flanges and penetrations would be removed and retested during every refueling outage. Airlocks to be tested every 24 months.</p>	<p>A range of 0.2 to 4.4 percent is provided for other plants for both B and C penetration types in NUREG-1493.</p>	
Type C	<p>0.002% of total risk 4.5E-06 person-rem/yr</p>	<p>0.006% of total risk, 1.1E-04 person-rem/yr, based on 48 months test intervals. 1.8E-4, 2.3E-4, and 5.01E-4 person-rem/yr risk, based on 60, 72, and 120 month test intervals.</p>	<p>A range of 0.2 to 4.4 percent is provided for other plants for both B and C penetration types in NUREG-1493.</p>	

1052 **11.3 Plant-Specific Testing Program Factors**

1053
1054 A licensee may adopt specific surveillance frequencies from Section 10.0
1055 provided that plant-specific test performance history is acceptable as discussed in
1056 Section 10.0, and certain performance factors and controls are reviewed and applied
1057 as appropriate in the determination of test intervals. Each licensee should
1058 demonstrate by quantitative or qualitative review that plant-specific performance
1059 is adequate to support the extended test interval.

1060
1061 An extension of up to 25 percent of the test interval (not to exceed 15 months) may
1062 be allowed on a limited basis for scheduling purposes only.

1063
1064 **11.3.1 Performance Factors**

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1066 Prior to determining and implementing extended test intervals for Type B
1067 and Type C components, an assessment of the plant's containment penetration and
1068 valve performance should be performed and documented. The following are some
1069 factors that have been identified as important and should be considered in
1070 establishing testing intervals:

- 1071
- 1072 • *Past Component Performance* — Based on a survey sample of industry data
1073 from approximately 1987 to 1993, 97.5% of the industry's containment
1074 penetrations have not failed a Type B test, and 90% of the isolation valves
1075 have never failed a Type C test in over 500 reactor-years of commercial
1076 operation. Of the 10% of the Type C tests that have failed, only 22% of those
1077 have failed more than once. A licensee should ensure that leakage rate
1078 testing intervals are not extended until plant-specific component
1079 performance of two successful consecutive ~~as~~-found tests are performed.
 - 1081 • *Service* — The environment and use of components are important in
1082 determining its likelihood of failure. For example, a plant may have
1083 experienced high leakage in valves in a high-flow steam environment due to
1084 effects of valve seat erosion. Certain valves that open and close frequently
1085 during normal plant operations may have experienced higher leakage. The
1086 licensee's existing testing program should identify these types of components
1087 to establish their testing intervals based on their performance history.
 - 1089 • *Design* — Valve type and penetration design may contribute to leakage. For
1090 example, motor operated valves in a plant may be found to leak less
1091 frequently than check valves, and may support a longer test interval. Vendor
1092 recommendations for valve or penetration subcomponent service life may be a
1093 factor in determining test intervals. Certain passive penetrations, such as
1094 electrical penetrations, may have had excellent performance history. Test
1095 intervals for these penetrations may be relatively longer.

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- 1097 • *Safety Impact* — The relative importance of penetrations can be judged in
- 1098 terms of the potential impact of failure in limiting releases from containment
- 1099 under accident conditions. Due to size or system inter-connections, some
- 1100 components or penetrations may be more important than others in ensuring
- 1101 the safety function of a containment penetration is achieved. This relative
- 1102 importance should be considered in determining the test interval.
- 1103
- 1104 • *Cause Determination* — For failures identified during an extended test
- 1105 interval, a cause determination should be conducted and appropriate
- 1106 corrective actions identified. Part of a corrective action process should be to
- 1107 identify and address common-mode failure mechanisms.
- 1108

1109 **11.3.2 Programmatic Controls**

1111 If a licensee considers extended test intervals of greater than 60 months for a Deleted: or three refueling cycles

1112 Type B tested component, the review to establish surveillance test intervals should Deleted: or Type C

1113 include the additional considerations:

1114

- 1115 • *As-found Tests* — In order to provide additional assurance that the increased
- 1116 probability of component leakage is kept to a minimum, and is reasonably
- 1117 within the envelope of industry data, a licensee should consider requiring
- 1118 three successive periodic as-found tests to determine adequate performance. Deleted: As
- 1119
- 1120 • *Schedule* — To minimize any adverse effects of unanticipated random
- 1121 failures, and to increase the likelihood unexpected common-mode failure
- 1122 mechanisms will be identified in a timely manner, a licensee should
- 1123 implement a testing program that ensures components are tested at
- 1124 approximate evenly- distributed intervals across the extended testing
- 1125 interval for valves or groups of valves. A licensee should schedule a portion
- 1126 of the tests during each regularly scheduled outage or on some regular
- 1127 periodic basis, such that some percentage of the components are tested
- 1128 periodically, and all components are tested at the new extended test interval
- 1129 of greater than 60 months. Deleted: or three refueling cycles
- 1130
- 1131 • *Review* — A review of the entire process should be performed prior to
- 1132 establishing alternate test intervals under Option B to 10 CFR 50, including
- 1133 plant-specific performance history, data analysis, establishment of
- 1134 surveillance frequencies, and, if available and applicable, any risk-impact
- 1135 assessment. This review should include adjustments to the program as
- 1136 required, based on expert insight or engineering judgment. Results of the
- 1137 review should be documented.
- 1138

1139 **12.0 RECORDKEEPING**

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1141 **12.1 Report Requirements**

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1143 A post-outage report shall be prepared presenting results of the previous
1144 cycle's Type B and Type C tests, and Type A, Type B, and Type C tests, if performed
1145 during that outage. The technical contents of the report are generally described in
1146 ANSI/ANS 56.8-1994, and will be available on-site for NRC review. The report
1147 shall also show that the applicable performance criteria are met, and serve as a
1148 record that continuing performance is acceptable.

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1150 **12.2 Records**

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1152 Documentation developed for implementation of Option B to Appendix J
1153 should be done in accordance with licensee established procedures. Sufficient
1154 documentation shall be collected and retained so that the effectiveness of the
1155 implementation of Option B to Appendix J can be reviewed and determined. This
1156 documentation, including the plant-specific confirmatory risk impact assessment for
1157 extending ILRT intervals beyond ten years shall be available for internal and
1158 external review, but is not required to be submitted to the NRC.

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