

# DRAFT

## ILRT Type A Test Interval Optimization Methodology Problem Statement

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### 1.0 INTRODUCTION

NEI has initiated a project to revise the industry guidance and associated requirements for containment integrated leakage rate testing (ILRT). Based on performance history, risk insights, and other containment testing and inspections, it is believed that the required ILRT Type A testing interval, presently minimum of one test in ten years, can be optimized to one test in up to twenty years.

This project builds on the previous work performed in EPRI TR-104285, Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals [1] and NUREG-1493, Performance-Based Leakage Test Program [2]. In fact, NUREG-1493 states, *"Reducing the frequency of Type A tests (ILRTs) from the current three per 10 years to one per 20 years was found to lead to imperceptible increase in risk"*. Since the publication of NUREG-1493 additional containment inspections are now performed at all nuclear power plants (i.e., IWE and IWL) and historical ILRT performance has been good. Using new methods and the additional more recent data, this project will demonstrate that this conclusion remains valid.

## **2.0 BACKGROUND**

A revision to the NEI Guidance (NEI 94-01) permitting an optimized ILRT Type A testing interval of up to once per twenty years is planned. The revision will be based on a risk impact assessment that will be documented in a revision to EPRI TR-104285, Risk Impact Assessment of Revised Containment Leak Rate Testing Intervals [1]. The risk impact assessment will generically assess the risk impact of the up to once per twenty-year testing interval and consider industry experience and appropriate regulatory guidance (RG 1.174) [4].

This document focuses on a “problem statement” that illustrates the need for, and the role of, the expert elicitation in process of developing the risk impact assessment of the revised containment leak rate testing intervals. Additional details on the expert elicitation process are contained in the “ILRT Type A Test Interval Optimization Methodology - Expert Elicitation Process”.

## **3.0 FRAMEWORK**

Risk is defined as the product of probability and consequence, where probability is the periodic occurrence of an undesired event and the consequence is defined as the magnitude of the undesired event.

$$\text{RISK} = \text{PROBABILITY} \times \text{CONSEQUENCE}$$

In the case of the risk associated with the revised ILRT testing interval, the probability is defined as the probability of a significant containment leakage event that would not be detected by alternative means such as a local leak rate test or other inspection. Note that containment leakage or degradation detectable by

alternative means does not impact the risk associated with revising the ILRT interval.

The consequence is defined as the increase, or delta, large early release frequency (LERF). The large early release frequency figure of merit is one traditional figure of merit in risk informed applications [4]. In the case of the risk impact assessment of the revised ILRT testing interval, the delta LERF is determined by multiplying the core damage frequency (CDF) by the change in the probability of a significant containment leakage event that would not be detected by means other than an ILRT.

An additional figure of merit, the increase, or delta, population dose is also developed. The delta population dose is calculated by multiplying the base population dose by the change in the probability of a significant containment leakage event for the affected core damage frequency endstates.

$$\begin{aligned}
 \text{RISK} &= \text{Probability} \times \text{Consequence} \\
 \Delta \text{ LERF} &= \Delta \text{ ILRT Failure Probability}^1 \times \text{CDF} \\
 \Delta \text{ Population Dose} &= \Delta \text{ ILRT Failure Probability}^1 \times \text{Population Dose}
 \end{aligned}$$

In the previous “one time” ILRT extension submittals [3] [6], and as a matter of course in most risk informed applications, a bounding approach was taken. This

<sup>1</sup> The term “ILRT failure” is used in this report. The reader is reminded that “ILRT failure” is not a failure of the ILRT test to measure the containment leakage. Rather, the term “ILRT failure” is used to describe those ILRT tests in which containment leakage was identified above the acceptance criteria that would not be detected by a local leak rate test, containment inspections, or other alternate means.

bounding approach utilized very conservative assumptions with respect to assessing the risk increase as a function of a revised ILRT testing interval. These assumptions include conservatisms associated with the determination of the ILRT failure probability as well as conservatisms associated with the determination of the consequences (delta population dose and delta LERF):

- **Data Applicability.** Data used to estimate the initial probability of ILRT failure is conservatively classified. Containment leakage events, that would not significantly affect population dose and/or LERF calculations are included in the estimation of the ILRT failure probability. For example, events such as steam generator manway leakage are included in the estimation of ILRT failure probability. Steam generator manway leakage would be discovered during reactor startup or during normal operation.
- **No Alternate Means of Detection.** The probability of alternate means of detection such as local leak rate tests, inspections or other means is not always considered.
- **Estimation of Population Dose.** Low containment leakage rates (i.e., low  $\lambda_a$  values) with higher probabilities of occurrence are used to represent a large early release.

Despite the very conservative assumptions above, the submittals to date have been able to demonstrate that the revised ILRT testing interval has little impact on risk. That is, the risk or the delta population dose and delta LERF are small.

In the case of delta LERF, Regulatory Guide 1.174 describes changes to the licensing basis with a delta LERF impact below  $1\text{E-}7$  as “very small.” Such changes are generally acceptable. Proposed delta LERF impacts between  $1\text{E-}6$  and  $1\text{E-}7$  per year are described as “small” changes, and are acceptable, but

result in increased NRC management and technical attention, including consideration of the plant's baseline LERF.

When applying the existing methods to the all plants, particularly those with higher CDF values, it is possible that a fraction of the calculated delta LERF values will fall into the "small" change region and therefore result in increased NRC management and technical attention. The increased NRC management and technical attention, when based on a conservative conclusion, is not an optimum use of either the NRC's or utility resources. By considering and reducing the conservatisms in the current methods most, if not all, calculated delta LERF values will be in the "very small" change region thereby optimizing resources associated with the ILRT testing as well as NRC and utility management and technical resources.

## **4.0 EXPERT ELICITION INPUT**

In order to obtain more realistic values for delta LERF, the conservatisms in the current methodology and presented in Section 3 must be addressed. The report-sub-sections consider the conservative assumptions individually.

### **4.1 Data Applicability**

Based on NEI utility surveys [8][9], data has been collected for 182 ILRT Type A tests that have been performed in the nuclear industry. Based on this data, the number of significant containment leakage events, found during the performance of these tests is very small. In fact, no large failures that would produce a large early release (LERF) have been found. As such, the testing data alone does not, without expert opinion, support the development of realistic values for the probability of a significant containment leakage event.

Consider the significant containment leakage or degradation event data contained in Attachment 1. This attachment is a compilation of data from two NEI utility surveys, NUREG-1493, and other events discovered in reviewing other industry data (LER's, reportable events, etc.). The first survey was performed in early 1994 [8] and represented the NEI (known as NUMARC at that time) input used in NUREG-1493. In this survey, the data from 144 ILRT Type A tests was collected. The second survey was performed in the fall of 2001 [9]. In the second survey, data was collected from 58 plants (91 units), reporting 38 ILRT Type A tests performed. The combined surveys do not represent all ILRTs performed. In the initial survey, utilities were chosen that represented a broad spectrum of reactor designs and was considered a representative sample of industry ILRTs performed. The response to the most recent survey was significant (91 nuclear units responded) and the data is considered a representative set of ILRT Type A test experience. Lastly, the data collected by the surveys is supplemented by additional literature searches including LERs and reportable events.

The data was then sorted by those events that resulted in excessive leakage when compared with the established acceptance criteria. This includes all causes that resulted in ILRT tests exceeding the acceptance criteria including those that are a result of local leak rate test penalties. A total of 70 significant leakage or degraded liner events are included in Attachment 1. The details associated with these 70 events are provided in the attachment.

From a review of the data in Attachment 1 and knowledge of the number of tests performed, a failure rate can be determined. In order to determine a failure rate, the number of failed events are divided by the number of demands, or in this case the number of ILRTs performed. Some previous submittals have conservatively assumed (based on reference 1) that three (3) failures have occurred (based on the 1994 NUMARC survey). However, based on a more comprehensive review of the data, no significant containment leakage events

(where an increase in the ILRT surveillance interval would have increased the time the leak pathway was not detected) have been discovered. (Events that were initially counted as significant leakage events were due to steam generator manway leakage or other leakage events for which an alternate means of detection exists.) Therefore, there are zero (0) significant containment leakage events. Based on the data obtained by NUMARC and NEI surveys [8] [9] only, 182 ILRTs have been performed.

With zero (0) failed events a variety of statistical methods are available to estimate a failure rate. Each method assumes a number of failed events to obtain a failure rate. The number of assumed failed events varies by the statistical method as illustrated in the table below. The comments section of the table provides the basis for the use of the statistical method.

Statistical Method	Assumed No. of failures	No. of Demands	ILRT "Failure" Probability	Comments
Chebychev	1	182	5.5E-3	Upper bound estimate
Jeffery's Non-Informative Prior	0.5	182	2.7E-3	Based on no physical or engineering information available
Typical range	0.3	182	1.6E-3	Typical range of values for a non-informative basis
	0.1	182	5.0E-4	

As can be seen from the table above the resulting ILRT failure probabilities vary widely depending on the statistical method employed. The statistical method is in turn dependent on the uses of the final information (i.e. upper bound estimate) or assumptions concerning the amount of physical or engineering information concerning failure rates or failure modes and causes. Choosing the statistical

method and resulting significant containment leakage event probability is therefore a matter for expert elicitation.

## **4.2 No Alternate Means of Detection**

Various alternative methods of detecting a significant leakage pathway ("ILRT failure") in containment exist. These methods include local leak rate tests (LLRT), reactor startup, normal operation and other containment and piping inspections. Since the publication of NUREG-1493, additional containment inspections are now performed at all nuclear plants (i.e., IWE and IWL). In addition, during normal reactor startup and during normal power operation it is fairly routine, for most containment designs, to either vent the overpressure that has built up or to provide nitrogen makeup (for inerted containment designs). Significant changes in the venting or makeup rate during normal operation may provide an indication of the existence of a leakage pathway. These factors, as well as others, provide additional means of detection of significant containment leakage pathways. Expert opinion will assist in the determination of the appropriate alternative means ILRT failure detection as well as the probability of detection over an increased ILRT interval.

## **4.3 Estimation of Population Dose**

ILRT extension submittals have used an estimated leakage rate as a result of an assumed large ILRT failure of 35 La. The leakage value of 35 La is then assumed to represent the leakage rate associated with a large early release as calculated in the Level 2 probabilistic risk assessment (PRA). However, the definition of LERF is generally given as the exchange of a single containment volume before the effective implementation of the offsite emergency response and public protective actions [7]. In turn, public protective actions, are generally assumed to be taken approximately 2 to 4 hours following a core damage event. The exchange of a single containment volume within a 4 hour period

corresponds to a leakage rate of 600% per day or 600 – 6000 times  $L_a$  assuming that the ILRT acceptance criteria for the plant in question is between 1% and 0.1% per day.

From an examination of the events in Attachment 1, one event (No. 35) discovered during performance of an ILRT, with a stated leak rate, was greater than 2  $L_a$  (15.3 $L_a$ ). There were several events reported with leakage rates greater 2  $L_a$ , with a maximum of ~21  $L_a$ . However, with the single exception, all these events were identified by local leak rate tests. In any event, it does not appear that extension of the ILRT interval would increase the time that a leak path was not detected, as the single exception should have been identified by local leak rate testing<sup>2</sup> and has not repeated. Two ILRTs have been conducted at the plant since the event. With no increase in the non-detection time, there would be no increase in risk attributable to ILRT extension.

Three events were identified which could have been detected only by conducting an ILRT (Nos. 1, 45, and 57). However, these events had leakage rates less than 2  $L_a$  or did not have state leakage rates. One involved two holes drilled in a liner (no stated leakage rate), one was a construction deficiency where pipes were not capped (0.9  $L_a$ ), and the third involved the ejection of a radiation monitor during an ILRT (1.3  $L_a$ ). None of the three events have repeated and the maximum measured leakage rate was less than 1.3  $L_a$ .

In summary, from a detailed review of the available data, there have been no events that could have resulted in a large early release as currently defined.

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<sup>2</sup> Section 9.1.1 of NEI 94-01 discusses the performance criteria for establishing Type A test intervals and states that if leakage cannot be determined by local leak rate testing, the performance criteria are not met. I.e., if an ILRT fails due to excessive local penetration leakage after a local test of the penetration, then the performance criteria for extending the ILRT intervals have not been met.

#### **4.4 Expert Elicitation Example**

As stated in Section 3, the generic application of the existing statistical treatment of ILRT events (e.g., Jeffery's Non Informative Prior) can result in some plants having a delta LERF in the "small" increase versus the "very small" increase region of Regulatory Guide 1.174 when calculating the risk impact of revised ILRT intervals. Given the minimal number of significant leakage events in the ILRT testing experience, the expert elicitation process will be used to develop a more informed basis for the determination of the probability of a significant containment leakage event.

The expert elicitation process is used to determine the probability of a significant containment leakage event. The expert elicitation would be based on the expert elicitation methods outlined in reference [11] and [12] as well as experts whose areas of expertise include one or more of the following:

- Available ILRT off-normal events
- Knowledge of containment systems
- Knowledge of ILRT
- Knowledge of containment inspections (IWE/IWL, maintenance)
- Knowledge of containment failure modes and causes
- Typical range of failures for non-informative priors

The expert panel would be asked to provide an estimate of the probability of a significant containment leakage event as a function of the magnitude of the failure. That is, the expert panel would be asked to estimate the probability of a significant containment leakage event for various  $L_a$ . The magnitudes, or  $L_a$ , would be provided for at least three points. The expert panel would also be asked to determine the shape of the probability distribution for a significant containment leakage event as a function of the magnitude ( $L_a$ ) of the leakage.

The expert panel estimates would be based on the existing data and knowledge of the panel.

Following the solicitation of the estimates from the expert panel, the curve of probability of a significant containment leakage event versus magnitude of the leakage would be extrapolated for larger magnitudes ( $L_a$ ). A bounding  $L_a$  that represents LERF would be chosen. Using the extrapolated curve and the bounding value of LERF chosen, a probability of a significant containment leakage event will be determined at the bounding LERF leakage value. The base population dose and LERF would be determined using the guidance in reference 10. Continuing to assume that the ILRT failure probability is linear with time, the ILRT failure probability and magnitude will be used to estimate the risk in terms of population dose for the revised ILRT test interval. The methods for estimating the delta population dose and the delta LERF would be also be based on the interim guidance contained in reference 10.

## **5.0 REFERENCES**

1. Electric Power Research Institute, "Risk Impact Assessment of Revised Containment Leak Rate Test Intervals", EPRI TR-104285, August 1994.
2. Nuclear Regulatory Commission, "Performance-Based Containment Leak-Testing Programs", NUREG-1493, September 1995.
3. Entergy Nuclear Northeast, Indian Point 3 Nuclear Power Plant Letter of January 18, 2001, "Supplemental Information Regarding Proposed Change to Section 6.14 of the Administrative Section of Technical Specifications".
4. Nuclear Regulatory Commission, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis", Regulatory Guide 1.174, July 1998.

5. Nuclear Regulatory Commission, "Indian Point Nuclear Generating Station Unit No. 3 – Issuance of Amendment Re: Frequency of Performance-Based Leakage Rate Testing", April 17, 2001.
6. Florida Power – Progress Energy, Crystal River Nuclear Plant Letter of June 20, 2001, "Supplemental Risk Informed Information in Support of License Amendment Request No. 267".
7. Electric Power Research Institute, "PSA Applications Guide", EPRI TR-105396, August 1995.
8. NUMARC, "ILRT Survey Data", February 18, 1994.
9. NEI ILRT Survey, 2001
10. Nuclear Energy Institute, "Interim Guidance for Performing Risk Impact Assessments in Support of One-Time Extensions for Containment Leakage Rate Test Surveillance Intervals", Developed for NEI by EPRI and DS&S, November 2001.
11. Nuclear Regulatory Commission, "Branch Technical Position on the Use of Expert Elicitation in the High-Level Radioactive Waste Program", NUREG-1563, 1996.
12. Nuclear Regulatory Commission, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts", NUREG/CR-6372, April 1997.

**ATTACHMENT 1:  
SIGNIFICANT CONTAINMENT LEAKAGE OR  
DEGRADED LINER EVENTS**

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
1	Mar-77	NUMARC Note	NUMARC Letter 2/18/94 to NRC	Unknown	Unknown	ILRT	Holes inadvertently drilled in liner			Yes
2	Apr-77	NUMARC 24		>1La	175000	ILRT	SG manway gasket leak	Excessive leakage identified by ILRT	Manway gasket leakage is detectable during startup and operation, releases through SG would be late and scrubbed.	No
3	Mar-78	NUMARC 4		0.88 La+ (B&C)	346000	ILRT	SG manway gasket leak	Excessive leakage identified by ILRT	Manway gasket leakage is detectable during startup and operation, releases through SG would be late and scrubbed.	No
4	Jun-80	NUMARC 25		0.072La+ (B&C)	538000	LLRT Penalty		Excessive C local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
5	Feb-81	NUMARC 21		N/A		Verification Test		ILRT exceeded due to instrument verification test discrepancy		No
6	Jun-82	NUMARC 4		0.43La+ (B&C)	346000	ILRT	Lineup Error	Excessive local leakage identified by ILRT due to lineup error		No
7	Aug-83	NUMARC 19		1.3La	83200	LLRT		Excessive C local leakage identified by LLRT		No
8	Apr-84	NUMARC 25		0.031La+ (B&C)	538000	LLRT Penalty		Excessive C local leakage identified by LLRT		No
9	Aug-84	NUMARC 28		0.071La(A) 14.91La w/(B&C)	95330	LLRT Penalty		Excessive C local leakage identified by LLRT		No
10	Jun-85	NUMARC 26		0.19La(A) 20.82La w/(B&C)	862307	LLRT Penalty		Excessive B&C local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
11	Nov-85	NUMARC 3		0.36La (A) 1.89La w/(B&C)	211600	LLRT Penalty		Excessive C local leakage identified by LLRT		No
12	Apr-86	NUMARC 28		<0.05La(A) <9.55La w/(B&C)	95330	LLRT Penalty		Excessive C local leakage identified by LLRT		No
13	May-86	NUMARC 23		0.27La(A) 0.99La w/(B&C)	135920	LLRT Penalty		Excessive B&C local leakage identified by LLRT		No
14	Jun-86	Susquehanna 2	NUREG-1493	2.6La	1.0%	ILRT		ILRT without prior LLRT		No
15	Nov-86	Quad Cities-2	NUREG-1493	0.88La	1.0%	ILRT	Faulty drywell head gasket	Excessive local leakage identified by ILRT and not identified by LLRT	Drywell head gasket would have probably been replaced at each refueling	No
16	Nov-86	TMI-1	NUREG-1493	1.0La	0.1%	ILRT		ILRT without prior LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
17	Nov-86	NUMARC 24		1.0La 1.0La w/(B&C)	175000	ILRT	SG manway gasket leak	Excessive leakage identified by ILRT	Manway gasket leakage is detectable during startup and operation, releases through SG would be late and scrubbed.	No
18	Aug-87	NUMARC 27		0.027La(A) 2.46La w/(B&C)	236203	LLRT Penalty		Excessive local leakage identified by LLRT		No
19	Sep-87	Quad Cities-1	NUREG-1493	Unknown		ILRT		ILRT without prior LLRT		No
20	Sep-87	NUMARC 28		0.43La+ (B&C)	287407	LLRT Penalty		Excessive B&C local leakage identified by LLRT		No
21	Sep-88	NUMARC 30		Unknown	218503	LLRT Penalty		Excessive C local leakage identified by LLRT		No
22	Oct-89	Harris-1	NUREG-1493	Unknown		ILRT		ILRT without prior LLRT		No
23	Nov-89	Hatch-2	NUREG-1493	0.86La	1.2%	LLRT Penalty		Excessive local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
24	Nov-89	Fermi-2	NUREG-1493	1.9La	0.5%	LLRT Penalty		Excessive local leakage identified by LLRT		No
25	Dec-89	Beaver Valley-1	NUREG-1493	Unknown	0.1%	ILRT	Two penetration leaks discovered during ILRT	Excessive local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
26	Feb-90	Dresden 3	NUREG-1493	0.78La	1.6%	LLRT Penalty		Excessive local leakage identified by LLRT		No
27	Feb-90	Brunswick-2	NUREG-1493	0.94La	0.5%	LLRT Penalty		Excessive local leakage identified by LLRT		No
28	May-90	Sequoyah-1	NUREG-1493	2.8La	0.25%	LLRT Penalty		Excessive local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
29	May-90	Sequoyah-2	NUREG-1493	<1.0La	.25%	ILRT		Excessive local leakage identified by ILRT and not identified by LLRT		No
30	Jun-90	LaSalle-2	NUREG-1493	>La	0.63%	Unknown				No
31	Jun-90	Trojan	NUREG-1493	Unknown	1.3%	ILRT	Instrumentation Problems			No
32	Sep-90	NUMARC 31		Unknown	218503	LLRT Penalty		Excessive C local leakage identified by LLRT		No
33	Oct-90	Callaway	NUREG-1493	>La	0.2%	ILRT	Penetration Leakage	Excessive local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
34	Oct-90	NUMARC 20		1.7La w/(B&C)	188945	ILRT		Excessive B&C local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
35	Dec-90	Dresden 2	NUREG-1493	15.3La	1.6%	ILRT	Vacuum breaker leakage discovered during ILRT	Excessive local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
36	Feb-91	Braidwood 1	NUREG-1493	0.56La	0.1%	ILRT	Type B failure found during ILRT, Airlock hatch shaft seal	Excessive local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
37	Feb-91	Brunswick 1	NUREG-1493	0.99	0.5%	LLRT Penalty		Excessive local leakage identified by LLRT		No
38	Apr-91	NUMARC 2		0.47La (A) 0.84La w/(B&C)	163000	ILRT		Excessive B&C local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
39	Jun-91	Millstone-1	NUREG-1493	>0.75La	1.2%	LLRT Penalty		Excessive local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
40	Jun-91	NUMARC 27		0.29La+ (B&C)	236203	LLRT Penalty		Excessive C local leakage identified by LLRT		No
41	Jul-91	Pilgrim	NUREG-1493, LER 91-023-00	1.2La	1.0%	ILRT	Drywell head bolts loose, improper spherical washer material	Failure of spherical washers led to loosening of 11 of 76 bolts, drywell head contribution to leak rate 0.74%/day	Had this not been identified in an ILRT, loose bolts and washer failures may have been identified in the next refueling outage.	No
42	Sep-91	Braidwood 2	NUREG-1493	0.55La	0.1%	ILRT	Several local leaks found during ILRT	Excessive local leakage identified by ILRT and not identified by LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
43	Dec-91	Brunswick 2	NUREG-1493	0.79La	0.5%	LLRT Penalty		Excessive local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
44	Dec-91	PVNGS-2	NUREG-1493	0.83La	0.1%	LLRT Penalty		Excessive local leakage identified by LLRT		No
45	Dec-91	Cooper	NUREG-1493, LER 91-020-00	1.4La	149623	ILRT	Structural failure of radiation monitor;	Radiation monitor breached its shield chamber during ILRT pressurization at 51 psig	Leakage from monitor path= 0.61La	Yes
46	Mar-92	Dresden-3	NUREG-1493	>La	1.6%	LLRT Penalty		Excessive local leakage identified by LLRT		No
47	Mar-92	LaSalle-2	NUREG-1493	0.56La	0.63%	LLRT Penalty		Excessive local leakage identified by LLRT		No
48	Apr-92	Sequoyah-2	NUREG-1493	1.68La	0.25%	LLRT Penalty		Excessive local leakage identified by LLRT		No
49	Apr-92	Vogtle-2	NUREG-1493, NUMARC 1	0.62La(A) >.75La w/(B&C)	360000 0.2%	LLRT Penalty		Excessive B&C local leakage identified by LLRT	ILRT La exceeded due to B&C leakage penalty identified by LLRT	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
50	May-92	ANO-1	NUREG-1493	>La	0.2%	LLRT Penalty		Excessive local leakage identified by LLRT	ILRT La exceeded due to B&C leakage penalty identified by LLRT	No
51	Aug-92	River Bend	NUREG-1493	>La	0.26%	LLRT Penalty		Excessive local leakage identified by LLRT		No
52	Sep-92	NUMARC 21		1.3La+ (B&C)	442525	ILRT	SG manway gasket leak	Excessive leakage identified by ILRT	Manway gasket leakage is detectable during startup and operation, releases through SG would be late and scrubbed.	No
53	Oct-92	Fermi-2	NUREG-1493	<2La	0.5%	LLRT Penalty		Excessive local leakage identified by LLRT		No
54	Nov-92	Hatch-2	NUREG-1493	1.11La	1.2%	LLRT Penalty		Excessive local leakage identified by LLRT		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
55	Nov-93	NUMARC 3		0.21La(A) 1.34La w/(B&C)	211600	ILRT	Lineup Error	Excessive local leakage identified by ILRT due to lineup error		No
56	Feb-94	Ginna	LER 94-003-00	Unknown		I&C Observation	Instrument plug not installed	Instrument Plug not installed following I&C work. Procedures enhanced to insure installation in future	Leakage pathway from containment to atmosphere would exist only when the equipment hatch inner door was open	No
57	Feb-94	Surry 1	LER 94-003-00	>La		Piping Inspection	Failure of coal tar epoxy coating followed by corrosion	Hole in piping for recirculation spray water heat exchanger	A leak in this pathway would be scrubbed. Radiation monitors and isolation valves are also provided. Fluid leakage would be detected by subsequent piping inspections.	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
58	Mar-94	Braidwood 1	LER 94-003	0.9La	216908 0.1%	ILRT	Construction deficiency not previously identified	Concrete vent pipes associated with emergency hatch not capped	Leakage from vent pipes =0.09La	Yes
59	Apr-94	Sequoyah-1	LER 94-005-00	.0.75-1.0La	.25%	Inability to maintain PRT P	Circumferential crack in RV bellows	This bellows failure was detected during normal operation		No
60	Dec-94	Pilgrim	LER 94-007-00	>La	1.0%	I&C inspection	Instrument plug not installed	Plug for torus-atmosphere dp transmitter not installed; corrective action includes verification surveillance	This pathway would probably have been identified in the next instrument calibration cycle	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
61	Apr-95	Vermont Yankee	NEI Survey	2La	0.8%	ILRT	Excessive local leakage	Valves contaminated with construction debris after passing LLRT	If leakage cannot be identified by local testing, Type A test does not meet NEI 94-01 performance criteria for ILRT interval extension	No
62	Sep-95	Indian Point 3	LER 95-019-00	N/A	0.1%	Inspection/Radiograph	Excessive local leakage	Through wall cracks on pipe caps on spare penetration due to contaminated stagnant water	Containment integrity was not an issue as the penetration was pressurized and monitored.	No
63	Feb-96	Surry 2	LER 96001	Unknown		Observation at power		Leaking weld on return pipe from refueling cavity to RWST	A leak in this pathway would be scrubbed, and leakage from piping would be observed.	No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
64	Oct-96	Oyster Creek	LER 96-011-0	2La		Low Pressure monitoring	Vacuum breaker valve cover leaking	Misalignment of valve cover during assembly, shifting during heatup	This pathway would probably have also been identified in the next local leak rate test.	No
65	Sep-99	North Anna 2	NEI Survey, LER 1999-002-00			Liner coating inspection	1/4" defect hole	Wooden timber in concrete in back of liner	Leakage thru defect 0.07La	No
66	Nov-99	PVNGS 1	LER 2000-004		0.1%	ILRT	Inadequate procedure for LLRT of Purge valves, valve seat adjustment	Excessive local leakage identified by ILRT	Revised procedure	No
67	Nov-99	Cook 2	NEI Survey			Liner, Coatings Inspection	3/16" hole in liner	Leak rate within limits	Cook 1 had identified pitting in 1998, but no thru wall penetration	No
68	99	Brunswick 2	NEI Survey	<La	0.5%	IWE Inspection	Three thru wall defects in liner	Pitting corrosion and debris in concrete		No

No.	Date	Unit	Reference LER, report	Leakage, fraction of La	La Sccm or %/day	How Detected	Cause	Description	Comments	Preliminary Assessment Effect Non Detection Time?
69	Aug-01	PVNGS-3	Non-emergency event report 8/17/01	Unknown	0.1%	Operations monitoring containment sump	Quick opening closure device not properly closed, or loosening of device in service.	Fuel transfer tube quick operating closure device leak path.	Leak path should be detected during LLRT.	No
70	Oct-01	Vermont Yankee	Non-emergency event report 10/30/2001	>La	0.8%	Operator observation and isolation		Tube broke on discharge of H2O2 monitor sample pump.	Engineering evaluation determined that under accident conditions leakage would have exceeded allowable leakage limits	No
71	?	Vermont Yankee	NUREG-1493	1.0La	0.8%	ILRT	Drywell manway penetration leakage		Leak path should be detected during LLRT.	No

